Block-I

Project & Operations Management

Project Management - An Overview

Block

I

PROJECT MANAGEMENT – AN OVERVIEW

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COURSE INTRODUCTION

Project management plays an important role in an organization's corporate strategy. Projects enable organizations to convert their strategies into actions, and their objectives into reality. Although many of the project management tools are derived from other management disciplines, project management is a specialized field, with unique management techniques such as critical path analysis and work breakdown structures. In the present scenario, the application of project management is no longer limited to the projects in construction and engineering sectors; these techniques are also applied to projects in fields as diverse as education, healthcare, and software development.

Timely and proper implementation of project and operations management techniques enables effective management of resources which are used by the organizations to produce goods and services. Growing inter-firm rivalry and competition has increased the importance of operations management in organizations. Of late, operations management has gained a lot of importance, and has become a key discipline in management science. Organizations use various operations management techniques to make decisions on various aspects like facility location and capacity determination, identification of appropriate manpower, determination of optimum inventory levels, and production scheduling and job assignment.

Project & Operations Management examines key issues involved in the fields of project management and operations management. The course is divided into two major parts.

The first part of the course introduces students to the project management functions that are carried out at the different stages of a project's life cycle. The course discusses the complexities involved in handling projects and managing the various phases of the project life cycle.

The second part of the course presents a step-by-step analysis of the activities of operations managers and provides an understanding of the planning, organizing, controlling, directing, motivating and coordinating activities of an operations system in manufacturing and service organizations.

BLOCK I: PROJECT MANAGEMENT – AN OVERVIEW

The first block of the course on Project & Operations Management provides an introduction to project management. The block contains five units. The first unit provides an idea about project management. The second unit focuses on the first stage of the project life cycle, that is, idea generation and screening of projects. The third unit discusses the market, technical and environmental analysis of projects, while the fourth unit examines the financial analysis of projects. The fifth unit discusses project selection.

The first unit, *Introduction to Project Management*, discusses the definitions of a project, program and project management. The unit focuses on the characteristics, parameters and classification of projects. It examines the relationship between the various project parameters, between project management and other management disciplines, and between project management and line management. The unit also deals with the project management environment. It discusses project stakeholders, organizational influences and project life cycle.

The second unit, *Project Idea Generation and Screening*, deals with the generation of project ideas and discusses the various creative techniques involved in the generation of ideas. The unit explains the various aspects in scanning of the business environment. It then discusses the activities that can be carried out to generate new project ideas. The unit explains the process of initial screening of project ideas, and about the project rating index, an evaluation method used to streamlining the initial screening process. Finally, the unit discusses the factors that can be used by the firms to enhance the net present value of a project.

The third unit, *Market and Technical Analysis of Projects*, deals with market analysis, demand analysis, and technical analysis of projects. Under market and demand analysis, the unit provides an idea about situational analysis and objectives specification, collection of data, market survey, market description, demand forecasting, uncertainties in demand forecasting and market planning. Under technical analysis, the unit explains technology selection, input requirements and utilities, product mix, plant capacity and functional layout, location of the project, machinery and equipment and consideration of alternatives.

The fourth unit, *Financial Analysis of Projects*, discusses the means of financing the project. It provides an idea about the working capital requirements and financing. It discusses the concepts of time value of money, cost of capital, project appraisal criteria and risk analysis in capital investment decisions. Finally, it discusses social cost benefit analysis.

The fifth unit, *Project Selection*, provides the criteria for project selection models. The unit explains the various project selection models. It discusses the ways and techniques used to analyze the uncertainties in a project. Finally, the unit explains project proposal.

Unit 1

Introduction to Project Management

Structure

1.1 Introduction

1.2 Objectives

1.3 Definition of Project

1.4 Project Characteristics

1.5 Project Parameters

1.6 Relationship between Project Parameters

1.7 Classification of Projects

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1.10 Project Management – Relationship with Other Management Disciplines

1.11 Relationship between Project Management and Line Management

1.12 Project Stakeholders

1.13 Organizational Influences

1.14 Socio-economic Influences

1.15 Environmental and Legal Influences

1.16 Project Phases and the Project Life Cycle

1.17 Summary

1.18 Glossary

1.19 Self-Assessment Exercises

1.20 Suggested Readings/Reference Material

1.21 Answers to Check Your Progress Questions

1.1 Introduction

In this unit, we introduce you to the concepts in project management. Men have been planning and managing projects since the beginning of civilization. Of late, people recognized that techniques like cost control, scheduling of activities, resource procurement, and risk management that are relevant for the success of a variety of projects, whether building dams, laying roads, or organizing events. This led to the evolution of a set of unique management tools, techniques, and methodologies, which constitute the present day ‘project management’. Project management gained recognition as a specialized area of management about 50 years ago. Today, project management has spread from its traditional focus on the fields of construction and engineering into sectors as diverse as education, healthcare and software development.

This unit will introduce you to project management by discussing the definitions of project, program, and project management. We will discuss the characteristics, parameters and classification of projects. We shall then move on to discuss the relationship between the various project parameters, between project management and other management disciplines and between project management and line management. Finally, we would be discussing the project management environment including project stakeholders, organizational influences and project life cycle.

1.2 Objectives

By the end of this unit, students should be able to:

- Define a project.
- Discuss the characteristics of a project.
- Identify the various project parameters, and demonstrate the relationship between them.
- Classify projects.
- Define a program.
- Explain project management, and recognize the relationship of project management with other management disciplines.
- Demonstrate the relationship between project management and line management.
- Define project stakeholders.
- Identify organizational, socio-economic, environmental and legal influences.
- State the project phases, and explain the project life cycle.

1.3 Definition of Project

A project is a production process which has a unique setup configured to imperatively meet a specific set of requirements by a fixed deadline date-time under possibly changing environmental conditions.

A project is a group of unique, inter-related activities that are planned and executed in a certain sequence to create a unique product and/or service, within a specific time frame, budget, and the client's specifications.

According to the Project Management Institute's (PMI) publication, 'A Guide to the Project Management Body of Knowledge' (PMBOK), a project is defined as, "a temporary endeavor undertaken to create a unique product or service.*"*

The British Standard 6079 of 1996 (BS6079) defines a project as, "a unique set of coordinated activities, with definite starting and finishing points, undertaken by an individual or organization to meet specific objectives within defined schedule, cost, and performance parameters."

Projects and day-to-day operations are both carried out and operations are generally considered similar as both are carried out by people, and are planned,

implemented, and controlled to produce results within the given resource constraints. However, projects are different from day-to-day operations in that they are a different type of production process as will be seen later in this book. However, projects are different from operations as they play a crucial role in an organization's corporate strategy or relate directly to the policies and initiatives of the government.

Check Your Progress - 1

1. In which of the following sectors is project management applicable?
   i. Construction and engineering
   ii. Education
   iii. Healthcare
   iv. Software development
   a. Only i, ii, and iii
   b. Only i, iii, and iv
   c. Only ii, iii, and iv
   d. i, ii, iii, and iv
2. Which of the following options has defined project as "a temporary endeavor undertaken to create a unique product or service"?
   a. British Standard 6079 of 1996
   b. Project Management Institute
   c. Tandon Committee
   d. American National Standards Institute (ANSI)
3. _____ can be defined as a group of unique, inter-related activities that are planned and executed in a certain sequence to create a unique product or service, within a specific time frame, budget and client's specifications.
   a. Operations
   b. Process
   c. Project
   d. Program
4. Which of the following statements is **true** regarding projects and operations?
   i. Projects and operations are generally considered similar.
   ii. Projects and operations are both carried out by people.
   iii. Projects and operations are planned, implemented, and controlled to produce results within the given resource constraints.
   a. Only i and ii
   b. Only i and iii
   c. Only ii and iii
   d. i, ii, and iii

1.4 Project Characteristics

Organizational structures and processes are custom-made to produce a specific product and/or service. Sometimes, organizations have to take up new tasks that they are not equipped to handle. These tasks are new to the organization as they are not performed earlier or they may not be repeated in the future again. To perform such unique tasks, organizations adopt the project approach. The project approach is adopted when the existing systems in the parent organization are not equipped to handle new task. Some of the characteristics of the tasks that qualify to be projects are – unique activities, attainment of a specific goal, sequence of activities, specified time and interrelated activities.

To enable it to implement the business strategy of a firm, the firm's production process may be setup to be product-focused and carry out repetitive operations from day-to-day to produce a standardized product/service on the one hand whereas on the other hand it may be process-focused, wherein, the production process must be reset for each customized product/service it produces.

Projects are process focused to the extreme. The production process must be uniquely set up to meet a specific objective. For the firm, this specific objective is expected to achieve the business strategy, but unlike day-day operations that comprise a familiar set up each day, project set up, being unique in order to meet objectives that are unprecedented, is something the firm is unfamiliar with, no matter how experienced the firm may be.

Projects definitely vary with the scale, complexity and uncertainty that they must handle. Nevertheless, all projects have defining features that characterize them. These characteristics distinguish a project from repetitive production processes, which is necessary because each of these processes require different management approaches.

A project is identified as being a production process that is unique and unfamiliar, set up to meet a specific objective with something at stake if the objective is not met within a specific period of time and that more often than not requires multiple skillsets that may be available indifferent functional departments within the firm or may need to be outsourced from professional organizations outside the firm. Each of these characteristics is discussed below –

Is a production process

A project is a process that produces a customized deliverable or result in order to meet a requirement. It is often mistaken and confused for or loosely understood to mean the deliverable or result it produces, which it is not.

With a Unique Configuration

Every project must be configured differently each time depending on the requirements it is trying to satisfy. The context in which the requirements are

addressed and the requirements themselves are neither being nor expected to be repeated. E.g. construction of a metro rail will require a process to be set up differently even if it is being executed by the same project company with the same set of workers in the same city.

That meet a defined Objective

Projects must be uniquely configured because each project has particular result or a specific objective to be attained. These results or objectives differ from project to project. The projects in an organization could be constructing a new facility, computerizing the accounts department or studying the demand for a new product that the organization plans to launch in the market. Each of these projects will need to be set up as a production process uniquely based on the result or objective it is trying to achieve.

1.4.1 Unique Activities

Every project has a set of activities that are unique, which means it is the first time that an organization handles that type of activity. These activities do not repeat in the project under similar circumstances, i.e., there will be something different in every activity or even if the activity is repeated, the variables influencing it change every time.

1.4.2 Attainment of a Specific Goal

Organizations take up projects to perform a particular task or attain a specific goal. These tasks differ from project to project. The projects in an organization could be constructing a new facility, computerizing the accounts department or studying the demand for a new product that the organization plans to launch in the market. All these projects have a specific goal or result to attain and hence we can say that every project is goal-oriented.

1.4.3 Sequence of Activities

A project consists of various activities that are to be performed in a particular sequence to deliver the end-product. This sequence depends on the technical requirements and interdependency of each of the activities.

1.4.4 Specified Time

Every project has a specified start date and completion date. This time limit is either self-imposed or it is specified by the client. The life span of a project can run from a few hours to a few years. A project comes to a close when it delivers the product and/or service as per the client's requirements or when it is confirmed that it is no longer possible for the project to deliver the final product and/or service as required by the client.

Requires multidisciplinary skillsets available across organizational boundaries but which often require different skillsets all of which rarely reside in one professional, a functional department or even within a single organization. These people must collaborate on the project, although they might not work together regularly and probably have never met earlier. Project activities are either interrelated as they must be built or must function simultaneously or one or more activities must mandatorily precede one or more of the other activities. E.g. consider the project of building a luxury hotel. This project consists of various activities such as seeking permissions from the concerned authorities, inaugurating the project, laying the foundation, making a building plans, landscaping the garden, constructing the building, electrical layouts, plumbing and sewerage lines, designing the interiors, furnishing the rooms, etc. Not only are these activities interrelated in one or both ways outlined above but also will require people with the specific skillsets to carry out these activities to work together in order to complete the project since only when all of them are complete can the project be considered complete.

Involves unfamiliarity therefore uncertainty

Projects must be set up to produce a deliverable that is custom built to meet specific requirements in a given period of time utilizing skillsets that reside in people who must be brought to work together by cutting across organizational boundaries. How this is done differs with project. This makes the project an unfamiliar endeavour which means everything is uncertain to varying degree.

With something at stake if it does not succeed

Finally, a project almost always has something at stake if it fails to achieve what was agreed – be it requirements, scope, time or cost. Often contracts outline service agreements where in penalties are specified to be paid out if pre-decided criteria are not considered to be met.

1.4.5 Interrelated Activities

Projects consist of various technically interrelated activities. These activities are considered interrelated as the deliverable (output) of one activity becomes the input for another activity of the project. Consider the project of building a multistoried luxury hotel. This project consists of various activities such as making a building plan, landscaping, constructing the building, designing the interiors, furnishing the rooms, etc. All these activities are interrelated and are equally important for the completion of the project.

1.5 Project Parameters

The primary aim of a project is to deliver a product and/or service to a client within the specified time, budget (resources and cost), and according to the

quality and performance specifications. Usually, the clients ask for too much to be delivered within limited resources. Therefore, it is important for the project manager to make the clients aware of the limitations pertaining to time, budget, technicalities, etc., that he/she is working under. The success of a project depends on the project manager's ability to strike a balance between these interrelated variables or constraints. Some common constraints that influence a project are – scope, quality, time, cost and resources.

The primary aim of a project is to deliver a product and/or service to a client within a specified time and that will meet the performance requirements for a negotiated price. It is important to remember that project is characterized by being unique, and thereby to understand the implication that scope and time and cost cannot be exactly pre-determined. Project teams think that clients ask for too much to be delivered in unrealistic timeframes and at unreasonable cost. Clients on the other hand tend to think that project teams compromise scope, waste time and do not control costs. Who is right? How can the answer to this be known, when the very nature of projects makes it impossible to determine - what can be done, how much time it will take and how much it will cost? It is important for project teams to be aware of and for the project manager to make the clients aware of, the limitations under which projects are undertaken. They must collectively identify the parameters that may influence project success and negotiate how to configure and monitor these variables. The success of a project depends on the project's ability to strike a balance in managing these variable and interrelated parameters. Apart from the triple constraint dimensions of scope, time and cost against which a project's ability to attain its objectives is measured, some practitioners as well as authors think that additionally, quality, resources, risk, sustainability and organizational process/structure are variables that must be distinctly monitored for their influence on project success. However, others disagree and believe that these additional parameters are not distinct but are already included when considering the triple constraint. This is discussed below.

1.5.1 Scope

Scope is a brief and accurate description of the end-products or deliverables to be expected from the project that meet the requirements. Scope describes all the activities that are to be performed, resources that will be consumed, and the end-products from the successful completion of the project, including the quality standards. The scope also includes the target outcomes, prospective customers, outputs, work, financial and human resources required to complete the project. Fundamentally, then, scope defines a boundary. A boundary that configures the work that will be and work that will not be taken on. The boundary therefore works as a guiding as well limiting constraint of the project.

1.5.2 Quality

It may be argued, that quality is a parameter included within the scope parameter. The counter argument is even when a project team manages to meet the scope as specified, the client might be dissatisfied with the outcome of the project. According to this point of view, quality is the intangible aspect of scope and therefore it must be articulated separately. Every project has to satisfy the quality requirements at two levels – product quality and process quality. The first quality requirement relates to products resulting from the project and the second relates to the management processes that have to be in place to implement the project. A comprehensive quality management system ensures effective utilization of scarce resources to achieve the project objective of delivering products and/or services to the client's satisfaction.

Risk

Project Management, all said and done, is nothing but the management of risk. Scope is a project parameter that must be monitored because it is variable and therefore there is a risk that it will deviate from the specifications. Time is a project parameter that must be monitored because it is variable and therefore there is the risk of the project getting delayed beyond the specified deadline. Cost is a project parameter that must be monitored because it is estimated and variable, so it runs the risk of varying from the budget allocated on the basis of the estimates. Without risk, project parameters would not require identification, monitoring or control. Why then should this parameter be considered separately? It was discussed earlier that uncertainty is one of the distinguishing characteristics of a project. It will be discussed elsewhere, that risk is uncertainty that can be quantified using probability (of occurrence). Some events have a low probability of occurrence and some a high probability of occurrence. Uncertainty, on a project, can be categorized into 2 types - known-unknowns – that can be planned for and sometimes quantified and unknown-unknowns– which by definition cannot be anticipated. Also, since risk and therefore uncertainty is variable throughout the course of the project, it is perhaps the ultimate or parent parameter that must be monitored for project success.

1.5.3 Time

Time is one of the important resources available to a project manager. The client and/or the sponsor of the project specifies the time limit which is often called the deadline - for the completion of the project. 'Dead' line implying that – in keeping with another characteristic of projects – being temporary – the project life comes to an end beyond what defines a second type of boundary for the project. If this boundary is crossed, the cost of the project will increase as allocated resources must be paid for and also because delays often affect engagements and therefore attract penalties. Project teams must carefully manage this parameter and

schedule, coordinate and monitor the completion of activities. At the same time, it is one of the major constraints within which a project has to be completed. Generally, the client or the sponsor of the project specifies the time limit for the completion of the project. The time required to complete a project is inversely related to the cost of the project. Therefore, the cost of a project increases as the time available for its completion decreases. Since time cannot be stored as an inventory, it is the duty of the project manager to manage time by carefully scheduling the various activities on time.

1.5.4 Cost

Cost plays a major role in the various stages of a project life cycle. Project costs include the monetary resources required to complete the activities mentioned in the scope of the project. Project costs are costs associated with all the activities in the planning and implementation phases. The client or the sponsor of the project prepares a budget which is a third type of boundary – a boundary that configures the limit to spending on the project. This parameter is set using the estimated costs of various project activities that have to be completed as per decided scope and time. Cost acts as a constraint for individual activities as well as the overall project since lower or higher expenditures, are influenced by as well as impact the project scope as well as its completion time. The client or the sponsor of the project prepares a budget based on the estimated costs of various project activities, within which the project manager has to deliver the product.

1.5.5 Resources

Technically speaking resources is included under the cost parameter. Resources include the people, finances, and the physical and information resources required to perform the project activities. Resources may often only be obtained by crossing organizational boundaries and may either be absent, unavailable or withdrawable during the course of a project. Such resources could sometimes be critical to the project but they may not be obtainable at any cost. Monitoring resources separately rather than under the cost parameter might be useful, since at the very least such projects could be terminated early or before they incur further costs.

Sustainability

The long term strategy of a firm sometimes conflicts with its the short or medium term objectives. This is another reason why it was emphasized earlier that project selection must be done in alignment with firm strategy. Conflicts typically occur when there is a lack or lacuna in leadership or when leader tenures are short lived. Considerations of economic or environmental/social sustainability of the firm as well as the context in which it is operating and the context it is trying to serve are variable and are of advantage in making project decisions.

Organizational Structure/Processes

Strictly speaking this is not a parameter that is within the control of the organization that is doing the project. However, the extent to which the structure of the organization in terms of the roles, responsibilities, reporting and accountability as well control procedures and measures that check and balance the activities of people, can influence a project is often underestimated, overlooked. Hierarchically organized companies can be rigidly bureaucratic and delay the pace of projects and make inter-departmental collaboration, which is required on projects difficult. Likewise, the unstructured informality typical of startup firms can adversely affect time and cost constraints to be broken. Being aware of how organizational structure and process can positively or negatively determine project success is useful.

Check Your Progress - 2

5. Organizations adopt the project approach when _____.
   i. the tasks are new to the organization
   ii. the tasks may not be repeated in the future
   iii. the existing systems in the parent organization are not equipped to handle the new task.
   a. Only i and ii
   b. Only i and iii
   c. Only ii and iii
   d. i, ii, and iii
6. Which of the following is **not** a characteristic of a project?
   a. Every project has a set of unique activities.
   b. A project is taken up to perform a particular task or attain a specific goal.
   c. A project consists of various technical activities that are independent and unrelated.
   d. A project consists of various activities that need to be performed in a particular sequence to deliver the end-product.
7. _____ can be defined as a brief and accurate description of the end-products or deliverables to be expected from the project that meet the requirements.
   a. Quality
   b. Scope
   c. Program
   d. Strategy

8. Identify the project resources.
   i. People resources
   ii. Financial resources
   iii. Physical resources
   iv. Information resources
   a. Only i, ii, and iii
   b. Only i, iii, and iv
   c. Only ii, iii, and iv
   d. i, ii, iii, and iv

1.6 Relationship between Project Parameters

The scope and quality of a project are influenced by a variety of configurable variables (which is why they are called parameters). These parameters, apart from the triple constraint dimensions of scope, time and cost against which a project's ability to attain its objectives is measured, as well as, the arguably distinct variables of quality, resources, risk, sustainability and organizational process/structure, must be managed for a project to be successful. The success of a project largely depends on the project team's ability to keep the project in equilibrium. In a project environment, the management prepares a project plan by estimating the approximate time, cost, and the resources (people, equipment, land and buildings, etc.) required to accomplish the goals mentioned in the scope and quality of the project as required by the client/sponsor.

The project manager is given this plan describing the time, cost, and resource allocations that are in equilibrium. But the success of the project depends on the project manager's ability to balance these variables according to the changes arising from within and outside (clients) the project system. The projects usually go off balance when clients request for changes in time frame, scope and quality. The client may want these changes because: there is a change in the market demand that requires adding some more features to the end product; the product needs to be launched ahead of its due date for competitive reasons; there is loss of key personnel or breakdown of machinery that calls for rescheduling; and a new technology is expected in the market.

1.7 Classification of Projects

Projects can be classified based on their characteristics such as business value, risk level, time span, complexity of tasks and the monetary value of the project. Projects can be classified after studying them carefully. Once the project is classified, it becomes easy for the management to select the project management style that best suits that class of project.

Activity: Madurai Textiles is one of the leading manufacturers and exporters of silk sarees in India. The company's revenues come from the export of sarees weaved in traditional designs to various countries in Europe, America and the Middle-East. The demand for its products in the export market has declined come down significantly owing to the changing tastes of the customers abroad. The company has sensed the need for modern designs and embarked on a project to introduce the latest designs. It recruited three young graduates from the NIFT (National Institute of Fashion Technology) to work on developing the new saree designs. Why do you think organizations undertake projects? What are the different types of projects that an organization can take up?

Answer:

1.8 Definition of a Program

According to PMI's PMBOK, "A program is a group of projects managed in a coordinated way to obtain benefits not available from managing them individually." Since a program is a collection of inter-related different projects, it has wider scope than an individual project. In business situations, it is very difficult for one project to deliver all the benefits needed to achieve the objectives of an organization. An inter-related set of projects therefore must be managed as a whole for an organization to achieve its strategic objectives. Hence, organizations take up business programs that are a combination of various projects aimed at achieving corporate objectives.

1.9 Project Management

Project management is a system of procedures, practices, methods and skills required to plan, control and ensure that client requirements are addressed and met within the triple constraints of scope, time and cost. According to PMI, "Project Management is the application of knowledge, skills, tools and techniques to project activities in order to meet or exceed stakeholder needs and expectations."

Project management is a carefully planned and organized effort to accomplish a specific (and usually) one-time effort, for example, constructing a residential complex or implementing a new computerized banking system. Project management includes developing a project plan that includes defining project goals, specifying how the goals will be accomplished, what resources are needed, and relating budgets and time for completion. It also includes implementing the project plan, along with careful controls to ensure that the project is being managed according to the plan. Project management usually follows four (sometimes considered five) major phases – conception, definition, implementation monitoring & control, and termination. Implementation and

monitoring & control are sometimes considered as separate phases. Project management usually follows five major phases – feasibility study, project planning, implementation, evaluation, and closing.

Check Your Progress - 3

9. Projects usually go off-balance due to several reasons. Which of the following options may **not** be a valid reason in such cases?
   a. Change in the market demand that requires addition of new features
   b. Breakdown of machinery
   c. Recruitment of new employees in the organization
   d. Loss of key personnel
10. Which of the following is **not** one of the five major phases in a project?
   a. Controlling
   b. Purchase management
   c. Implementing
   d. Closing
11. _____ is a group of projects managed in a coordinated way to obtain benefits not available from managing them individually.
   a. Process
   b. Program
   c. Operation
   d. None of the above

1.10 Project Management – Relationship with Other Management Disciplines

Although project management has derived most of its knowledge from other management disciplines, it has evolved as a specialized science over a period of time. It has its own management techniques such as critical path analysis and work breakdown structures (discussed later) that are unique to project management. Like general management, project management also involves all aspects of planning, organizing, implementing, and controlling. In many strategic projects, the function of project management will involve disciplines like:

Finance: Preparing the financial statements while sending the project proposal and managing the costs of the project.

Personnel: Identifying the skills required to carry out the project, selecting the project team, and maintaining a good working environment.

Operations: Managing the activities/operations that are repetitive in nature.

Purchase and logistics: Identifying resources (raw materials, equipment, and services) required for the project, preparing a list of eligible suppliers and negotiating with them for procuring the right materials and managing the logistics for a smooth implementation of the project.

R&D: New product development and quality assurance.

Marketing: Marketing the project idea to internal and external sponsors.

1.11 Relationship between Project Management and Line Management

According to the definition of project management, a project manager has to control variables such as time, cost and other resources allocated for the project. But in practice, he/she only has an indirect control over these resources as they are controlled by the line managers or functional managers. Therefore, the project manager has to maintain good relations with line managers to ensure a smooth flow of resources. Thus, a project manager should exercise judicious control over the resources (money, manpower, machinery, facilities, materials, technology, and information) allocated to the project from various functional departments. The success of a project depends on the various aspects of project and line managers' relations. The characteristics of a good relationship are:

- Amicable working relations between the project manager and the departmental heads who allocate resources to the project.
- Functional project member's ability to report to the functional manager of the department from where he/she comes from and the project manager for whom he/she currently works for.
- Employees of various functional departments who are selected to work on a project usually face difficulties in reporting to multiple bosses. The issue of who should have control over the functional employees becomes a source of conflict between the line and the project managers. The relations can be strained further if any one of them claims sole credit for the success of the project or rewards for the profits generated by the project. These conflicts can be resolved when the managers understand their distinct roles in achieving the overall objectives of the organization.

Check Your Progress - 4

12. In case of strategic projects, the quality assurance function is taken care of by the following discipline of project management:
    a. Marketing
    b. Purchase and Logistics
    c. Operations
    d. Research and Development

13. Which of the following statement is **false** regarding project management?
    a. Project management involves developing a unique product or process and managing change.
    b. Project management involves managing many risk variables.
    c. Project management involves managing the existing systems and services in an organization.
    d. Project management is performed as a one-time initiative that is conducted in a relatively short time.
14. Which of the following situations will lead to conflicts between the project managers and the line managers?
    i. Issue of control over the functional employees who work for the project
    ii. Difficulty in reporting to multiple bosses
    iii. Claiming sole credit for the success of the project
    iv. Claiming rewards for the profits generated by the project
    a. Only i, ii, and iii
    b. Only i, iii, and iv
    c. Only ii, iii, and iv
    d. i, ii, iii, and iv

1.12 Project Stakeholders

According to the Project Management Institute's (PMI) Guide to the Project Management Body of Knowledge, project stakeholders are 'individuals and organizations who are actively involved in the project, or whose interest may be positively or negatively affected as a result of project execution or successful project completion.'

The project management team should try to identify the stakeholders, determine their needs and expectations, and then manage and influence those expectations to ensure a successful project. The manager can use methods like stakeholder analysis to identify all the potential stakeholders who might have an impact on the project and then determine their relative ability to influence the project. Project stakeholders will include those -- who are directly related to the project like suppliers, clients, employees, and managers; who can influence the physical, organizational, technological, socio-economic, legal and political environments; who have an authoritative relation to the project like government agencies at local, regional, and national levels; and persons, groups, and associations that have a stake in the project.

1.12.1 Types of Stakeholders

The major stakeholders of any project include project manager, customers, project team members, sponsor, and parent organization.

Project manager

The project manager is an important stakeholder of the project as he is responsible for channelizing the project's resources; developing the project plan; and ensuring that the project activities are completed on time, within budget, and according to quality standards. He also acts as an interface between customers and management. The project manager is responsible for:

- Ensuring the overall success of the project
- Applying the experience gained from past and present projects, in future projects
- Setting priorities for various project activities
- Acting as a catalyst for resolving project problems and conflicts
- Evaluating the strengths and weaknesses of the completed projects, and applying the lessons learned to future projects
- Providing timely information about the project to other stakeholders.

Customers

Customers are those who will use or pay for the deliverable (product or service) produced by the project. These customers may be internal or external to the organization. It is the responsibility of the customers to be actively involved in the project to help ensure its successful completion. For some projects it may be difficult to identify a specific group of customers. Generally, there are three categories of customers: internal customers, intermediate customers and external customers.

Internal customers consist of individuals who are internal to the parent company. In the above example, the production department is an internal customer. Intermediate customers are usually external to the company, but they will not be the final users of the product. Distributors and wholesalers constitute the intermediate customers of a project. External customers are the individuals or organizations, who pay for the final product and use it. The project team should consider all the requirements of different categories of customers.

Project team members

All the groups and individuals who devote time, skills, and effort to the project are regarded as project team members. Sometimes, the personnel of the vendor and the client are also appointed members of the project team, along with the employees of various functional departments who are assigned to the project. Generally, project team members take care of the technical, managerial or the administrative aspects of a project. They work directly with or under a project

manager, depending on the way the project is organized. The team members who look after the technical aspects of a project perform activities concerned with engineering, construction, procurement, quality and performance testing. The members in charge of the administration of the project are involved in activities concerned with planning, scheduling, budgeting, preparing status reports, managing project communication etc. Team members play a crucial role in the success of a project. Therefore, the project manager should use various team-building skills to encourage the members to work as a team.

Sponsor

A sponsor is an individual or a group within the parent organization who arranges the resources for the project themselves. This assistance can be in cash or kind. The sponsor may be a senior executive or a junior manager with formal authority who is responsible for the project. He acts as a link between the project and the parent organization.

Parent Organization

The parent organization is a major stakeholder of the project since its employees are directly involved in executing the project. Therefore, the project should contribute towards achieving the corporate goals of the parent organization.

Activity: L&T is the commissionaire for the Hyderabad Metrorail project. The company took up this project more to prove their capacilities in successfully executing such large social projects of the government. The project manager constituted the project team and addressed them as follows: All of you have been handpicked for this prestigious project in view of the expertise you demonstrated in executing complex projects.I am very confident of your expertise in handling this type of project also, but the success of this project depends more on how well you manage the stakeholders, as this place is known for labor unrest, rivalry among local tribes, and many other political problems." Do you agree with the CEO's statement on the role of the stakeholders in the success of this project? If yes, who are the stakeholders of this project and what should the project team do to manage the stakeholders effectively?

Answer:

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15. Which of the following statements are **true** regarding project stakeholders?
    i. Project stakeholders are directly related to the project.
    ii. They have a stake in the project.

iii. They have an authoritative relationship with the project.

iv. They influence the socioeconomic and political environments.

a. Only i, ii, and iii

b. Only i, iii, and iv

c. Only ii, iii, and iv

d. i, ii, iii, and iv

16. Which of the following activities is **not** a major responsibility of the project manager?

a. Arranging the resources for the project

b. Channelizing the project's resources

c. Developing the project plan

d. Ensuring that the project activities meet the cost, time and quality standards

17. Intermediate customers to a project are _____.

a. customers who are internal to the company and the final users of the product.

b. customers who are external to the company but are not the final users of the product.

c. customers who are external to the company and pay for the final product and use it.

d. customers who provide financial and/or non-financial resources to the project.

18. Sahara International has a design team that has taken up a project to design a multi-purpose machine. The production department has expressed a desire to use the machine. The company also plans to sell the product to outside customers. The production department will be the _____ customer of the project while the outside customers will be the _____ customers of the project.

a. internal or external, intermediate

b. internal, intermediate or external

c. external or intermediate, external

d. internal or intermediate, external

19. Which of the following statements is/are **not true** regarding project team members?

i. Project team members are all the groups and individuals who devote time, skills, and effort to the project.

ii. Project team members take care of only the technical aspects of a project.

iii. Project team members work directly with or under a project manager, depending on the way the project is organized.

a. Only i and ii

b. Only i and iii

c. Only ii

d. Only ii and iii

20. The project team members who look after the technical aspects of a project carry out activities like:

i. Engineering

ii. Budgeting

iii. Quality and performance testing

iv. Managing project communication

a. Only i and ii

b. Only i and iii

c. Only ii and iii

d. Only iii and iv

21. Which of the following aspects is looked after by the project team members who are in charge of the administrative aspects of a project?

a. Procurement

b. Quality testing

c. Preparing status reports

d. Construction

22. Which of the following stakeholders is responsible for arranging the resources required for the project?

a. Project manager

b. Customer

c. Sponsor

d. Parent organization

1.13 Organizational Influences

Projects are usually taken up by organizations larger than the projects themselves. These organizations can be business corporations, government organizations, professional associations, research and development centers etc. Organizations that initiate a project will have an influence on the implementation of the project. These organizational influences even act on projects that have been initiated by joint ventures or partnerships. Some of the major aspects of large organizations that influence projects are – organizational systems, organizational culture and style, and organizational structure.

1.13.1 Organizational Systems

Organizations, which primarily carry out projects, are known as project-based organizations. They earn revenues mainly by undertaking projects. Some examples of project-based firms are consultancy firms, architecture firms, software development firms, infrastructure contractors etc. Some organizations adopt a management by project approach to manage their ongoing operations. These organizations treat various aspects of ongoing operations as projects and apply project management principles to them.

Project-based organizations have well designed management systems (such as financial systems, control systems, etc.) to help them manage projects effectively. These organizations have a number of specifically designed systems in place to monitor the progress of the activities of a project. For example, finance systems are designed to take care of accounting, tracking and reporting activities of multiple projects.

Non-project-based organizations, such as manufacturing firms, hotels etc., may not have any management systems for addressing project needs. Managing projects in these organizations is a difficult activity. But some non-project-based organizations will have separate divisions or sub-divisions that work as project-based organizations with project oriented management systems. So, the project management team should be capable of understanding the influence of various management systems on the project.

1.13.2 Organizational Culture and Style

Each organization has its own culture, i.e., its shared values, norms and beliefs. An organization's policies, procedures and attitude towards authority also reflect its culture. Organizational culture and management styles have a direct impact on the functioning of the project team. As a result, organizations that have an aggressive, risk-taking culture will not employ conservative, cautious project managers.

1.13.3 Organizational Structure

Sometimes, the organization structure obstructs the free flow of resources from the parent organization to the project. The organizational structure can be functional, matrix, or project-based.

A *functional organization* has a hierarchical structure. In such a structure, superior-subordinate relationships are clear, i.e., the line of control is clearly defined. The employees are grouped into departments according to their areas of specialization, e.g., mechanical, engineering, electrical engineering, production, marketing, accounting etc. Functional organizations also work on the projects but their project activities are limited to a single function, e.g. engineering, manufacturing, marketing etc.

In a *project-based organization,* the project manager has the authority to assign priorities and to direct the work of individuals assigned to the project. Most of the organization's resources are allotted to various projects. These organizations also have functional departments, but the groups working in these departments report directly to the project manager and help in the execution of various projects.

A *matrix organization structure* combines some of the characteristics of functional and project-based organizational structures. In matrix organizations, project managers and functional managers are jointly responsible for assigning priorities and for directing the work of individuals assigned to the projects. In this organizational setup, project managers have equal authority to functional managers and the staff members report to functional managers as well as project managers.

Every organization has one of the above discussed organizational structures and they have an impact on the projects initiated by them. For example, when a project team is formed by a functional organization, those teams have to form their own operating procedures and reporting structures that are similar to that of project-based organizations. This organizational structure also has an impact on the functioning of a project manager.

Example: Impact of Organization Structure on the Project Manager

Selecting the right organizational structure will provide a competitive advantage for an organization. Some of the effects of organizational structure on the functioning of a project manager are given below.

Authority: The type of organizational structure existing in a firm may favor projects or the ongoing operations of the firm. In the function-driven organization, the project manager has almost no authority, and in the project-oriented firm, the project manager has complete authority. A project manager having less authority requires more effort to get decisions approved and implemented.

Communication: Communication plays a major role in the success of a project, irrespective of the organizational structure of the parent organization. Most organizational structures facilitate vertical (top-down and bottom-up) communication patterns, but sometimes the project manager's communication requirements may run counter to the existing communication patterns. Crossing organizational boundaries always takes more effort. In this situation, the project manager should do whatever is necessary to keep all the stakeholders informed and coordinated for achieving the project objectives.

Priority: Multiple projects often compete for the limited resources of an organization, such as people, equipment, and funding, especially in firms with a traditional, function-driven management style.

Contd….

Project managers working in a function-driven structure often have their teams and resources trimmed to meet the needs of the ongoing operations of the organization or for starting a new project.

Focus: In project-oriented organizations, projects are in focus as they play a major role in generating revenues for the organization. Every employee works towards achieving a single objective, and this focus on a single objective helps to increase productivity. The employees are focused on their projects as they work on them throughout the year. This focus and sense of responsibility towards a single project increases employee morale.

Chain of command: When the chain of command for a project goes against the organizational structure, it takes more effort to bring a problem to the notice of the manager concerned. As the project breaks through functional boundaries, more and more functional managers are required to approve decisions. And, if certain functional groups have competing interests, clashes over authority can bring the progress of the project to a standstill.

Project-oriented organizations make it easy to run projects because their entire structure is set up for that purpose. In most organizations, however, project managers may have difficulties dealing with the authority structure. In these cases, they will have to rely more on their own expertise – and on other project management techniques.

Adapted from Eric Verzuh, "The Fast Forward MBA in Project Management," John Wiley & Sons, Inc. p 29-30.

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23. Identify the major factors that influence projects in large organizations.
    i. Organizational systems
    ii. Organizational culture
    iii. Organizational style
    iv. Organizational structure
    a. Only i, ii, and iii
    b. Only i, iii, and iv
    c. Only ii, iii, and iv
    d. i, ii, iii, and iv
24. From the following options, identify the statements that are **true** regarding a functional organization.
    i. The line of control is clearly defined.
    ii. Functional organizations work on projects and their project activities cover all functions.

iii. The employees are grouped into departments according to their areas of specialization.

a. Only i and ii

b. Only i and iii

c. Only ii and iii

d. i, ii, and iii

25. In the case of project-based organizations,

a. The project manager has the authority to assign priorities and to direct the work of individuals assigned to the project.

b. Project managers and functional managers are jointly responsible for assigning priorities and for directing the work of individuals assigned to projects.

c. All the departments concentrate on a single project and therefore, all the resources are allotted only to this project.

d. Both (a) and (c)

1.14 Socio-economic Influences

A wide range of socio-economic issues influence projects. The project team should be aware of these issues as even a minor change in the socio-economic environment can sometimes affect the success of a project. Some of the socio-economic factors that influence projects are – standards and regulations, internationalization and culture.

1.14.1 Standards and Regulations

Standards are measures for judging the quality of products. Generally, standards are documented and approved by a recognized agency/body. These standards specify the rules and guidelines that organizations must observe when producing a product or a service. Even when these standards are not mandatory, following them will enhance the marketability of the products produced by the project organization.

Regulations are mandatory guidelines that lay down the necessary characteristics of products or services. Building codes established by Roads and Buildings (R&B) department are an example of regulations. Usually, these regulations are drafted by various governmental regulatory agencies and are enforced by regulatory personnel.

The project team should be cautious enough to ensure that the project meets the standards and regulations. The early detection of deviations from standards and regulations can help reduce project costs and duration.

1.14.2 Internationalization

Many organizations have subsidiaries in different countries. The projects undertaken by such organizations generally cross many national boundaries. Project managers must therefore be familiar with the political and economic environment of the countries in which the projects are being executed. They must also design a communication plan that enables them to manage and coordinate the project activities that are being carried out in different countries.

1.14.3 Culture

The culture of an organization and the external environment of a project have a significant impact on the success of the project. The culture includes the organizational culture, work environment, and the culture of various stakeholders of the project. The project manager should have an in-depth understanding of the organizational culture as it has a direct influence on the functioning of the project. The organizational environment and culture depend on – the philosophy and managerial style of the top management; the organizational structure of the project (functional, project-based, or matrix); the character and maturity level of project team members i.e., achievement level, motivation level, etc.; and the size of the project.

The culture of the project team members (their values, beliefs and convictions) influences their attitudes towards ethics, achievement, training and supervision and their interpersonal, problem-solving and conflict resolution skills. It also determines their level of motivation. A good understanding of different cultural values, languages, and special business styles and techniques would be an asset for a project manager, especially when handling international projects.

1.15 Environmental and Legal Influences

Environmental and legal concerns have a major impact on the successful completion of a project. Therefore, the impact of the environment on the project should be assessed before and after a project has been undertaken. In addition, analyzing the impact of a future project on the environment will help the project manager define rational goals for the project and the organization.

The project manager should acknowledge these regulatory processes as a part of good planning, instead of regarding them as barriers to the achievement of project goals. The project manager should obtain the necessary clearances from environmental protection agencies before starting the project. If possible, he should integrate these regulations (legal, environmental, etc.) into the overall plan of the projects.

All the projects should comply with all aspects of the law. Organizations usually take the help of legal advisors to ensure that the activities of the project manager

and his team are in compliance with the law. Legal advisors must also ensure that the project has applied for and received all the required permits and licenses.

1.15.1 Safety Focus in Project Management

Safety has become a key consideration in Project Management. Many projects are currently being executed in automobile and infrastructure sectors. Safety is usually taken for granted in them, especially in such projects involving construction activities where unskilled and semiskilled labour are employed. Notwithstanding the public concerns, there is a need for tightening safety management systems in all operations as environmental concerns became an integral part of safety management. Global standards and guidelines are available to ensure compliance and certification. It has been adequately established that safety, like quality is a cultural issue and flows from top to bottom, calling for commitment, participation and support of top management. Safety is a major aspect in ensuring quality of work life and has a significant influence on the productivity of employees. In these days of outsourcing as an operations strategy, vendor qualification and ensuring vendor's commitment and compliance to safety is equally important in operations management while executing critical projects. The following Exhibit 1.1 exemplifies the impact of ineffective safety management in global disasters.as happened for Boeing aircraft.

Exhibit 1.1: Impact of Flawed Safety Management on Boeing's Fortunes

Introduction

Boeing 737 Max jets are cleared to fly after a 30-month-long ban imposed across the world in the aftermath of two fatal crashes raised serious safety concerns. On October 29, 2018, an Indonesian airline Lion Air Flight 610 crashed into the Java sea moments after takeoff, killing all 189 passengers and crew. On March 10, 2019, an Ethiopian Airlines Flight 302, which took off from Addis Ababa, Ethiopia, went into a fatal dive shortly after takeoff, leaving all the 157 people on board dead. Both the crashes happened under similar circumstances, suspecting the aircraft to be fundamentally unsafe. The investigators blamed faulty flight control system for the crashes.

Launch of Boeing 737, the crisis and the impact

Boeing launched the 737 MAX jets, of latest fourth generation of aircraft family, in 2016. It was certified by the US Federal Aviation Administration (FAA). However, a series of engineering and quality issues surfaced a few months after its much hyped-launch. The twin accidents had raised serious safety concerns, forcing aviation regulators to order Boeing to ground all its Max planes (434) across the world. But by then, it was too late for the company to do a damage control—the crown went to Airbus.

Contd….

Boeings deliveries, during 2019, totaled a mere 345 (down from 806 in 2018) and incurred its first loss in more than a decade. It looked Boeing would cede further ground to Airbus, but being a much older company had not given up.

Breather

On August 26, 2021, India's aviation regulator lifted the ban on Max 8/9 aircrafts, paving way to make a comeback, following clearances by safety regulators like the FAA.

The pointers

Safety management calls for a meticulous life-cycle approach. The Boeing episodes point towards grave lapses in safety management, calling for robust design, training, and regulatory compliance.

Source: Sisodia Amit Singh, "The Max is Back- Not the Music Album, But the Boeing 737 Aircraft", Analyst, September, 2021

Safety in Transportation Systems: Vehicle safety is undergoing revolutionary changes in the light of technological advances. Safety is a key driver in the emergence of a new stage of intelligent transportation systems. Safety should therefore receive top priority while ensuring customer focus in supply chain management.

Safety Systems: Passive and Active systems are the two major categories in vehicle safety. Passive safety is relatively mature both as a concept and technology and active safety is progressing. The future may see info-safety based on Information Communication Technologies, governing the vehicle safety landscape followed by connected mobility. All these developments influence the customer focus on safety. Frequent recall of vehicles by automobile manufacturers due to safety related issues stresses the need for focus on vehicle safety. The evolutionary trends in vehicle safety may be summarized as follows:

Stage	Main Features	Current Status	Remarks
Passive safety	Focus on containing damage in case of accident. Foundation of vehicle safety. Includes bumpers, crumple zones, airbags, seatbelts, head restraints and shoulder harnesses. Advances in vehicle safety are mainly in this area	Becoming predictive so that safety gadgets like seatbelts, airbags etc. can react to possible accidents in more sophisticated ways	The improvements in vehicle safety are mainly due to the initiatives of **a**. automakers and suppliers and **b.** Regulators and safety evaluation organization's Seatbelt was introduced by Volvo in 1959.

Stage	Main Features	Current Status	Remarks
Active Safety	Focus on preventing damage by sensing dangers. Uses information obtained from surroundings (traffic, road configuration and condition, nearby objects etc.) and works along with passive systems to mitigate damage in the event of an unavoidable collision. Major objective is to prevent human error. The predictive capacity of active safety is a result of the use of advanced sensors, radars and cameras.	Active safety systems are largely deployed in luxury cars at present and are expected to trickle down to other vehicles. Ford introduced active safety features in low priced cars like Ford Fusion.	Speed of implementation depends upon **a**. Introduction of safety assessments and **b**. Endorsement of active safety features by service providers such as insurance (lower premiums) or leasing companies (reduced repair costs and low downtimes, yielding higher profits). Active safety systems rely heavily on high-tech electronics both for hardware and software. This brings in new players to the value chain.
Info-safety	Enables the sharing of information gathered by the sensors between vehicles and vehicles and their surroundings to increase safety further.	Used in higher end vehicles and is now extending to all types.	This is the concept behind V2X technology (vehicle to other vehicles, infrastructure, roads etc.). This is called info-safety as an integral part of networked mobility environment.
Connected Mobility	Comprises information sensors, portals and centers throughout the environment, which together can sense, exchange, compile, process and store information for further use.	Integration of mobile sensors is expected to expand coverage and foster quicker reaction times to changes in a situation.	It is the next stage in the evolution of intelligent transportation. While active safety systems are currently geared mainly for passenger vehicles, it will extend to buses, trucks and personal mobility vehicles.

1.16 Project Phases and the Project Life Cycle

Organizations generally divide a project into various project phases to help management have better control over the project and to coordinate the project activities with those of the organization. Projects generally consist of a begin-plan-do-check&act-end phases. Sometimes, depending on the types of projects and traditional practices various practitioners, authors and professional bodies vary in their description of these essential lifecycle phases. A lifecycle model developed with large scale space agency projects or a conglomerate firm with multiple lines of business which introduces new products through product development projects would consider projects as consisting of a separate execution/launch phase (the do of the begin-plan-do-check&act-end sequence) and a separate monitoring & controlling phase (the check&act of the begin-plan-do-check&act-end sequence) so that there are 5 phases. A lifecycle model developed with public works or construction projects would probably consider execution and monitoring&controlling as part of the same phase (do and check&act of the begin-plan-do-check&act-end sequence merging into a single phase that follows the plan phase to become begin-plan-do-and-check&act-end, so that there are 4 phases. All the project phases put together comprise the project life cycle.

It is also worth noting that a project life cycle is subtly different from a project management lifecycle.

1.16.1 Project Phases

A project phase is a collection of related project activities, which result in the production of one or more major project deliverable. These phases are arranged in a sequence to enable better understanding of the project. A review of the performance of the deliverable is conducted at the end of every project phase to check if the project can proceed to the next phase, and to identify and correct mistakes in a cost-effective manner. All the activities of a project can be classified into five phases – initiate, plan, organize, control, and close.

1.16.2 Project Life Cycle

The project life cycle is a collection of generally sequential project phases. The number of project phases is determined by the control needs of the project organization. The project life cycle represents the linear progression of a project, from defining the project, through developing a plan, implementing the plan and closing the project. A project life cycle usually specifies the technical work that must be carried out in various phases of the project and the list of individuals and their roles in each phase of the project. The project life cycles of many projects share some common characteristics:

- The manpower and finances required in the initial stages of the project are low. They increase as the project progresses and gradually decrease as the project nears completion.

- The project starts with a very low probability of success. The probability of success increases as the project passes through various phases and nears completion.
- Project stakeholders are very influential at the beginning of the project. Their influence decreases as the project progresses.
- The cost of incorporating change requests and correcting mistakes increases as the project comes to an end.

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26. _____ are measures for judging the quality of products. These are documented and approved by a recognized agency.
    a. Codes
    b. Standards
    c. Procedures
    d. Regulations
27. From the following options, identify the factor that influences the environment and culture of an organization, which, in turn, can have a significant impact on the success of the project.
    a. Level of socialization in the organization
    b. Type of technology used in the organization
    c. Philosophy and managerial style of the top management
    d. Cost involved in the project
28. A project life cycle is
    a. a collection of project processes
    b. a collection of project phases
    c. a collection of project programs
    d. a collection of project operations
29. Review of the performance of the deliverable is conducted at the end of every project phase in order to:
    i. check if the project can proceed to the next phase
    ii. identify and correct mistakes in a cost-effective manner
    iii. close the project
    a. Only i and ii
    b. Only i and iii
    c. Only ii and iii
    d. i, ii, and iii

1.17 Summary

- A project is a group of unique, inter-related activities that are planned and executed in a certain sequence to create a unique product and/or service, within a specific time frame, budget and the client's specifications.
- A project is a production process which has a unique setup configured to imperatively meet a specific set of requirements by a fixed deadline date time under possibly changing environmental conditions.
- Some of the characteristics of the tasks that qualify to be projects are unique activities, attainment of a specific goal, sequence of activities, specified time and interrelated activities.
- The primary aim of a project is to deliver a product and/or service to a client within the specified time, budget (resources and cost) and according to the quality and performance specifications. Some common constraints that influence a project are scope, quality, time, cost, and resources.
- The scope and quality of a project are influenced by a variety of constraints like time, cost and availability of resources. The success of a project largely depends on the project manager's ability to keep the dynamic system (project) in equilibrium according to the changes arising from within and outside the project system.
- Projects can be classified based on their characteristics such as business value, risk level, time span, complexity of tasks and the monetary value of the project.
- A program is a group of projects managed in a coordinated way to obtain benefits not available from managing them individually. Since a program is a collection of different projects, it has wider scope than an individual project.
- Project management is the application of knowledge, skills, tools and techniques to project activities in order to meet or exceed stakeholder needs and expectations.
- Project management has evolved as a specialized science over a period of time, though it has derived most of its knowledge from other management disciplines.
- Project management like general management involves all aspects of planning, organizing, implementing, and controlling, apart from techniques like critical path analysis and work breakdown structures that are unique to its own.
- In many strategic projects, the function of project management will involve disciplines like finance, personnel, operations, purchase and logistics, R&D, and marketing.
- The project manager has to maintain good relations with line managers to ensure a smooth flow of resources. He/she should exercise judicious control over the resources allocated to the project from various functional departments.
- Project stakeholders are individuals and organizations who are actively involved in the project, or whose interest may be positively or negatively affected as a result of project execution or successful project completion.

- The major stakeholders of any project include project manager, customers, project team member, sponsor, and parent organization.
- Organizations that initiate a project will have an influence on the implementation of the project. Some of the major aspects of large organizations that influence projects are – organizational systems, organizational culture and style, and organizational structure.
- A wide range of socio-economic issues influence projects such as standards and regulations, internationalization, and culture.
- Impact of the environment on the project should be assessed before and after a project has been undertaken. Also, analyzing the impact of a future project on the environment will help the project manager define rational goals for the project and the organization.
- Organizations generally divide a project into various project phases to help management have better control over the project and to coordinate the project activities with those of the organization. All the project phases put together comprise the project life cycle.
- A project phase is a collection of related project activities, which result in the production of one or more major project deliverable. These phases are arranged in a sequence to enable better understanding of the project.
- The project life cycle is a collection of generally sequential project phases. It represents the linear progression of a project, from defining the project, through developing a plan, implementing the plan and closing the project.

1.18 Glossary

Functional organization structure: A hierarchical structure in which the employees are grouped into departments according to their areas of specialization, e.g., mechanical, engineering, electrical engineering, production, marketing, accounting etc.

Matrix organization structure: A hierarchical structure that combines the characteristics of functional and project-based organizational structures. The project managers and functional managers are jointly responsible for assigning priorities and for directing the work of individuals assigned to projects.

Program: A group of projects managed in a coordinated way to obtain benefits not available from managing them individually.

Project life cycle: A collection of generally sequential project phases. The number of project phases is determined by the control needs of the project organization.

Project management: The application of knowledge, skills, tools and techniques to project activities in order to meet or exceed stakeholder needs and expectations.

Project phase: A collection of related project activities, which result in the production of one or more major project deliverable. These phases are arranged in a sequence to enable better understanding of the project.

Project stakeholders: Individuals and organizations who are actively involved in the project, or whose interest may be positively or negatively affected as a result of project execution or successful project completion.

Project: PMI defined project as a temporary endeavor undertaken to create a unique product or service. The British Standard 6079 of 1996 (BS6079) defined a project as a unique set of coordinated activities, with definite starting and finishing points, undertaken by an individual or organization to meet specific objectives within defined schedule, cost, and performance parameters.

Project-based organization: A hierarchical structure in which the project manager has the authority to assign priorities and to direct the work of individuals assigned to the project. Most of the organization's resources are allotted to various projects. These organizations also have functional departments, but the groups working in these departments report directly to the project manager and help in the execution of various projects.

Regulations: Mandatory guidelines that lay down the necessary characteristics of products or services. These are usually drafted by various governmental regulatory agencies and are enforced by the regulatory personnel.

Scope: A brief and accurate description of the end-products or deliverables to be expected from the project that meet the requirements. It describes all the activities that are to be performed, resources that will be consumed, and the end-products from the successful completion of the project, including the quality standards.

Sponsor: An individual or a group within the parent organization who arranges the resources for the project themselves. This assistance can be in cash or kind.

Standards: Measures for judging the quality of products. They specify the rules and guidelines that organizations must observe when producing a product or a service.

1.19 Self-Assessment Exercises

1. Projects have been planned and managed since the beginning of civilization. Define a project. Explain the characteristics of a project. How are the projects different from operations?
2. The success of a project depends on the ability of the project manager to strike a balance between the various project parameters. What are the parameters of a project? In what way are these parameters related to each other. In what way can the projects be classified?
3. 'A program is a collection of different projects, and it has wider scope than an individual project.' Substantiate the given statement.
4. Project management has spread from its traditional focus on the fields of construction and engineering into diverse sectors like education and healthcare. What is project management? How is it related to the other management disciplines? Explain its relationship with the line management.

5. The project management team should identify the stakeholders, determine their needs, and manage these needs to ensure a successful project. Who are these project stakeholders? In what way are they important to a project?
6. Organizations that start a project will have an influence on the implementation of the project. What are the various organizational issues that influence a project?
7. The project team should be aware of the socio-economic, environmental and legal issues that influence a project. Describe in detail these influences.
8. Dividing a project into various phases helps the management to gain control over the project. What is a project phase? Explain a project life cycle and its characteristics.

1.20 Suggested Readings/Reference Material

1. Prasanna Chandra, "Projects," McGraw Hill, Seventh Edition, 2017
2. James Wood, Kory Kogon, and Suzette Blakemore, Project Management for the Unofficial Project Manager: A Franklin Covey Title, Goodreads, 2018
3. Heagney, Fundamentals of Project Management Paperback, Amacom, September 2018
4. NA, Nagarajan, Project Management 8/ED, New Age International Publications, 2019
5. IES Master Team,,ESE 2020 - Basics of Project Management Paperback – 1 IES Master Publication, January 2019

1.21 Answers to Check Your Progress Questions

Following are the answers to the Check Your Progress questions given in the unit.

1. (d) i, ii, iii, and iv

Project management is a system of procedures, practices, technologies, and know-how that helps in the planning, organizing, staffing, directing, and controlling necessary to successfully manage a project. Traditionally, project management focused on the construction and engineering sectors. Of late, it is being widely used in diverse sectors like education, healthcare, and software development.

2. (b) Project Management Institute

A project is a group of unique, inter-related activities that are planned and executed in a certain sequence to create a unique product or service, within a specific time frame, budget, and the client's specifications. The Project Management Institute's (PMI) publication 'A Guide to the Project Management Body of Knowledge,' has defined a project as "a temporary endeavor undertaken to create a unique product or service."

3. (c) Project

A project is a group of unique, inter-related activities that are planned and executed in a certain sequence to create a unique product or service, within a specific time frame, budget, and the client's specifications. Operations refer to the operating end of the business, where resources are transformed into goods and services. A process is a series of activities that brings about a result. A program is a group of projects managed in a coordinated way to obtain benefits not available from managing them individually.

4. (d) i, ii, and iii

Projects and operations are generally considered similar. Both are carried out by people. They are both planned, implemented, and controlled to produce results within the given resource constraints.

5. (d) i, ii, and iii

Organizations adopt the project approach when they have to perform tasks that are new to them. This approach is also adopted when the tasks are not likely to be repeated in the future, and when the existing systems in the parent organization are not equipped to handle the new task.

6. (c) A project consists of various technical activities that are independent and unrelated

Projects consist of various technically interrelated activities. These activities are considered interrelated as the deliverable (output) of one activity becomes the input for another activity of the project.

7. (b) Scope

Scope is a brief and accurate description of the end-products or deliverables to be expected from the project that meet the requirements. It describes all the activities that need to be performed, resources that will be consumed, and the end-products from the successful completion of the project, including quality standards.

8. (d) i, ii, iii, and iv

The various project parameters are scope, quality, cost, time, and resources. Resources in a project comprise the people resources, the financial resources, the physical resources, and the information resources. These resources are required to carry out the project activities.

9. (c) Recruitment of new employees in the organization

Projects usually go off balance when clients ask for changes in their time frame, scope, and quality. Some of the reasons for projects going off-balance could be change in market demand that requires the addition of new features, product needing to be launched ahead of due date due to competition, loss of key personnel, breakdown of machinery, new

technology expected in the market, etc. Recruitment of new employees in the organization will not make a project go off balance.

10. (b) Purchase management

Project management usually follows five major phases, namely, the initiating phase, planning phase, implementation phase, controlling phase and closing phase. The initiating phase identifies the beginning of a project. The planning phase involves designing and maintaining a realistic and achievable plan to attain the business objective. The implementation phase involves managing all the coordination and resource requirements to implement the plan. The controlling processes include reviewing and measuring project progress and implementing corrective measures when needed. The closing phase includes the formal submission of the project to the client to give the project or phase a structured ending. Purchase management is an operations activity and is not a phase in project management. It is a process carried out by the operations manager of an organization.

11. (b) Program

A program is a group of projects managed in a coordinated way to obtain benefits not available from managing them individually. It is a collection of different projects. It has wider scope than an individual project. A process is a series of activities that brings about a result. Operations refer to the operating end of the business, where resources are transformed into goods and services.

12. (d) Research and Development

The Research and Development discipline of project management takes care of new product development and quality assurance functions, in case of strategic projects.

13. (c) Project management involves managing the existing systems and services in an organization.

Line management involves managing the existing systems and services in an organization. The other options come under project management.

14. (d) i, ii, iii, and iv

Functional employees selected from various departments usually face a difficulty in reporting to multiple bosses. A major source of conflict that could arise between the project managers and the line managers is the issue of who should have control over the functional employees. The relations will be under further strain when any one of them claims sole credit for the success of the project or for the rewards generated by the project. These conflicts can be resolved when the project and line managers understand their distinct roles in achieving the overall organizational objectives.

15. (d) i, ii, iii, and iv

Project stakeholders are those who are directly related to the project – suppliers, clients, employees, and managers; those who can influence the physical, organizational, technological, socioeconomic, legal, and political environment; those who have an authoritative relationship with the project – government agencies at the local, regional, and national levels; and persons, groups, and associations that have a stake in the project.

16. (a) Arranging the resources for the project

The project manager is an important stakeholder of the project. He/she is responsible for channelizing the project's resources, developing the project plan, and ensuring that the project activities are completed on time, within the budget, and according to quality standards. The resources for the project are arranged by the sponsor, who could be an individual or a group within the parent organization.

17. (b) Customers who are external to the company but are not the final users of the product.

Customers are those who will use or pay for the product or service produced by the project. These customers may be internal or external to the organization. Internal customers are those individuals who are internal to the parent company. Intermediate customers are usually external to the company but they are not the final users of the product or service. External customers are the individuals or organizations who pay for the final product or service and use.

18. (b) internal, intermediate or external

Customers are the project stakeholders who will use or pay for the deliverable produced by the project. They can be internal or external to the organization. Internal customers are individuals who are internal to the parent company. The production department is an internal customer. In the given instance, the production department will be the internal customer of the project as it will use the machine. The company wants to sell the product to outside customers. These can be intermediate customers (distributors or wholesalers who will not be the final users of the machine) or external customers (individuals or organizations who will pay for and use the machine) to the project.

19. (c) Only ii

All the groups and individuals who devote time, skills, and effort to the project are regarded as project team members. Project team members take care of the technical, managerial, or the administrative aspects of a project. They work directly with or under a project manager, depending on the way the project is organized.

20. (b) Only i and iii

Project team member are individuals and groups who devote their time, skills, and effort to the project. They look after the technical and managerial or administrative aspects of a project. The team members who look after the technical aspects of a project carry out activities concerned with engineering, construction, procurement, and quality and performance testing. Activities concerned with planning, scheduling, budgeting, preparing status reports, managing project communication, etc., are carried out by team members who are in charge of the administrative aspects of the project.

21. (c) Preparing status reports

Project team member are individuals and groups who devote their time, skills, and effort to the project. They look after the technical and managerial or administrative aspects of a project. Activities concerned with planning, scheduling, budgeting, preparing status reports, managing project communication, etc., are carried out by team members who are in charge of the administrative aspects of the project. The team members who look after the technical aspects of the project carry out activities concerned with engineering, construction, procurement, and quality and performance testing.

22. (c) Sponsor

The sponsor is an individual or a group within the parent organization who arranges the resources for the project. This assistance could be in cash or in kind. The project manager is responsible for channelizing the project's resources; developing the project plan; and ensuring that the project activities are completed on time, within the budget, and according to quality standards. Customers are those who will use or pay for the deliverable produced by the project. The parent organization is a major stakeholder of the project as its employees are directly involved in executing the project.

23. (d) i, ii, iii, and iv

Organizations that initiate a project will have an influence on the implementation of the project. These organizational influences even act on projects that have been initiated by joint ventures or partnerships. Some of the major aspects of large organizations that influence projects are organizational systems, organizational culture and style, and organizational structure.

24. (b) Only i and iii

A functional organization has a hierarchical structure. In such a structure, superior-subordinate relationships are clear, i.e., the line of control is clearly defined. The employees are grouped into departments

according to their areas of specialization. Functional organizations also work on projects, but their project activities are limited to a single function.

25. (a) The project manager has the authority to assign priorities and to direct the work of individuals assigned to the project.

In a project-based organization, the project manager has the authority to assign priorities and to direct the work of individuals assigned to the project. Most of the organization's resources are allotted to various projects. These organizations also have functional departments, but the groups working in these departments report directly to the project manager and help in the execution of various projects.

26. (b) Standards

Standards are measures for judging the quality of products. These are generally documented and approved by a recognized agency/body. Standards specify the rules and guidelines that organizations must observe when producing a product or a service.

27. (c) Philosophy and managerial style of the top management

The organizational environment and culture depend on the philosophy and managerial style of the top management, the organizational structure of the project, the character and maturity level of project team members, and the size of the project.

28. (b) a collection of project phases.

The project life cycle is a collection of generally sequential project phases. A project phase is a collection of related project activities, which result in the production of one or more major project deliverables. These phases are arranged in a sequence to enable better understanding of the project.

29. (a) Only i and ii

A project phase is a collection of related project activities, which result in the production of one or more major project deliverable. These phases are arranged in a sequence to enable better understanding of the project. A review of the performance of the deliverable is conducted at the end of every project phase to check if the project can proceed to the next phase and to identify and correct mistakes in a cost-effective manner.

Unit 2

Project Idea Generation and Screening

Structure

2.1 Introduction

2.2 Objectives

2.3 Generating Project Ideas

2.4 Creativity and Idea Generation

2.5 Scanning the Environment

2.6 Searching for New Project Ideas

2.7 Initial Screening

2.8 Project Rating Index

2.9 Sources of Positive Net Present Value

2.10 Summary

2.11 Glossary

2.12 Self-Assessment Exercises

2.13 Suggested Readings/Reference Material

2.14 Answers to Check Your Progress Questions

2.1 Introduction

In the previous unit, we have discussed about the fundamental concepts of project management. We have also discussed about the project management environment. In this unit, we will discuss how to generate project ideas and screen them.

When developing a new project, the project manager generates several ideas from different sources like customers, employees and competitors, and finally selects those project ideas that can be implemented. The generation of ideas requires creativity, sensitivity to the changes in the external environment and assessment of resources and capabilities for a project management firm. A number of techniques such as assessment of firm's capabilities for any individual. So, the project manager has to be aware of several techniques like attribute listing, checklist and brainstorming for generating new project ideas.

After the ideas have been collected, the project manager has to screen them. The objective of screening is to drop the poor ideas at the initial stages of new project development. Project Rating Index, an initial evaluation method, helps management streamline the process of initial screening. Net Present Value (NPV) is used to conduct a financial analysis of projects. In the case of financial projects, with conditions where financial viability dominates other criteria in the assessment and evaluation of project candidates, the projects with higher NPV are selected.

This unit deals with the generation of project ideas and discuss the various creativity techniques involved in the generation of ideas. We will discuss the scanning of the business environment, and the activities that can be carried out to generate new project ideas. We shall then move on to discuss the initial screening of project ideas and about the project rating index. Finally, we would be discussing the factors that can be used by firms to enhance the net present value of a project.

2.2 Objectives

By the end of this unit, students should be able to:

- Identify ways to generate project ideas.
- Define creativity, and state how it can be used for generating project ideas.
- Assess the strengths, weaknesses, opportunities, and threats of an organization
- Explain how to search for new project ideas.
- Perform the initial screening of new project ideas.
- Explain the project rating index.
- Identify the sources of positive net present value.

2.3 Generating Project Ideas

Changing customer needs and preferences, new technologies, shortened product life cycles and increased competition force the project manager to be innovative. The project manager always has to be on the look out for new ideas since an idea that seem unattractive at one point can look appealing later. Most project ideas except those arising from technological breakthroughs involve combining existing fields of technology or adding more features to the present products or services.

New project ideas help firms achieve their objectives in an efficient manner. Ideas can come from different sources like customers, competitors and employees and even from accidents or luck. They can be derived from various sources, but it is the duty of the project manager to ensure that the chosen idea for a new or modified product or a service can really cater to a present unmet need. The project manager should also ensure that the product based on that idea can effectively compete with similar products or services through features like better quality or lower price.

Before deciding whether an idea is worth pursuing, the project manager must gather as many ideas as possible. Since only a few ideas succeed commercially, most of the firms develop purposeful, systematic approaches for generating new project ideas. Several firms foster an organizational climate that encourages employees to come up with new, creative ideas.

Customer needs and interests are the logical place to start the search for new project ideas. Many of the best ideas have come from customers' answers to different questions. The project manager can conduct customer surveys and interview the customers to find out their problems with current products. Through customer interviews, the project manager can learn about customer needs. Several companies maintain an open culture that encourages a free flow of ideas from all its employees. Companies also discover good ideas by thoroughly examining their competitor's products and services. Project manager analyzes the competitor's processes so that they can refine them.

Check Your Progress - 1

1. Of the following stakeholders, who help the project manager in generating new project ideas?
   i. Customers
   ii. Competitors
   iii. Employees
   a. Only i and ii
   b. Only i and iii
   c. Only ii and iii
   d. i, ii, and iii
2. Which of the following techniques does a project manager use to conduct a financial analysis of projects?
   a. Break-even analysis
   b. Attribute Listing
   c. Net Present Value
   d. Program Evaluation and Review Technique
3. Screening is done to
   a. Generate new project ideas.
   b. Drop the unviable ideas at the initial stages of new project development.
   c. Select a project with a higher net present value.
   d. All of the above
4. From the following options, identify the factors that help in generating ideas.
   i. Creativity
   ii. Sensitivity to external environmental changes
   iii. Assessment of firm's capabilities by any individual
   a. Only i and ii
   b. Only i and iii
   c. Only ii and iii
   d. i, ii, and iii

5. Identify the statement that **does not hold true** where the Net Present Value (NPV) of a project is concerned.
   i. NPV is the difference between the present value of the future revenues minus future costs.
   ii. In the case of financial projects, the projects with negative NPV are selected.
   iii. Superior technology, product differentiation, etc., help in enhancing the NPV of a project.
   a. Only i
   b. Only i and ii
   c. Only ii
   d. Only ii and iii

2.4 Creativity and Idea Generation

Creativity refers to the ability of an individual or a group to develop something new. It involves the ability to combine or synthesize the available information and experience to see new patterns and possibilities. Creativity is best nurtured in a liberal climate where everybody is encouraged to develop new ideas and new ways of doing things. But few managers are able to create such a climate.

2.4.1 Stages of Creativity

The process of creativity involves four stages – preparation, incubation, illumination and verification.

Preparation

In this stage, an individual gathers necessary information, defines the problem precisely, analyzes the data and generates a number of alternatives.

Incubation

An individual comes out with unusual alternatives because of subconscious mental activity coupled with divergent thinking. In this stage, an individual does not consciously focus on the problem, but allows the subconscious mind to look for a solution.

Illumination

In this stage, an individual gets an insight into a problem all of a sudden while he is thinking several alternatives. The practicability of this idea is then examined.

Verification

In this stage, the feasibility of the alternative ideas is examined. The ideas for which the solutions are not feasible are rejected.

Creativity can be nurtured at two different levels – the individual level and the group level. Organizations prefer to nurture creativity at the group level as it ensures participation and acceptance of all the employees concerned.

2.4.2 Individual Creativity

It is not possible to establish a technique to enable someone to think creatively, but the following methods have been found helpful in improving the creativity of an individual.

- **Attribute listing**: In this method, the attributes that can be attached to the end product or service are listed. Based on the listed attributes, the final product is designed.
- **Checklist**: A checklist consists of a set of questions that are relevant to a given situation. Answering to these questions can help the individual find a solution to the problem.
- **Black box**: In this technique, all the required and available inputs as well as the desired outputs are listed. It is also checked whether these outputs can be produced through the use of available inputs.

Group Creativity

Organizations encourage group creativity to elicit more and better ideas. Some of the popular group creativity techniques used by several organizations are discussed below:

- **Brainstorming**: This technique encourages group members to generate as many ideas as possible. Improving the ideas of other members and synthesizing two or more ideas is allowed, but criticism of any idea is not entertained.
- **Delphi technique**: This is a structured approach for finding out the ideas and opinions of a number of experts. A panel of experts is asked to generate ideas, at the individual level, for a given issue. The information is collected, analyzed and then summarized by the group facilitator. Then the summarized information is given to each individual member, and then opinion is requested again. Again, the information is collected and summarized. The process continues till the entire panel of experts accepts a particular idea. The project manager is expected to note down all the ideas that have been generated throughout the process for further consideration. This is the most frequently used method in evaluating and finalizing project ideas and during COVID pandemic, all decisions related to qualification, acquisition, distribution and vaccination are being taken by a panel of experts appointed by the government.
- **Nominal group technique**: This is a structured technique administered by a coordinator. All the individual members prepare their ideas independently. Then they are requested to present the ideas before the other members, who rate the ideas. The coordinator notes down all the ideas generated, including the positive and negative arguments of each idea, for future use.

Activity: Kamlesh Bharadwaj, an aircraft maintenance engineer with Kuwait Airways came back to India and started searching for a job. By a strange coincidence, the manager of the garage where he was getting his car serviced wanted him to sort out some technical problem with an imported car. Bharadwaj saw that the facilities available at most of the garages were primitive and imported cars required better servicing facilities. Bharadwaj realized that he could start a garage for imported cars in India. He started an exclusive garage for imported cars. Discuss some of the ways in which individuals/organizations can generate new project ideas.

Answer:

Check Your Progress - 2

6. Which of the following is **not** a technique used for developing creativity in an individual?
   a. Attribute listing
   b. Brainstorming
   c. Checklist
   d. Black box
7. Identify the **correct** sequence of steps in the process of creativity from the given sequences.
   a. Illumination – Incubation –Verification – Preparation.
   b. Preparation – Incubation – Illumination – Verification.
   c. Incubation – Preparation – Illumination – Verification.
   d. Verification – Preparation – Illumination – Incubation.
8. _____ refers to the ability of an individual or a group to develop something new, and involves the ability to combine or synthesize available information and experience to see new patterns and possibilities.
   a. Culture
   b. Innovation
   c. Creativity
   d. Screening
9. In which technique do all individual members prepare their ideas independently and present them before other members, who rate the ideas?
   a. Brainstorming
   b. Delphi technique

c. Nominal group technique

d. Black box

10. In which of the following stages in the creativity process does the individual define the problem precisely, analyze the data, and generate a number of alternatives?

    a. Incubation

    b. Preparation

    c. Illumination

    d. Verification

11. Identify the statement/s that explains/explain the characteristics of brainstorming **correctly**.

    a. Brainstorming is a structured technique administered by a coordinator.

    b. Brainstorming is used for eliciting the ideas and opinions of a number of experts for a given issue.

    c. Brainstorming encourages group members to generate as many ideas as possible, helps in improving ideas of other members, and allows synthesizing of two or more ideas.

    d. All of the above

12. Of the following options, which are **true** with regard to the activity carried out in the verification stage in the creativity process?

    i. The individual allows his/her subconscious mind to look for a solution.

    ii. The feasibility of alternative ideas is examined.

    iii. The ideas for which the solutions are not feasible are rejected.

    a. Only i and ii

    b. Only i and iii

    c. Only ii and iii

    d. i, ii, and iii

13. _____ is a structured technique administered by a coordinator in which all the individual members prepare their ideas independently.

    a. Black box

    b. Brainstorming

    c. Nominal group technique

    d. Delphi technique

14. Identify the stage in the creativity process in which the practicability of the idea generated is examined.

    a. Preparation

    b. Incubation

    c. Illumination

    d. Verification

15. In the incubation stage of the creativity process,
    a. The individual gets an insight into a problem all of a sudden while he/she is thinking about several alternatives.
    b. The individual comes out with unusual alternatives because of subconscious mental activity coupled with divergent thinking.
    c. The individual gathers the necessary information, defines the problem precisely, analyzes the data, and generates a number of alternatives.
    d. The practicability of the idea generated is examined.
16. Of the following techniques, which is **not** used by organizations for developing group creativity?
    a. Brainstorming
    b. Delphi technique
    c. Black box
    d. Nominal group technique
17. Of the following statements, identify those that hold **true** with regard to creativity.
    i. Creativity is the ability of an individual or a group to develop something new.
    ii. Creativity involves the ability to combine or synthesize available information and experience to see new patterns and possibilities.
    iii. Creativity is best nurtured in a liberal climate where everybody is encouraged to develop new ideas and new ways of doing things.
    iv. Creativity can be nurtured only at the individual level.
    a. Only i, ii, and iii
    b. Only i, iii, and iv
    c. Only ii, iii, and iv
    d. i, ii, iii, and iv
18. Which of the following statements is **false** regarding the attribute listing technique that organizations use to improve creativity in individuals?
    a. All the required and available inputs as well as the desired outputs are listed.
    b. The attributes that can be attached to the end product and/or service are listed and based on them the final product is designed.
    c. Questions are developed and individuals have to answer these questions to find a solution to the problem.
    d. Both (a) and (c)
19. _____ consists of a set of questions that are relevant to a given situation, answering which helps the individual find a solution to the problem.
    a. Attribute listing
    b. Black box
    c. Delphi technique
    d. Checklist

20. Which of the following techniques involves finding out the ideas and opinions of experts?
    a. Black box
    b. Brainstorming
    c. Nominal group technique
    d. Delphi technique
21. Identify the technique in which all the required and available inputs as well as the desired outputs are listed. It is also checked whether these outputs can be produced using the available inputs.
    a. Checklist
    b. Black box
    c. Attribute listing
    d. Delphi technique

2.5 Scanning the Environment

Before accepting a project, a firm must conduct a corporate appraisal. A realistic appraisal of strengths and weaknesses of the internal organization, provides for exploiting opportunities and mitigating threats in the external environment. A framework called a SWOT analysis is used to identify a firm's strengths and weaknesses, and the business environment's opportunities and threats. A realistic appraisal of corporate strengths and weaknesses provides for exploiting the opportunities in the environment. Firms use their competitive strengths to exploit the opportunities available. Most firms conduct a SWOT analysis to identify their strengths and weaknesses, and the opportunities and threats in the business environment. Firms take advantage of the market opportunities through use of their strengths. For the purpose of scanning the environment, the whole business environment may be divided into six broad sectors: economic sector, governmental sector, technological sector, socio-demographic sector, competition sector, and supplier sector. Each of these sectors is discussed below.

2.5.1 Economic Sector

The economic sector comprises the macro level factors like the state of the economy, the overall rate of economic growth, the growth rate of primary, secondary and tertiary sectors, position of BoP (Balance of Payment) and trade deficit/surplus of the country. The project company manager should also analyze the economic environment to assess the viability of new project ideas.

The project company manager should also closely observe the major trends in the income and consumption patterns of the target customers. A study of consumer expenditures can reveal several important facts. Such information can be useful when the project company has to take the financial decisions.

2.5.2 Governmental Sector

The economic and industrial policies of the government have a great impact on the business. These policies can have a favorable impact on some categories of business and an adverse impact on some other categories of business.

For example, the liberalization, privatization and globalization policy adopted by the Indian government, has had a significant impact on several markets. Exports and imports increased and the Balance of Payments (BoP) situation improved.

The policy has benefited many companies. Because of less regulation, many firms have changed their product mix and increased production capacity. Some companies, however, have been adversely affected by the increase in competition.

2.5.3 Technological Sector

The study of technological sector is important, as technology can effectively be used to develop new materials and machines for increasing the production of goods and services. Since new foreign and indigenous technologies are emerging rapidly, the project manager should ensure that he has access to the latest information.

Technological changes often take place to meet changing customer needs. Because of a rise in petrol prices, many customers preferred to purchase cars that give more mileage. As a result, the automobile manufacturers had to design fuel-efficient vehicles. Similarly managers should adopt and/or develop new technologies to meet the needs and interests of the customers.

2.5.4 Socio-demographic Sector

A study of socio-demographic sector involves the study of population growth, age shifts in population, educational profile of the people, gender composition, and religious interests. During the industrial revolution, western countries faced the problem of labor supply due to low population growth. This situation encouraged the growth of labor saving technologies and automation.

Today, many multinational corporations are investing in developing countries to take advantage of the cheap labor and large consumer markets. Project companies should understand all the above aspects while setting the objectives of the project and in preparing the relevant procedures.

2.5.5 Competition

The project company manager should carefully analyze the competition in the market to design a successful project. It should be aware of the number of firms in the industry and the degree of homogeneity and differentiation among their products. The effect of complementary and substitute products on the end product or service should also be analyzed. Information on and understanding of all the

above issues enables the project company manager to prepare necessary plans to sustain themselves in the face of cut-throat competition.

2.5.6 Supplier Sector

The project company manager should carefully analyze the input requirements for carrying out the project. It should be aware of the availability and cost of raw materials and other requirements like power and water. The project company manager should ensure that the firm has good contractual agreements with all its suppliers so that all the necessary goods are delivered on time.

2.6 Searching for New Project Ideas

A wide variety of sources should be tapped to get good project ideas. Project company managers perform numerous activities to generate more and more project ideas. These activities are discussed below.

2.6.1 Study the Existing Industries

A study of existing industries enables the project manager to assess the performance of various industries in terms of their profitability and capacity utilization. A project company manager should identify and implement more profitable and risk-free activities so that the probability for success of a project increases. It should also try to identify those markets where the demand is going to be high relative to supply in near future.

2.6.2 Observe the Inputs and Outputs of Various Industries

An analysis of inputs and outputs of various industries can provide new project ideas. A project opportunity exists when materials that are expensive or difficult to procure can be obtained at a low cost from manufacturer a manufacture who enjoys economies of scale. An opportunity also exists when the waste products of certain firms can be used to develop a new product. For example, fly ash, a by-product of coal- fired electric generating plant, is now used to improve the performance and quality of concrete.

2.6.3 Analysis of Imports and Exports

The project company manager should study the imports and exports that have taken place over the last five to seven years to understand the import trends of various goods. This will enable it to identify the potential areas for import substitution. The project company manager can also plan for getting governmental benefit as part of its program to encourage indigenous manufacturing.

Analysis of exports also helps the project company manager to explore the profitable foreign markets. Indian software products have lot of demand in the

western markets. This makes project companies to manager think of different plans in the software industry, considering its potential in the foreign markets.

2.6.4 Study of Economic and Social Trends

A study of the current economic and social trends can help the project company manager understand changes in customer preferences. For instance, because of the increase in nuclear, double-income families, demand for time saving products like pressure cookers, microwave ovens and canned food items has grown. As the desire for leisure and recreational activities is increasing, there is a growing demand for products like Audio Compact Disks, Video Compact Disks and Digital Versatile/Video Disks.

2.6.5 Observe New Technologies

India has a large network of research laboratories. The project company manager should closely examine the new research work carried out in those laboratories. Since technology only can really bring new products, project manager can generate lot of ideas to develop breakthrough products. A project manager can organize tie-ups with research institutions to develop new products.

2.6.6 Identifying Psychological Needs

Questionnaires and interviews cannot reveal every need and interest of the customers. Therefore projects the project manager should carefully identify the hidden demands and psychological needs of customers. He can use a special technique called Spectrum analysis.

Spectrum analysis enables projects the project manager to identify the gaps between the consumers' psychological needs and the needs met by the existing products. In Spectrum analysis, the important factors influencing customers' brand preferences are identified and then the existing brands in the market are placed on a continuum in respect of the factors identified by the customers. Then the project managers attempt at in order to help identify the gaps relative to the listed psychological needs.

2.6.7 Study the Government Guidelines and Recommendations for Financial Institutions

The government continuously encourages new project outlays in different sectors. These outlays provide profitable areas where new initiatives can be taken up. A study of these outlays of the government generates new project ideas. Recommendations made by financial corporations or state industrial development corporations should be carefully analyzed to identify the areas to be considered. The feasibility studies and suggestions of research agencies help the project manager to identify promising project ideas.

Above all, project companies should assign its people the project manager should attend trade fairs to know about new products and current developments. Chance

also plays an important role in identifying the new project initiatives. When KVK Raju, founder of the Nagarjuna Group, visited the Bokaro Steel Plant, he came to know that the factory was going to lose a Rs. 60,000 tonne order for hot rolled coil, because of its sub-standard packaging. This incident prompted him to set up an exclusive industry to cater to the packaging needs of the steel industry.

Exhibit 2.1 briefly narrates the success story of innovative ideas that led to globalization of operations of the NR Group.

Exhibit 2.1: Rags-to-riches: The Power of Innovation at NR Group

Cycle agarbathi brand was started at home, sells 12 billion agarbathies globally as of 2020. Innovation has been a significant part of NR Group's business. The group was one of the first agarbathi manufacturers to shift from tin packaging to cardboard packaging, which brought about a drastic reduction in the cost of production, waste, and ultimately the cost of the final product. NR Group clocked a turnover of Rs 1,700 crore during 2019 with a strong presence in 75 countries and sold 12 billion agarbathies worth Rs 1,000 crore during 2018. Cycle Pure Agarbathies launched an IoT-powered sales Diary App to streamline and keep a tab on its production process. The company also launched Pure Prayer App that helps consumers book pilgrimages, stream live footage from temples across the country, and even book a priest to visit their homes to perform rituals. It also recently launched PFIS (Pure Fragrance Infusion System), a patented technology, which is able to infuse the fragrance of two agarbathies into one. Process innovation drives NR Group's activities to generate new and sustainable ideas.

Source: Palak Agarwal, https://yourstory.com/smbstory/cycle-pure-agarbathi-large-business-arjun-ranga/amp, March 20, 2020

Check Your Progress - 3

22. Which of the following activities can aid in searching for new project ideas?
    i. Studying existing industries
    ii. Observing new technologies
    iii. Analyzing the imports and exports
    iv. Identifying psychological needs
    a. Only i, ii, and iii
    b. Only i, iii, and iv
    c. Only ii, iii, and iv
    d. i, ii, iii, and iv

23. Of which of the following sectors does the scanning environment comprise macro level factors like the growth rate of the primary, secondary, and tertiary sectors; Balance of Payments position; and trade deficit/surplus of the country?
    a. Competition sector
    b. Economic sector
    c. Governmental sector
    d. Socio-demographic sector
24. A corporate appraisal should be conducted
    a. Before the environment is scanned.
    b. Before a project is accepted.
    c. Before idea generation.
    d. All of the above
25. Arrange the following sentences based on the sequence in which the project manager conducts a spectrum analysis.
    i. The important factors influencing customers' brand preferences are identified
    ii. The project managers attempt to identify the gaps relative to the listed psychological needs
    iii. The existing brands in the market are placed on a continuum in respect of the factors identified by the customers
    a. iii-ii-i
    b. i-iii-ii
    c. ii-i-iii
    d. i-ii-iii
26. A study of which of the following sectors involves the study of population growth, age shifts in population, educational profile of the people, gender composition and religious interests?
    a. Competition sector
    b. Economic sector
    c. Socio-demographic sector
    d. Governmental sector
27. Which of the following techniques enables the project manager to identify the gaps between the consumers' psychological needs and the needs met by the existing products?
    a. Black box
    b. Brainstorming
    c. Spectrum analysis
    d. Project rating index

2.7 Initial Screening

After a pool of ideas has been generated, the project manager must screen them. In this phase, the ideas that have limited commercial potential or do not match the firm's objective are rejected. Initial screening is a process of rejection rather than a process of selection. The objective is to reject those ideas that cannot be considered for implementation. Ideas can be screened in a variety of ways. Some managers use an informal screening process to eliminate unsuitable ideas. A formal screening process involves a checklist, rating system, and an economic analysis.

When screening ideas, the project manager must avoid two types of errors; drop error and go error. A drop error occurs when a company rejects a good idea. This is what statistically is called a Type I error The project manager should review ideas that have been rejected to avoid a drop error. If a project manager makes too many drop errors, it reveals that the manager is too conservative. A go error occurs when the project manager permits a poor idea to move into the development and commercialization phase. This is what statistically is called a Type II error. If a project manager makes too many go errors it reveals that the manager is too liberal. Since costs rise substantially with each successive development stage, poor ideas have to be dropped as early as possible.

Even the project ideas of establishing manufacturing plants in India is good because of high market potential, Ford decided to close manufacturing operations in India. Intense competition from other multinationals and the dominance of Maruti Suzuki and Hyundai, left little room for Ford to demonstrate its competitive advantage.

The project manager must consider the following aspects to eliminate ideas that are not promising:

2.7.1 Acceptable Risk Level

Assessment of the level of risk associated with a selected idea is a factor considered during the initial screening. Particularly in large infrastructural projects, the management considers the levels of risk involved in the project. The project manager has to consider factors like the project's vulnerability to social and environmental conditions, sustainability over long periods, government policies and controls and expected cash inflows.

2.7.2 Reasonability of Costs

The project manager should ensure that the costs involved for implementing the project are reasonable and that the project provides an acceptable level of profits. An analysis of raw materials costs, labor costs, factory overheads and administration costs provides a clear picture of total cost involved. Management must ensure that these costs are within allowable limits.

2.7.3 Compatibility with Promoter

The project idea should be compatible with the interests and abilities of the person who is promoting the project. Since the promoter provides the necessary basic resources, the project manager must ensure that the project is acceptable to him. He should discuss the underlying facts, risks involved and expected returns of the project with the promoter to avoid any clashes later on. For any intermediary problems, the project manager should consult the promoter to take necessary steps.

2.7.4 Consistency with Government Priorities

The project manager should carefully screen the project ideas keeping in view the priorities of the government. On several occasions, projects have been terminated before completion because of their harmful effects on the society. The project manager should therefore be familiar with all the rules and regulations framed by the government concerning the issuance of licenses for commencing a project and the import of raw materials from foreign countries.

2.7.5 Availability of Inputs

The project manager should consider the input requirements, their availability and cost while screening project ideas. In India, many projects have to cope with shortages of power and irregular supplies of required agricultural raw materials like cotton, jute and oil seeds. Sometimes, many of the raw materials have to be imported. So, the project manager should ensure in advance that all the necessary input requirements for the project are available.

2.7.6 Adequate Market Demand

The project manager should estimate the potential for growth and the return on investment for the proposed project ideas. Obviously all firms wish to invest in the areas where demand exceeds supply. When screening the project ideas, the project manager should consider factors like present domestic market demand, expected future demand, number of competitors and their market shares and entry barriers for the new entrants.

Check Your Progress - 4

28. Which of the following aspects should the project manager consider to eliminate ideas that are **not** promising?

    i. Reasonability of costs

    ii. Compatibility with promoter

    iii. Availability of inputs

    iv. Adequate market demand

a. Only i, ii, and iii
b. Only i, iii, and iv
c. Only ii, iii, and iv
d. i, ii, iii, and iv

29. Identify the activity or technique that is **not** a part of the formal screening process.
    a. Checklist
    b. Black box
    c. Rating system
    d. Economic analysis
30. Initial screening is a process of rejection rather than a process of selection. What are the types of project ideas rejected in the initial screening process?
    a. Ideas that have limited commercial potential
    b. Ideas that do not match with the firm's objective
    c. Ideas which are less risky
    d. Both (a) and (b)
31. Acceptable risk level is a factor considered during the
    a. initial screening stage.
    b. market and technical analysis stage.
    c. financial analysis stage.
    d. project idea generation stage.
32. _____ occurs when the project manager permits a poor idea to move into the development and commercialization phase.
    a. Stand alone risk
    b. Drop error
    c. Systematic risk
    d. Go error
33. Identify the factors that should be considered by the project manager to check the acceptable risk level of a project.
    i. Project's vulnerability to social and environmental conditions
    ii. Sustainability over long periods
    iii. Government policies and controls
    iv. Expected cash inflows
    a. Only i, ii, and iii
    b. Only i, iii, and iv
    c. Only ii, iii, and iv
    d. i, ii, iii, and iv

34. Which of the following statements is **true** regarding a drop error?
    a. A drop error occurs when a company rejects a good idea.
    b. A drop error occurs when the project manager permits a poor idea to move into the development phase.
    c. The project manager can avoid a drop error by reviewing ideas that have been rejected.
    d. Both (a) and (c)

2.8 Project Rating Index

The Project Rating Index is an evaluation method that helps management to streamline the process of initial screening. In this method, the management identifies factors for rating projects and assigns a weight to each factor. The projects are then measured against these factors and assigned a score. The Project Rating Index is a multi-attribute evaluation method used in the process of initial screening, which calculates a weighted sum that helps management compare and decide between alternatives. Management identifies factors for rating projects and assigns a weight to each factor, depending on how important the factor is for the project. Project alternatives are then assigned a rating score against each of these factors, which indicates the extent to which the project alternative is benefitted by or benefits this factor. This is done for each project alternative for all factors. Then, a weighted sum for each project alternative is calculated as the sum, of the product of each factor's weight and the rating score assigned to the project alternative against that factor, for all factors. Comparing weighted sums helps companies decide between project alternatives. This method is useful for the firms when a large number of project ideas have to be evaluated.

The steps involved in developing a project-rating index are described below.

1. Identify the relevant factors useful for rating a project.
2. Assign factor weights to each factor, based on the relative importance of each factor.
3. Use an appropriate rating scale (5-point or 7-point) and rate the project on the listed factors.
4. Multiply the factor rating with the factor weight to calculate the factor score for each factor.
5. Add all the factor scores to determine the 'rating index' of the project
6. Reject the project if the rating index of the project is less than the desired value.

Activity: The management of Zenix Turbo Machines Limited wanted to screen the project ideas generated by its employees. He entrusted the job to a management team selected by one of the senior managers of the company, Mr. Kamal Nath. The management of the company decided to use the project rating index method. The CEO of the company wanted to use the project index method for screening the project ideas. The job of screening was entrusted to one of the senior managers of the company, Kamal Nath. The management of the company identified the following factors in rating a project – input availability, complementary relationship with other products of the firm, adequacy of market demand, technical know-how, and consistency with government priorities. The factor weights assigned to these factors were 0.2, 0.15, 0.3, 0.1, 0.15, and 0.1 respectively. The management decided to reject a project idea, if its project rating index was less than 3, and consider an idea, if its project rating index is more than 3. Nath's factor ratings for a project idea were 3, 2, 1, 2, 4 and 3 respectively. Do you think, the management of the firm will consider this project for final selection?

Answer:

2.9 Sources of Positive Net Present Value

Project companies, obviously prefer to select project ideas that are expected to yield current and future revenues which are higher than current and expected investments. Consequently, they consider the Net Present Value (NPV) while screening the project ideas. The net present value is defined as the sum of all expected current and discounted future cash inflows minus the sum of all expected current and discounted future cash outflows. It is calculated by using a discount rate as a multiplier of revenues or costs, raised to the power depending on the year in which the revenue or cost is expected to be incurred. This brings all revenues and costs to the present irrespective of the year in which they are expected to occur. The net of all the present values then indicates if profits will be made or not, depending on whether it is greater than, equal to or less than zero. NPV calculation for projects therefore helps in assessing project viability. Needless to say, the discount rate chosen will determine the assessment, and therefore the discount rate must be carefully chosen taking into account a number of aspects of project viability.

In addition certain factors enhance the desirability of undertaking.

Project managers, obviously prefer to select project ideas that give higher returns than the investment made. Consequently, they consider the Net Present Value (NPV) while screening the project ideas. The net present value is defined as the present value of the future revenues minus future costs. Some of the factors that firms can use to enhance the net present value of a project are – government policy, economies of scale, product differentiation and superiority of technology.

2.9.1 Government Policy

The government imposes entry barriers to firms that import goods as part of its social obligation. It uses import restrictions, restrictive licensing, high tariffs, and environmental control to safeguard the interests of some specific industries. If a project idea seems to be financially profitable, the project manager must ensure that the project is not against the interests of the government. The project manager should choose those projects which can receive special tax benefits and exemptions. This results in positive net present value of the project.

2.9.2 Economies of Scale

If a company is able to sell a sufficiently large number of units if it is a product company or service transactions if it is a service provider, the revenue generated less the variable costs of producing that many units, i.e. the contribution, will be sufficient to recover the fixed costs of setting up the production process. This is sometimes conceptualized as the contribution per unit being able to recover the cost per unit. This can only occur when the production scales beyond a break-even point, which in turn can only occur when the company can definitely sell that many units. A company therefore is said to have gained economies of scale when it is able to reduce the cost per unit produced through an increase in the scale of production, marketing and distribution. Projects should select ideas which can be expected to achieve economies of scale. The larger the expected capital expenditure, the greater must be the expected revenues from the project. Projects must therefore carefully estimate not only expected benefits but also expected costs to analyze which projects can be expected to give how much return on investments. Mass production, particularly relevant in the industries like petroleum refining, mineral extraction, and aluminum, steel and iron production, have such huge investments that even though there is large demand, it takes many years before the fixed costs of setting such production processes are recovered. Furthermore, in price regulated markets, the selling price cannot be arbitrarily set to recover investments quickly. Even in free markets, there are limits to how high the selling price can be set, without altering demand for the product/service. A company is said to have actual economies of scale when it has reduced the cost per unit produced through an increase in the scale of production, marketing or distribution. The project managers should identify those ideas that will enable him to achieve the benefit of economies of scale. But a considerable amount of capital is required to achieve economies of scale. So it is the responsibility of the

project manager to screen the project ideas by analyzing the capital requirements of the project. The project managers can also consider the possibility of mass production. This is particularly relevant in the industries like petroleum refining, mineral extraction, and aluminum, steel and iron production.

2.9.3 Product Differentiation

An incumbent company can outsell its competitors as well as create barriers to entry to new firms by differentiating its products/services from those of the others. Indeed, since such companies create value, they also have the advantage of increasing their prices over the prices of competing products/services. A company can create entry barriers for other companies by differentiating its products from those of its competitors. Project managers try to select those ideas, which recommend the development of products or services that are quite different from those offered by its competitors. The factors that create differentiation are innovative product features, high quality products and customized service. Effective advertising and superior marketing yield better results when the product is truly differentiable.

2.9.4 Superiority of Technology

New technologies can create new markets. Firms that have developed new technologies will have an edge over their competitors. Firms like Xerox and Microsoft earned superior returns for longer periods because of their technological capabilities. Several Indian companies like Kinetic and Dr. Reddy's Labs outperformed their competitors because of their emphasis on technology.

Check Your Progress - 5

35. The factor score of a particular factor in calculating the project rating index is:
    a. a sum of factor weight and factor rating.
    b. a product of factor weight and factor rating.
    c. a division of project rating index by the factor rating.
    d. a product of factor weight and rating index.
36. Arrange the following options based on the sequence in which the project manager develops a project rating index.
    i. Multiply the factor rating with the factor weight to calculate the factor score for each factor.
    ii. Assign factor weights to each factor, based on the relative importance of each factor.
    iii. Identify the relevant factors useful for rating a project.
    iv. Add all the factor scores to determine the 'rating index' of the project.
    v. Use an appropriate rating scale and rate the project on the listed factors.

vi. Reject the project if the rating index of the project is less than the desired value.

a. iii-ii-v-i-iv-vi

b. iii-v-ii-iv-vi-i

c. iii-iv-vi-v-i-ii

d. iii-i-ii-v-iv-vi

37. _____ is an evaluation method that helps the management to streamline the process of initial screening.

a. Spectrum analysis

b. Project rating index

c. Delphi technique

d. Attribute listing

38. Identify the factors that firms can use to enhance the Net Present Value (NPV) of a project.

i. Favorable government policy

ii. Economies of scale

iii. Product differentiation

iv. Superiority of technology

a. Only i, ii, and iii

b. Only i, iii, and iv

c. Only ii, iii, and iv

d. i, ii, iii, and iv

Self-Assessment Exercises

(Questions 1 – 4)

Surjeet Technologies is planning to set up a plant in one of three locations – Bangalore, Chennai, or Hyderabad. Following are the details of the factors considered by the company for selecting the plant location, the weights attached to each of them, and the rating for various factors on a scale of 1 to 5.

Factors	**Hyderabad**		**Chennai**		**Bangalore**	
	Weights	*Rating Scale (1 to 5)*	*Weights*	*Rating Scale (1 to 5)*	*Weights*	*Rating Scale (1 to 5)*
Closeness to Market	0.30	5	0.35	4	0.20	4
Technology	0.15	3	0.15	5	0.25	5

Cost of inputs	0.15	4	0.15	2	0.15	2
Government regulations	0.15	3	0.10	3	0.20	3
Availability of inputs	0.25	4	0.25	4	0.20	4

Based on the given data, answer the following questions.

1. Calculate the rating index for Hyderabad.
2. Calculate the rating index for Chennai.
3. Calculate the rating index for Bangalore.
4. The company wants to go ahead with a location that gives a rating index of more than 4. Which of the locations would it select?

2.10 Summary

- When developing a new project, the project manager generates several ideas from different sources like customers, employees and competitors, and finally selects those project ideas that can be implemented.
- The generation of ideas requires creativity, sensitivity to the changes in external environment, and assessment of firm's capabilities for any individual.
- Creativity refers to the ability of an individual or a group to develop something new. It involves the ability to combine or synthesize the available information and experience to see new patterns and possibilities.
- The process of creativity involves four stages – preparation, incubation, illumination and verification.
- Methods like attribute listing, checklist and black box help in improving the creativity of an individual.
- Organizations encourage group creativity to elicit more and better ideas. Some of the popular group creativity techniques used by organizations are brainstorming, Delphi technique, and nominal group technique.
- Most firms conduct a SWOT analysis to identify their strengths and weaknesses, and the opportunities and threats in the business environment.
- For the purpose of scanning the environment, the whole business environment may be divided into six broad sectors: economic sector, governmental sector, technological sector, socio-demographic sector, competition sector and supplier sector.
- Before accepting a project, a firm must conduct a corporate appraisal. A realistic appraisal of corporate strengths and weaknesses provides for exploiting the opportunities in the environment.

- Project companies managers carry out various activities to generate more and more project ideas. These include – study the existing industries, observe the inputs and outputs of various industries, analysis of imports and exports, study of economic and social trends, observe new technologies, identifying psychological needs and study the government guidelines and recommendations for financial institutions.
- After a pool of ideas has been generated, the project manager must screen them. In this phase, the ideas that have limited commercial potential or do not match the firm's objective are rejected. Initial screening is a process of rejection rather than a process of selection.
- The project rating index is an evaluation method that helps management to streamline the process of initial screening. In this method, the management identifies factors for rating projects and assigns a weight to each factor. The projects are then measured against these factors and assigned a score.
- Project companies managers select project ideas that give higher returns than the investment made. They consider the net present value while screening the project ideas. The net present value is defined as the present value of the future revenues minus future costs.
- Some of the factors that firms can use to enhance desirability the net present value of a project are – government policy, economies of scale, product differentiation and superiority of technology.

2.11 Glossary

Creativity: The ability of an individual or a group to develop something new. It involves the ability to combine or synthesize the available information and experience to see new patterns and possibilities.

Net Present Value: The present value of the future revenues minus future costs.

Project Rating Index: An evaluation method that helps management to streamline the process of initial screening.

2.12 Self-Assessment Exercises

1. A project manager should always be on the look out for new ideas. Explain the need for generating project ideas.
2. 'Generation of ideas requires creativity, sensitivity to the changes in external environment, and assessment of firm's capabilities for any individual.' Do you agree with this statement? Why or why not?
3. For the purpose of scanning the environment, the entire business environment may be divided broadly into six sectors, namely, economic sector, governmental sector, technological sector, socio-demographic sector, competition sector, and supplier sector. Explain the importance of scanning these sectors in detail.

4. Project managers perform numerous activities to generate more and more project ideas. What are these activities? Describe them in detail.
5. After the idea generation process, the project manager must screen them. Explain the initial screening process. What are the aspects that are considered by the project manager to eliminate ideas that are not promising? How is the project rating index method used by the project manager to screen the project ideas?
6. A project manager selects ideas that give greater returns than the investment made. How can a project manager find out whether a project idea gives greater returns or not?

2.13 Suggested Readings/Reference Material

1. Prasanna Chandra, "Projects," McGraw Hill, Seventh Edition, 2017
2. James Wood, Kory Kogon, and Suzette Blakemore, Project Management for the Unofficial Project Manager: A Franklin Covey Title, Goodreads, 2018
3. Heagney, Fundamentals of Project Management Paperback, Amacom, September 2018
4. NA, Nagarajan, Project Management 8/ED, New Age International Publications, 2019
5. IES Master Team,,ESE 2020 - Basics of Project Management Paperback – 1 IES Master Publication, January 2019

2.14 Answers to Check Your Progress Questions

Following are the answers to the Check Your Progress questions given in the unit.

1. (d) i, ii, and iii

New project ideas can come from different sources like customers, competitors and employees. The project manager has to ensure that the chosen idea for a new or modified product or a service can really cater to a present unmet need.

2. (c) Net Present Value

Net Present Value (NPV) is used to conduct a financial analysis of projects. In the case of financial projects, those with higher NPV are selected. Break-even analysis is a technique used by the project manager to determine when the project will arrive at a 'no profit-no loss' situation. Attribute listing is a technique used to enhance creativity in individuals. The Program Evaluation and Review Technique is a technique used to prepare a plan for implementation of the project.

3. (b) Drop the unviable ideas at the initial stages of new project development.

After the ideas have been collected, the project manager has to screen them. The objective of screening is to drop the unviable ideas at the initial stages of new project development. It is a process of rejection rather than one of selection. Screening helps in rejecting ideas that cannot be considered for implementation.

4. (d) i, ii, and iii

The project manager uses different sources like customers, employees, and competitors to generate ideas and finally selects those project ideas that can be implemented. The generation of ideas requires creativity, sensitivity to changes in the external environment, and assessment of the firm's capabilities by any individual.

5. (c) Only ii

Net Present Value is used to screen project ideas. In the case of financial projects, the projects with higher positive NPV are selected.

6. (b) Brainstorming

Attribute listing, checklist, and black box are techniques that organizations use for developing creativity in an individual. Brainstorming is a technique used to improve creativity in groups.

7. (b) Preparation – Incubation – Illumination – Verification.

The process of creativity involves four stages – preparation, incubation, illumination, and verification. In the preparation stage, an individual gathers the necessary information, defines the problem precisely, analyzes the data, and generates a number of alternatives. In the incubation stage, he/she comes out with unusual alternatives because of subconscious mental activity coupled with divergent thinking. In the illumination stage, the individual gets an insight into a problem all of a sudden while he/she is thinking of several alternatives. In the verification stage, the feasibility of the alternative ideas is examined.

8. (c) Creativity

Creativity refers to the ability of an individual or a group to develop something new. It involves the ability to combine or synthesize available information and experience to see new patterns and possibilities.

9. (c) Nominal group technique

The nominal group technique is a structured technique administered by a coordinator. All the individual members prepare their ideas independently. They are then requested to present the ideas before the other members, who

rate the ideas. The coordinator notes down all the ideas generated (positive and negative arguments of each idea) for future use.

10. (b) Preparation

The process of creativity involves four stages – preparation, incubation, illumination, and verification. In the preparation stage, an individual gathers the necessary information, defines the problem precisely, analyzes the data, and generates a number of alternatives.

11. (c) Brainstorming encourages group members to generate as many ideas as possible, helps in improving ideas of other members, and allows synthesizing of two or more ideas.

The brainstorming technique encourages group members to generate as many ideas as possible. Improving the ideas of other members and synthesizing two or more ideas is allowed, but criticism of any idea is not entertained.

12. (c) Only ii and iii

Verification is the last and final stage of the creativity process. In this stage, the feasibility of alternative ideas is examined. The ideas for which solutions are not feasible are rejected.

13. (c) Nominal group technique

The nominal group technique is a structured technique administered by a coordinator. All the individual members prepare their ideas independently. They are then requested to present the ideas before other members, who rate the ideas. The coordinator notes down all the ideas generated (positive and negative arguments of each idea) for future use.

14. (c) Illumination

The process of creativity involves four stages – preparation, incubation, illumination, and verification. In the illumination stage, an individual gets an insight into a problem all of a sudden while he/she is thinking about several alternatives. The practicability of this idea is then examined.

15. (b) The individual comes out with unusual alternatives because of subconscious mental activity coupled with divergent thinking.

In the incubation stage, an individual comes out with unusual alternatives because of subconscious mental activity coupled with divergent thinking. In this stage, an individual does not consciously focus on the problem, but allows the subconscious mind to look for a solution.

16. (c) Black box

The popular group creativity techniques that organizations use are brainstorming, the Delphi technique, and the nominal group technique. Black box is a technique that organizations use for developing individual creativity.

17. (a) Only i, ii, and iii

Creativity refers to the ability of an individual or a group to develop something new. It involves the ability to combine or synthesize the available information and experience to see new patterns and possibilities. Creativity is best nurtured in a liberal climate where everybody is encouraged to develop new ideas and new ways of doing things. However, very few organizations are able to create such a climate. Creativity can be nurtured both at the individual as well as group levels.

18. (d) Both (a) and (c)

Attribute listing is a technique used to improve creativity in individuals. In this technique, attributes that can be attached to the end product and/or service are listed. Based on the listed attributes, the final product is designed.

19. (d) Checklist

A checklist consists of a set of questions that are relevant to a given situation. Answering these questions can help the individual find a solution to the problem. In the attribute listing technique, attributes that can be attached to the end product or service are listed. In the black box technique, all the required and available inputs as well as the desired outputs are listed. The Delphi technique is a structured approach to elicit the ideas and opinions of a number of experts.

20. (d) Delphi technique

Delphi technique is a structured approach for eliciting the ideas and opinions of a number of experts. A panel of experts is asked to generate ideas at the individual level, for a given issue.

21. (b) Black box

In the black box technique, all the required and available inputs as well as the desired outputs are listed. It is also checked whether these outputs can be produced using the available inputs.

22. (d) i, ii, iii, and iv

The various activities to be carried out while searching for new project ideas are – studying the existing industries, observing the inputs and outputs of various industries, analyzing imports and exports, studying economic and social trends, observing new technologies, identifying psychological needs, and studying the government guidelines and recommendations for financial institutions.

23. (b) Economic sector

The economic sector comprises macro level factors like the state of the economy, the overall rate of economic growth; the growth rate of the primary,

secondary, and tertiary sectors; the BoP (Balance of Payments) position; and the trade deficit/surplus of the country. The project manager should also analyze the economic environment to assess the viability of new project ideas.

24. (b) Before a project is accepted.

Before accepting a project, a firm must conduct a corporate appraisal. A realistic appraisal of corporate strengths and weaknesses helps in exploiting the opportunities in the environment.

25. (b) i-iii-ii

Spectrum analysis enables the project manager to identify the gaps between the consumers' psychological needs and the needs that existing products meet. In spectrum analysis, the important factors influencing customers' brand preferences are identified and the existing brands in the market are then placed on a continuum in respect of the factors identified by the customers. The project managers then attempt to identify the gaps relative to the listed psychological needs.

26. (c) Socio-demographic sector

A study of the socio-demographic sector involves the study of population growth, age shifts in population, educational profile of the people, gender composition, and religious interests. The project manager should understand all the socio-demographic aspects while setting the objectives of the project and in preparing the relevant procedures.

27. (c) Spectrum analysis

Spectrum analysis enables the project manager to identify the gaps between the consumers' psychological needs and the needs that existing products meet. In spectrum analysis, the important factors influencing customers' brand preferences are identified and then the existing brands in the market are placed on a continuum in respect of the factors identified by the customers. The project managers then attempt to identify the gaps relative to the listed psychological needs.

28. (d) i, ii, iii, and iv

The project manager must consider the following aspects to eliminate ideas that are not promising – acceptable risk level, reasonability of costs, compatibility with promoter, consistency with government priorities, availability of inputs, and adequate market demand. The project idea should be compatible with the interests and abilities of the person who is promoting the project. The promoter provides the basic resources to the project. Therefore, the project manager should ensure that the project is acceptable to him/her. The project ideas should be carefully screened keeping in view the government priorities. Sometimes, a project may be scrapped before completion due to its harmful effects on society. The project manager should

therefore be familiar with all the rules and regulations framed by the government.

29. (b) Black box

Ideas can be screened in a variety of ways. Some managers use an informal screening process to eliminate unsuitable ideas. A formal screening process involves a checklist, a rating system, and an economic analysis. Black box is a technique used to enhance creativity in individuals. In this technique, all the required and available inputs as well as the desired outputs are listed. It is also checked whether these outputs can be produced using the available inputs.

30. (d) Both (a) and (b)

In the initial screening phase, ideas that have limited commercial potential or do not match the firm's objective are rejected. Initial screening is a process of rejection rather than a process of selection. The objective is to reject those ideas that cannot be considered for implementation. A project manager usually implements more profitable and risk-free activities so that the probability for success of a project increases.

31. (a) Initial screening stage.

Assessment of the risk level associated with a selected idea is a factor considered during the initial screening stage. In the project idea generation stage, the project manager uses several techniques like attribute listing, checklist, brainstorming, etc., to generate new project ideas. In the market and technical analysis stage, the market and technical feasibility of the project idea is determined. Market analysis estimates the size of the potential market, patterns of consumption, level of competition, and market composition. Technical analysis includes the study of all the relevant design and engineering aspects, reliability, and sustainability of the product. The financial feasibility of the project idea is determined in the financial analysis stage of the project idea. In this stage, the project manager examines the capital costs and operating costs and revenues of the proposed project.

32. (d) Go error

When screening ideas, the project manager must avoid two types of errors – drop error and go error. A go error occurs when the project manager permits a poor idea to move into the development and commercialization phase. Since costs rise substantially with each successive development stage, poor ideas have to be dropped as early as possible.

33. (d) i, ii, iii and iv

Assessment of the risk level associated with a selected idea is a factor considered during the initial screening stage. The project manager has to

consider factors like the project's vulnerability to social and environmental conditions, sustainability over long periods, government policies and controls, and expected cash inflows.

34. (d) Both (a) and (c)

When screening ideas, the project manager must avoid two types of errors – drop error and go error. A drop error occurs when a company rejects a good idea. The project manager should review ideas that have been rejected to avoid a drop error. If a project manager makes too many drop errors, it shows that he/she is too conservative.

35. (b) A product of factor weight and factor rating.

The project rating index is an evaluation method that helps the management to streamline the process of initial screening. In this method, the management identifies factors for rating projects and assigns a weight to each factor. The projects are then measured against these factors and assigned a score. The factor score for each factor is calculated by multiplying the factor rating with the factor weight.

36. (a) iii-ii-v-i-iv-vi

The project rating index is an evaluation method that helps the management to streamline the process of initial screening. The steps involved in developing a project-rating index are – identify the relevant factors useful for rating a project; assign factor weights to each factor based on the relative importance of each factor; use an appropriate rating scale (5-point or 7-point) and rate the project on the listed factors; multiply the factor rating with the factor weight to calculate the factor score for each factor; add all the factor scores to determine the 'rating index' of the project; reject the project if the rating index of the project is less than the desired value.

37. (b) Project rating index

The project rating index is an evaluation method that helps the management to streamline the process of initial screening. In this method, the management identifies factors for rating projects and assigns a weight to each factor. The projects are then measured against these factors and assigned a score. This method is useful for firms when a large number of project ideas have to be evaluated.

38. (d) i, ii, iii, and iv

NPV is defined as the present value of the future revenues minus future costs. Some of the factors that firms can use to enhance the net present value of a project are: favorable government policy, economies of scale, product differentiation, and superiority of technology. Favorable government policies will have a positive affect on the business of the organization. Economies of

scale will reduce the costs of the organization, thus adding to its revenues. Product differentiation and use of superior technology will help the company in bringing out products that are much superior to those of its competitors. This will in turn add to the revenues of the organization. All these factors will enhance the NPV of a project.

Unit 3

Market and Technical Analysis of Projects

Structure

3.1 Introduction

3.2 Objectives

3.3 Market and Demand Analysis

3.4 Technical Analysis

3.5 Summary

3.6 Glossary

3.7 Self-Assessment Exercises

3.8 Suggested Readings/Reference Material

3.9 Answers to Check Your Progress Questions

3.1 Introduction

In the previous unit, we have discussed project idea generation and screening. In this unit, we will discuss market and technical analysis of projects. Once the project ideas are generated and screened, they are evaluated to test their marketability, technical feasibility, and cost considerations. Market and demand analysis provides a detailed analysis of all market demand conditions and technical analysis provides an assessment of all technical aspects of the project idea. The market analysis estimates the size of the potential market, patterns of consumption, level of competition, market composition and demand analysis determines the aggregated demand for a product or service for a particular period, variations in supply, hidden demands of the customers, etc. Technical analysis of a project idea includes the study of all the relevant design and engineering aspects, reliability and sustainability of the product. An in depth study of market and demand analysis followed by technical analysis reveals the probability of success of a project idea.

This unit will deal with market and technical analysis of projects. We shall first discuss market analysis of projects that involves aspects like situational analysis and objectives specification, collection of data, market survey, market description, demand forecasting, uncertainties in demand forecasting and market planning. We shall then move on to discuss technical analysis of projects that involves aspects like technology selection, input requirements and utilities, product mix, plant capacity and functional layout, location of the project, machinery and equipment, and consideration of alternatives.

3.2 Objectives

By the end of this unit, students should be able to:

- Explain how to conduct market and demand analysis of a project.
- Analyze the technical aspects of a project.

3.3 Market and Demand Analysis

A project company manager should carefully study the market potential for a given project idea. Conducting market surveys, collecting primary and secondary data, studying the characteristics of the market are some of the activities to test the market environment and see if the idea is feasible. Demand analysis of a product includes the study of consumption patterns, income and price elasticity of demand, nature of competition, availability and prices of substitutes and complementary products. The activities of a project company manager in conducting a market and demand analysis include situational analysis and objectives specification, collection of secondary data, market survey, market description, demand forecasting, and market planning.

3.3.1 Situational Analysis and Objectives Specification

Situational analysis is the process by which a project company manager studies customer preferences and their purchasing capacity and strategies of the competing firms and intermediaries. In the process, the project company manager interacts with the project stakeholders such as clients, channel members, employees and competitors of the firm to better understand market requirements.

A project company manager need not go in for a formal study when it is satisfied with the information generated through informal talks and feels that it is adequate to scale the present and future demand for a product. But if there is a need for a formal study, the project company manager has to define the objectives of the study. Once the objectives are clearly stated, the questions in the survey should be framed in such a way so as to elicit the required response (answer relating to market demand, expected revenue etc).

Suppose a small firm has developed an inverter that is technically competitive to cater to the customers whenever there is a power cut. The management of the firm should answer the following questions to check whether the objectives of the firm are in tune with market interests:

- Who are the customers of inverters?
- What is the existing demand for inverters? (specify country wise, state wise demand)
- How is the pattern of demand over the year?
- What are the areas with higher demand for power? (specify the hours of demand area wise)

- What are the prices and features of inverters being offered by the competitors?
- How sensitive are customers to the price of an inverter?
- How many types of distribution channels are available for inverters in the market?
- What are the constraints faced by intermediaries to capture the market?
- How can existing customers be convinced to use the newly developed product?
- What price and warranty will ensure the product's acceptance in the market?

3.3.2 Collection of Data

The project manager collects a lot of data from all the possible sources to answer the questions listed above. Broadly, data is of two types: primary data and secondary data.

Primary data is the data that is collected for a specific purpose and for the first time. *Secondary data* is the data that is already available but might have been collected for some other purpose or by some other institutions. Secondary data is considered to be more useful in market analysis as it is easy to obtain and is also economical.

Primary data can be obtained from sources both internal and external to the organization. Internal primary data is obtained from past and current sales of the firm, observations of employees of the firm etc.

External primary data is obtained from the opinion of the dealers, feedback of the sales personnel and sales trends. Survey methods or experimental methods are ideal for gathering primary data.

The survey method of data collection includes personal interviews, telephonic interviews and mail surveys with customers or middlemen. The experimental method includes product testing, psychological techniques and consumer panel techniques. Product testing is an objective appraisal of the product performance done on a limited scale without using the firm's brand name. In psychological techniques, a researcher who is trained in psychology, tests the subconscious emotions of customers.

Another technique called 'consumer panel technique', is done by selecting a group of customers (on a permanent basis) and interviewing the group at different intervals of time to observe their behavioral changes.

This enables the project manager to understand market trends and changing preferences of customers. The primary data provides problem specific and accurate information, but collection of primary data requires more time and it also incurs more costs.

Project managers prefer to use secondary data as it is readily available and economical. The secondary data are compiled by the government, non-profit organizations, or some social welfare institutions. Professional market research

agencies like Market Analysis and Research Group (MARG), publications of Center for Monitoring Indian Economy (CMIE), Journals of Federation of Indian Chambers of Commerce and Industry (FICCI), annual reports of Central Statistical Organization (CSO), Census of India, various research theses available in the universities and research organizations are some sources of the secondary data.

A project manager should carefully select the sources of secondary data as the data was collected by other organizations for their own needs. He should also ensure that the sources are authentic and the information is accurate, reliable, relevant and economical to obtain. Since the data is not collected for a specific problem, the project manager has to correlate the available information with the existing problem.

Check Your Progress - 1

1. The size of the potential market, the level of competition, etc., are estimated by conducting a _____.
   a. market analysis
   b. technical analysis
   c. financial analysis
   d. demand analysis
2. Variations in supply are determined by _____.
   a. technical analysis
   b. financial analysis
   c. market analysis
   d. demand analysis
3. Which of the following activities are conducted to test the market environment and see whether the project idea is feasible or not?
   i. Market surveys
   ii. Colleting primary and secondary data
   iii. Studying the characteristics of the market
   a. Only i and ii
   b. Only i and iii
   c. Only ii and iii
   d. i, ii, and iii
4. Identify the activities that the project manager uses to conduct a market and demand analysis.
   i. Situational analysis
   ii. Market description
   iii. Objectives specification
   iv. Demand forecasting

a. Only i, ii, and iii
b. Only i, iii, and iv
c. Only ii, iii, and iv
d. i, ii, iii, and iv

5. Which of the following statements is **false** regarding primary data and secondary data?
   a. Primary data is the data that is collected for a specific purpose and for the first time.
   b. Secondary data is data that is already available but might have been collected for some other purpose.
   c. Primary data can be obtained only from sources internal to the organization.
   d. Secondary data is readily available and economical to use.
6. Identify the statement(s) that **does/do not hold true** regarding secondary data.
   a. Secondary data is considered to be more useful than primary data in market analysis as it is easy to obtain and is also economical.
   b. Secondary data provides problem specific information.
   c. Secondary data is readily available and requires less time to collect than primary data.
   d. Both (b) and (c)
7. Which of the following is **not** an experimental method of data collection?
   a. Product testing
   b. Personal interviews
   c. Consumer panel techniques
   d. Psychological techniques
8. In psychological technique,
   a. a researcher tests the subconscious emotions of customers.
   b. a group of customers, selected on a permanent basis, are interviewed at different intervals of time to observe their behavioral changes.
   c. information about the changing preferences of customers is collected by sending mails to them.
   d. an objective appraisal of product performance is done on a limited scale without using the firm's brand name.
9. Identify the technique in which a group of customers are selected on a permanent basis and interviewed at different intervals of time to observe their behavioral changes.
   a. Product testing
   b. Consumer panel technique
   c. Personal interviews
   d. Psychological techniques

3.3.3 Market Survey

Sometimes information collected from secondary sources may not be enough to understand the market conditions completely. Hence, information obtained from secondary sources should be supplemented by primary data, which is problem-specific. A market survey is a useful method of obtaining the primary data.

Market survey is a technique that is aimed at gathering all possible information by conducting interviews. The surveyor should choose a representative sample, as it is not possible to study the entire population in the market. He/she conducts personal interviews with stakeholders of the project either directly or by phone to gather the information. Opinion surveys, attitude surveys, information surveys, future intervention surveys help the surveyor to understand what the customers wants.

The project surveyor considers the entire market population for the projects like manufacturing intermediate goods and investment goods, where the project customers (clients) are limited in number. These surveys are called census surveys. The results obtained from this survey are more reliable than the sample survey, but conducting the survey is more expensive.

A market survey is useful in determining the total market demand, demand growth rate in different segments of the market, understanding the inner motives of the customer and measuring the unsatisfied needs of the customers. Since it is not possible to interview the entire population of the market, sample survey is a good method to assess the market characteristics. The surveyor conducts the sample survey by choosing a sample that best represents the characteristics of the population. A small sample is more convenient and economical as well but a large sample is more representative of the population. The surveyor therefore has to balance the sampling error due to small sample size with the non-sampling error that results when the sample size is large. This must be carefully decided by the surveyor depending on the research problem being studied. The following are the steps in a sample survey:

Defining the Target Market

The surveyor defines the target market of a project idea in terms of market population. He/she then divides the population into the various segments based on the buyer characteristics. For Exhibit, the various segments of customers for a power project are household consumers, commercial consumers, industries, and all state/central government offices. This is called the sampling frame.

Selecting the Sample

The surveyor carefully selects a sample that represents all the characteristics of the population from various segments. The sample should not be very small as it cannot represent the characteristics of the population which will lead to error in

estimating the population characteristics, which is called sampling error. In the same way, the sample should not be large, as it is not economical for the firm conducting the survey and also the larger the sample the greater the non-sampling errors..

Developing the Questionnaire

A questionnaire is a formalized set of questions for generating information. The questions can be structured or unstructured or a combination of both, depending on the requirement. Structured questions are questions followed by a fixed number of choices from which the respondent should choose an answer. Unstructured questions require the respondent to give descriptive answers. However, it is tedious to analyze an unstructured questionnaire.

The questions in a questionnaire can be classified into three types based on the content: administrative questions, classification questions and target questions. Administrative questions include respondent identification, interviewer identification, date and place of interview etc. Classification questions are about the respondent's characteristics, socio-demographic and behavioral information. These provide information on sex, age, family size, household income, social class, education and attitudes. The target questions are about the present project and its products. Questions should carefully be sequenced so as to be understood by all segments of target customers. An understanding of end product or service of the project, its usage and a knowledge of human psychology are essential in developing the questionnaire.

Training the Surveyors

The management has to be diligent while recruiting the market surveyors who actually conduct the survey. As survey methods are mostly personal, the project company should ensure that these surveyors are able to tap the hidden interests of the customers. Proper training of the surveyors will ensure good results.

Recording the Information

The information obtained from the survey should be recorded for future use. This is done by thoroughly scrutinizing the obtained information to avoid inconsistent and unreliable data. Project manager does editing and tabulating of the information before recording the information. The recorded information is used whenever required.

Interpreting the Information

The recorded data is interpreted by analyzing it by using some standard statistical techniques such as Chi-Square test, correlation, regression, ANOVA analysis etc.

3.3.4 Market Description

Based on the information obtained from the secondary data sources and market survey, the project manager describes the marketability of the project idea in

terms of its effective demand, breakdown of demand, price, consumers' interests, method of distribution, types of sales promotion, supply and competition, impact of government policies, etc.

Effective Demand

In a perfect market, effective demand for a particular product or service is nothing but apparent consumption. Apparent consumption is calculated as the sum of production and trade surplus/deficit minus changes in stock level. Because of limitations like exchange restrictions and government controls over production and distribution, the effective demand is less than apparent consumption. Apparent consumption takes into account only the desirability and ability of the buyers. But effective demand also considers willingness of the buyers. The project manager analyzes the present and past effective demand for the product or service.

Breakdown of demand

The project manager can better determine the total demand of the product by dividing it into various segments as per nature of the product, type of customers, or by geographical location. For example, the total demand for steel is sum of the demand of all products that are made of steel. In case of power projects, the total demand can be divided into domestic consumers demand and industrial consumers demand. The demand as per geographical location would be demand in rural and urban areas.

Price

The project manager collects the price statistics of the proposed project idea to understand the market fluctuations and the changes of price of the product. This allows him to arrive at the best price for his product. The project manager can also explore the possibilities of keeping the price high by maintaining high quality or he can look for ways to reduce project costs and keep the prices low.

Consumers Interest

The project idea is evaluated on the basis of the consumers' demographical, sociological, cultural interests and values. A project idea that goes against these interests and values should not be taken up. The project manager has to observe different purchasing motives of the different consumer groups for a specific project idea.

Methods of Distribution

The 'reach' of a product or service plays an important role in determining the success of the product. As different products require different 'reach', project ideas should be evaluated by its reach. Depending on the nature of the product (consumer/industrial product), the project manager selects the method of distribution and plans the promotional practices to generate more sales.

Sales Promotion

The project manager adopts different techniques of sales promotion after considering the characteristics of the market, nature of product and the distribution channel. Discounts, free gifts, coupons are some of the sales promotion techniques used to increase sales of the product.

Supply and Competition

To survive competition, a project manager analyzes the 'supply and demand situation' for all project ideas. Any product or service that has demand exceeding supply is worth taking up. A project manager also considers the supply of complementary and substitute products while studying the market competition.

Government Policy

The government provides incentives to certain industries for the benefit of the country through its five-year plans, export incentives, preferential purchases and subsidies. Therefore, the project manager has to understand government interests to evaluate the project idea better. If the government provides certain incentives to a particular industry, then the prices of the product are lowered. This change in the price in turn will affect the demand for the product.

Activity: By looking at business opportunities for introducing products to ensure COVID appropriate behaviour, a start-up planned to manufacture a few types of face masks. The promoter wanted to estimate the market demand for these masks. He went through market estimates prepared by various agencies based on the secondary data. He was skeptical about the use of secondary data. He approached an agency and asked for estimates prepared on the basis of primary research. Why the promoter preferred primary data? What type of sampling should the agency use when conducting a market survey for collecting the primary data?

Answer:

Check Your Progress - 2

10. Arrange the following steps based on the sequence in which the sample surveys are conducted.
    i. Interpreting the information
    ii. Developing the questionnaire
    iii. Defining the target market

iv. Training the surveyors
v. Selecting the sample
vi. Recording the information

a. iii-ii-v-i-iv-vi
b. iii-v-ii-iv-vi-i
c. iii-iv-vi-v-i-ii
d. iii-i-ii-v-iv-vi

11. Target questions are
    a. questions about age, family size, education, and attitudes of the respondent.
    b. questions about the respondent's characteristics, socio-demographic information, and behavioral information.
    c. questions about the present project and its products.
    d. questions about the respondent identification, interviewer identification, and data and place of interview.
12. Apparent consumption is calculated as
    a. Production + Trade Surplus/Deficit + Changes in Stock Level
    b. Production + Trade Surplus/Deficit – Changes in Stock Level
    c. Changes in Stock Level + Trade Surplus/Deficit – Production
    d. Production – Trade Surplus/Deficit – Changes in Stock Level
13. Identify the aspects that apparent consumption **does not** take into account.
    a. Desire of the buyers
    b. Ability of the buyers
    c. Willingness of the buyers
    d. None of the above
14. The total demand for the product can be determined by dividing the entire market into various segments based on all **except**
    a. the nature of the product.
    b. the type of organizational structure.
    c. the type of customers.
    d. the geographical location.

3.3.5 Demand Forecasting

The project manager forecasts the demand for a particular product or service using information obtained from secondary sources, market survey and market description. Statistical techniques like trend projections are useful in forecasting the demand for a particular product. These methods extrapolate past trends into the future to forecast future demand, revenues or sales.

Apart from statistical methods, the project manager forecasts future demand using techniques like chain ratio technique, consumption level technique, end use technique, leading indicator technique and econometric technique. These techniques study the cause and effect relationship of several variables on demand of the product.

Chain Ratio Technique

This is a simple technique that applies a series of factors to forecast the demand for a particular product or service. For example, a firm manufactures office bags for men. The firm estimates the aggregate demand of the office bags for men in the following manner by using the chain ratio technique.

- Population of males in the country: 55 million
- Proportion of educated males in the population: 0.68
- So, population of educated males : 37.4 million
- Proportion of employees in the educated males : 0.42
- Population of male employees: 15.7 million
- Proportion of male employees who will purchase an office bag : 0.61
- So, potential sales of office bags : 9.58 million

The method seems simple to use, but the applicability of this method mainly depends on the accuracy of the ratios used. Project manager should carefully estimate these ratios to estimate demand for a particular product or service.

Consumption Level Technique

The consumption level technique estimates the demand for a particular product or service on the basis of income and price elasticities of demand.

3.3.6 Income elasticity of demand

Income elasticity represents the effect of the change in the demand as a proportion to change in the income. It is calculated as:

$$e_i = \frac{Q_2 - Q_1}{I_2 - I_1} \times \frac{I_2 + I_1}{Q_2 + Q_1}$$

e_i = Income elasticity of demand

Q_1 = Quantity demanded in the base year

Q_2 = Quantity demanded in the following year

I_1 = Income level in the base year

I_2 = Income level in the following year

The practical use of income elasticity of demand is explained below. Suppose per capita annual demand for rice in the country is 70 kg. The elasticity of demand for rice is 1.02. Assume the projected per capita annual income four years hence is 12% more the present.

Then the projected demand for rice would be = (present per capita demand) (1+ per capita income level × income elasticity of demand)

= (70 kg) {1+ (0.12 × 1.02)} = 78.57kg per capita per annum.

3.3.7 Price elasticity of demand

The price elasticity of demand represents the effect of the change in the demand as a proportion to change in the price. This is also calculated like income elasticity of demand. Both these techniques are useful in estimating the sensitivity of demand to changes in income and price levels.

End Use Technique

This technique is useful in estimating demand for intermediate products such as investment goods and industrial tools. The project manager estimates the consumption coefficient of the product for various uses for all users in the country.

Leading Indicator Technique

The change in the value of a particular variable leads to a change in the value of another variable. For example, a change in the level of literacy of a country leads to a change in the demand for paper. From the above example, the variable, literacy level is called a leading variable and the change in the demand for paper is called a lagging variable. There are two steps involved in using this technique -- identifying the appropriate leading indicators; and establishing a relationship between the leading variables and lagging variables to find the demand. In practice, identifying appropriate leading indicators is difficult and it cannot be assumed that the relationship between leading and lagging variables remains stable over a period of time.

Econometric Technique

This technique explains the behavior of the economic variables as per the equations developed. The equation may be a single equation or multiple equations. In a single equation model, the dependent variable is explained by several other independent variables.

For example, the demand for rice is explained by the variation in population and income as

$D_t = a_0 + a_1 P_t + a_2 I_t$

where D_t = demand for rice in year 't'

P_t = population in year 't'

I_t = income in year 't'

a_0, a_1 and a_2 are the constants.

Another model, called 'simultaneous equation model' explains the economic relationships between different variables in terms of two or more equations.

For example, the demand for paper is explained by the number of newspapers printed and the number of computers. Again, the variable, number of newspapers is explained by increase in population and the number of computers is explained by income levels.

$P_t = a_0 + a_1 N_t + a_2 C_t$

$N_t = a_3 + a_4 P_t$

$C_t = a_5 + a_6 I_t$

where, Pt = demand for paper in year t

N_t = rise in number of newspapers

C_t = rise in number of computers

I_t = income level

This technique is useful while understanding complex cause and effect relationships and in judging the sensitivity of certain variables.

3.3.8 Uncertainties in Demand Forecasting

The statistical techniques and causal methods explained above are prone to errors because of the many uncertainties involved. The major sources of uncertainty are: techniques of forecasting, past and present market data, and environmental change.

Techniques of Forecasting

Forecasts obtained by using statistical techniques are prone to errors as they take into account only quantitative factors and ignore qualitative factors. Also, as some factors are non-quantifiable, the outcome of these techniques is not accurate. Similarly, certain unrealistic assumptions may lead to the change in the estimates of future demand. For example, the consumption coefficients used in end-use method may be unrealistic assumptions.

Past and Present Market Data

Past and present market data are very useful in forecasting the demand for a product. But the data may not be completely reliable if some unusual events had occurred at the time when the data was collected. Then, this data cannot be considered for forecasting because of the influence of these unusual factors.

Environmental Changes

The changes in business environment like technological shifts, changes in the government policy, discovery of new raw materials, international trade developments, vagaries of monsoons influence projects in several ways. A rise in the prices of petroleum products at the international level will have an effect on the demand for automobiles.

3.3.9 Market Planning

The four Ps of marketing -- product, price, place, and promotion should be well designed to achieve the expected level of market penetration. When dealing with services, the market planning should also include the process, people, and physical evidence. For example, planning a thermal power station project should include determining its production capacity, likely cash inflows, place of construction and transportation and sales programs. For service projects like medical camps, the planning requires to find out the numbers of the people involved, the structure and schedule of the project.

Activity: Prasad Engineering Services, using different forecasting techniques, estimated that a new project would increase the company's revenues by 20% after completion. But after the project was completed, it increased company revenues by a mere 5%. The management of the company tried to understand why the project did not generate the forecasted revenues. After much discussion, the management concluded that the various uncertainties involved in the process of demand forecasting had led to an over-estimation of market demand. What uncertainties are normally involved in the process of demand forecasting? How can a project manager cope with the uncertainties of demand forecasting techniques?

Answer:

Check Your Progress - 3

15. The project manager forecasts the demand for a particular product or service using information obtained from which of the following sources?

    i. Secondary sources
    ii. Market survey
    iii. Market description

    a. Only i and ii
    b. Only i and iii
    c. Only ii and iii
    d. i, ii, and iii

16. Which of the following techniques applies a series of factors to forecast the demand for a particular product or service?
    a. Leading indicator technique
    b. Chain ratio technique
    c. Econometric technique
    d. End use technique
17. Identify the technique that makes use of income and price elasticities of demand for estimating the demand for a particular product or a service.
    a. End use technique
    b. Econometric technique
    c. Consumption level technique
    d. Leading indicator technique
18. Income elasticity represents the effect of a change in the demand as a proportion to a change in the income. Which of the following options give the correct formula for calculating income elasticity?

    a. $e_i = \frac{Q_2 + Q_1}{I_2 + I_1} \times \frac{I_2 \quad I_1}{Q_2 \quad Q_1}$

    b. $e_i = \frac{Q_2 \quad Q_1}{I_2 \quad I_1} \times \frac{I_2 + I_1}{Q_2 + Q_1}$

    c. $e_i = \frac{Q_2 \quad Q_1}{Q_1 Q_2} \times \frac{I_2 \quad I_1}{I_1 I_2}$

    d. $e_i = \frac{Q_2 \quad Q_1}{Q_1 Q_2} \times \frac{I_2 I_1}{I_2 + I_1}$

19. Identify the technique which assumes that a change in the value of a particular variable will lead to a change in the value of another variable.
    a. Chain ratio technique
    b. Econometric technique
    c. Leading indicator technique
    d. End use technique
20. Which demand forecasting technique explains the behavior of the economic variables as per the equations developed?
    a. End use technique
    b. Econometric technique
    c. Leading indicator technique
    d. Chain ratio technique

21. Which of the following formulae will help in finding out the demand for wheat in a particular year with variations in population (P) and income (I)?
    a. $a_0P_t + a_1I_t + a_0a_1$
    b. $a_0 + a_1P_t + a_2I_t$
    c. $a_1 + a_2P_t + a_3I_t$
    d. $a_1P_t + a_2I_t + P_tI_t$
22. Statistical techniques and causal methods are prone to errors because of the many uncertainties involved in the process of forecasting demand. Which of the following are the major sources of uncertainty?
    i. Techniques of forecasting
    ii. Past market data
    iii. Present market data
    iv. Environmental change
    a. Only i, ii, and iii
    b. Only i, iii, and iv
    c. Only ii, iii, and iv
    d. i, ii, iii, and iv

Self-Assessment Exercises

1. The per capita annual demand for wheat in India is 100 kg. The elasticity of demand for wheat is 1.05. Assume that the projected per capita annual income is expected to increase by 15% in the next year. Calculate the projected demand for wheat.
2. The current consumption of product P is 13 tons per year. If the income is expected to increase by 7% next year and the demand for Product P is 15.5 tons, calculate the income elasticity of the product.

3.4 Technical Analysis

Technical analysis of a project idea includes an in depth study of all technical aspects related to basic manufacturing operations, detailed design, assembling, modeling and prototype testing. A competent team of technical experts or reputed technical consultants evaluate the technical aspects of the project. A project manager can also appraise the current project idea with reference to similar technology already in use.

The project manager engages in detailed discussions with the technical crew to ascertain the technical viability and feasibility of the proposed project idea. Sometimes, technical analysis of a project idea includes technical testing of the model in a simulated environment. For example, software modules are tested internally on a limited scale to see if they meet the required standards. Similarly, O-shaped rings are tested at very low temperatures to test the viability of its shape. This is because metal contracts at low temperatures and the shape get distorted.

Technical evaluation of a project idea is a very crucial aspect and any wrong decision at this stage will have far-reaching implications for the viability of a project. This is because technical decisions are irreversible and they require high investments. Determining technical parameters also decides the competitiveness of the firm. The technical expert and the project manager have to establish a good rapport before they determine the key parameters.

3.4.1 Technology Selection

It is possible that a project manager does not have the required technical expertise. In such a case, the technical matters can be better handled by a specialist. But it can be argued that the project managers can make good technical decisions without deep technical knowledge.

According to W. Skinner, a management expert on technical aspects, a project manager should ask himself the following questions to select an appropriate technology -- What will the technology do? What will the technology not do? What is required to adopt new technology? How much does the technology cost? and How certain are the above apprehensions?

Apart from the above questions, the project manager also has to consider the scope for future expansion, and experiences of the previous users. The project manager can evaluate the project better if he has the details. Selecting an appropriate technology also includes evaluating alternative technologies available. Selecting an appropriate technology is also influenced by several other factors like the capacity of the firm, inputs and their availability, investment capability, production costs, overheads and technological upgradations.

3.4.2 Input Requirements and Utilities

To evaluate a project idea, one must also consider the availability and utility of the inputs. The project manager should carefully assess the materials required and their specifications. Material inputs for any project are normally classified into four categories: raw materials, processed industrial materials and components, auxiliary materials and factory supplies, and utilities. Raw materials include agricultural products, forest products, mineral products, livestock and marine products. The project manager has to determine the material inputs by assessing the quality of the raw materials, their costs and their availability.

While purchasing industrial materials and components, the project manager makes use of some testing equipments to measure parameters like quality, quantity, and specifications. Pharmaceutical companies may use some chemicals to test their chemical inputs. A project manager should develop a close relationship with the input suppliers to ensure timely and economical inflow of required inputs. Most firms make long term agreements with the suppliers till the completion of the project.

The manufacturing process is also determined by the availability and quality of raw materials. For example, the quality of limestone decides whether wet or dry process is to be used in a cement plant. Proper assessment of availability of infrastructure like power, water, steam, fuel etc should be made by the project manager to effectively run the project. All these utilities have to be evaluated in relation to the location, type of technology, supplier's capacity and plant capacity. The project manager can also obtain special permission from the local government to ensure better availability and use of several utilities.

3.4.3 Product Mix

The project manager has the choice between a broad range of products or a shortened product mix from a study of market requirements and the firm's ability to offer a variety of products. For example, a carpenter offers a wide range of furniture units with different features and specifications. But a supplier of electronic durables may offer only a limited range of products. Similarly, Xerox offers its products only on a limited scale. The project manager increases the product range when it adopts an expansion strategy and reduces the product range with a retrenchment strategy.

3.4.4 Plant Capacity and Functional Layouts

Plant capacity is the ability of the firm to produce certain volumes or a certain number of units in a given time period. It represents the production capacity of the firm under normal working conditions. This is determined on the basis of installed capacity, machinery, and availability of infrastructure and labor.

Input constraints, investments, market conditions, government policies, technological upgradations, and financial resources play a critical role in determining the capacity of a plant. Availability of skilled labor is also a crucial factor in evaluating the capacity of a project. Layouts are essential for setting up an effective plant. The three types of layouts are product layout, process layout, and fixed layout.

Product Layout

In this layout, machinery and equipment are arranged according to the products. This layout is also referred to as an assembly line or production line, if the equipment is dedicated to continuous production of a narrow product line. Suppose a firm produces three products: A, B and C. According to this layout, each product is manufactured separately and there will be no interferences in the production lines of these three products.

Process Layout

In this layout, all similar equipment or functions are grouped together like all lathes in one area, and all drilling machines in another area. Suppose a firm uses

three varieties of machines, say P,Q and R to produce a product X. All P type machines are grouped at one place, all Q type machines are grouped at another place, and all R type machines in another place.

Fixed Layout

A fixed position layout is used when the product is bulky, large, heavy, and remains stationary. For Exhibit, all manufacturing and construction firms select a fixed position layout for construction and all materials, machines, sub contractors and workers are taken to the the fixed place. Best Exhibits of such layouts are ship building, aircraft assembling, satellite assembling etc. The project can choose any of these layouts based on the requirements of the project. Usually, no single type of layout can exactly fulfill the purpose and the project may use a combination of different types of layouts called a hybrid layout

Activity: Once data is available on the principal dimensions of the project like market demand, plant capacity, technology used for production, plant site and supply of inputs for the project, the important decision is designing a layout that best suits the project. Why do firms need a layout? What are the different types of layout that a project manager can select? Describe the layouts to be used for the following projects:

i. Setting up a hospital

ii. Setting up a chemical plant

Answer:

Check Your Progress - 4

23. Which of the following options include a study of the relevant design and engineering aspects, and reliability and sustainability of the product?
    a. Financial analysis
    b. Market analysis
    c. Technical analysis
    d. Demand analysis
24. Samarth wanted to set up a sugar factory in Uttar Pradesh. He prepared a project proposal and approached SBI for a loan. The bank required details pertaining to the main products, plan outline, layout structure, soil test reports, socio-economic conditions of the project site, licenses, HR policies,

etc., in order to decide on the proposal. What sort of an evaluation is the bank carrying out in order to grant a loan to Samarth?

a. Market evaluation
b. Demand evaluation
c. Technical evaluation
d. Both (b) and (c)

25. Identify the statements that are **true** regarding plant capacity.

i. Plant capacity is the ability of the firm to produce certain volumes or a certain number of units in a given time period.
ii. Plant capacity represents the production capacity of the firm under normal working conditions.
iii. Plant capacity is determined on the basis of installed capacity, machinery, and availability of infrastructure and labor.

a. Only i and ii
b. Only i and iii
c. Only ii and iii
d. i, ii, and iii

26. Which of the following aspects play a vital role in determining the capacity of a plant?

i. Input constraints
ii. Investments
iii. Government policies
iv. Technological upgradations

a. Only i, ii, and iii
b. Only i, iii, and iv
c. Only ii, iii, and iv
d. i, ii, iii, and iv

27. When the equipment is dedicated to continuous production of a narrow product line, _____ is also called production line or assembly line.

a. Product layout
b. Process layout
c. Fixed layout
d. None of the above

28. In which of the following plant layouts are similar equipment or functions grouped together?

a. Product layout
b. Process layout
c. Fixed layout
d. Both (a) and (c)

29. Identify the layout that is used when the product is bulky and remains stationary?
    a. Product layout
    b. Process layout
    c. Fixed layout
    d. All of the above

3.4.5 Location of the Project

Several of India's space projects are conducted in Sriharikota as the place is close to the Bay of Bengal. Most thermal power projects are located near rivers to meet the high requirements of water. Airport projects are taken up in dry land areas so as to minimize the land costs. From the above examples, it is clear that the place of implementation of a project should be located strategically to take advantage of benefits like availability of necessary inputs, necessary infrastructure, and nearness to the markets.

The location of public sector undertakings is decided by the government, which imposes certain rules and regulations on the private projects. The project manager should carefully ensure that the location is as per the interests of the government. The government also provides subsidies, and tax reliefs if the projects are located in backward areas. Study of climatic conditions like temperature, rainfall, floods, and seismic activity is very important while choosing the location of a project.

Factors like integrating all departments of the organization, availability of transport, safety requirements, site cost, political, cultural and economic situation, geographical proximity to competitors are also to be considered by the project manager in finalizing the location of a project.

Steps in the Location and Selection Process

The size and scope of operations decide the approach to location and selection process.

Following is a general procedure for making a location decision:

Defining multiple location objectives

The project manager formulates the broad location objectives based on the interests and preferences of the project promoters, availability of technicians, proximity to customers and suppliers, and other relevant factors.

Identifying relevant decision criteria

The project manager selects the project location on the basis of many economic factors such as labor and material costs, and non-economic factors such as the impact of the plant on the environment and community.

Relating the objectives to the criteria

The relevance of criteria should be evaluated using decision-making models/ techniques such as break-even analysis, linear programming and qualitative factor analysis. Though firms prefer to use the aforesaid models for making the location decision, in practice it is difficult to quantify certain aspects such as the firm's relationship with local channel members, market sentiments etc.

Generating relevant data to evaluate the alternative locations

Alternative location choices are made that satisfy the location objectives of the firm. They are evaluated based on the data obtained.

Selecting the best location

Finally, a location that meets the organization’s objectives, best satisfies the criteria and benefits the community is selected.

Machinery and Equipment

Technical evaluation of a project idea should include the study of required machinery and equipment to run the project. The machinery and technology required depend on the plant capacity and type of process selected to implement the project. The project manager should study constraints like transportation of heavy equipment, import of foreign machinery, and after sales service from the sellers of the equipment, before selecting the necessary machinery and equipment. Machines should be installed in appropriate places and they should be sequenced to ensure continuous flow of the production process. Experiences of the existing users should also be taken into account to find out the practical difficulties in running different machines. Suggestions from external technical consultants and in-house technical experts are also helpful.

Consideration of Alternatives

No single criterion is exactly useful in transforming a good project idea into a perfect project. A great idea might not be technically feasible. Some good ideas may be poor at gaining a market while others may require huge investments, which the firm may not have. All these constraints force the project manager to think of alternatives and come up with a workable project idea. Reconsideration of nature of the project also generates new ideas and makes the idea feasible.

Market characteristics also force the project manager to produce a high quality product at a premium price or a low quality item at a cheaper price. To meet the required market demand, the project manager has two options – either to construct a single plant to cover the entire market or to construct multiple plants in different locations. As none of the choices may be perfect, the ultimate decision regarding the project will depend on the trade-off between the economies of scale in manufacturing and the economies of distribution. The next chapter talks about how a project manager selects a project from the several alternatives, on the basis of the financial considerations. Following Exhibit 3.1 briefs Ikea’s location decision for its first India store.

Exhibit 3.1: Hyderabad Chosen as IKEA's First INDIA Destination

Ikea invested about Rs 700 crore in setting up its India's first store in Hyderabad. Ikea had earlier said it has purchased 13 acres of land parcel to build retail store here. The site is close to the IT hub in Hyderabad's HITEC city, and within easy access to public transport and next to an upcoming Metro line. Ikea was one of the first companies in India to get approval for setting up 100 per cent FDI in single brand retail. "The decision by Ikea to set up its first store in Hyderabad will place the city on the international map of Ikea stores. The retail outlets have a standard design and each location entails an investment of USD 100 million (Rs 550-600 crore)," the company had said earlier."In addition, the backward integration of supplier linkages will have tremendous economic impact to the state," it had said.

Source: https://qz.com/india/1692282/why-ikea-india-picked-hyderabad-over-mumbai-bengaluru-delhi-ncr/

Check Your Progress - 5

30. Arrange the following steps based on the procedure followed to make location decisions.
    i. Selecting the best location
    ii. Relating the objectives to the criteria
    iii. Defining multiple location objectives
    iv. Generating relevant data to evaluate the alternative locations
    v. Identifying relevant decision criteria
    a. iii-ii-v-i-iv
    b. iii-v-ii-iv-i
    c. iii-iv-v-i-ii
    d. iii-i-ii-v-iv
31. Which of the following aspects is **not** covered by market and demand analysis?
    a. Specification of objectives
    b. Making the location decision
    c. Conducting a market survey
    d. Making a situational analysis
32. Technical evaluation of a project idea **does not** include:
    a. collection of data.
    b. availability and utility of the inputs.
    c. the study of required machinery and equipment to run the project.
    d. location of the project.

3.5 Summary

- Market and demand analysis and technical analysis are carried out by the project manager in the process of evaluating a project idea.
- There are six steps in the market and demand analysis: situational analysis and objectives specification, collection of data, market survey, market description, demand forecasting and market planning.
- The market and demand analysis helps the project manager to understand how the firm's abilities can be synchronized with market requirements.
- Market analysis studies market needs and consumer preferences for a given project idea and demand analysis aims at calculating the aggregated demand for a particular product or service.
- Technical analysis of a project idea includes designing the various processes, installing equipment, specifying material and prototype testing.
- The project manager has to be careful in finalizing the technical aspects of the project as the decision is irreversible and the investments involved may be high.
- The project manager has to select the technology required in consultation with technical experts and consultants.

3.6 Glossary

Chain ratio technique: A simple technique that applies a series of factors to forecast the demand for a particular product or service.

Consumption level technique: This technique estimates the demand for a particular product or service on the basis of income and price elasticity of demand.

Demand analysis: It determines the aggregated demand for a product or service for a particular period, variations in supply, hidden demands of the customers, etc.

Econometric technique: This technique explains the behavior of the economic variables as per the equations developed. The equation may be a single equation or multiple equations.

End use technique: This technique is useful in estimating demand for intermediate products such as investment goods and industrial tools.

Fixed layout: It is used when the product is bulky, large, heavy, and remains stationary.

Income elasticity of demand: It represents the effect of the change in the demand as a proportion to change in the income.

Leading indicator technique: This technique is used when the change in the value of a particular variable leads to a change in the value of another variable.

Market analysis: It estimates the size of the potential market, patterns of consumption, level of competition, and market composition.

Plant capacity: The ability of the firm to produce certain volumes or a certain number of units in a given time period. It represents the production capacity of the firm under normal working conditions.

Price elasticity of demand: It represents the effect of the change in the demand as a proportion to change in the price.

Primary data: Data that is collected for a specific purpose and for the first time.

Process layout: In this layout, all similar equipment or functions are grouped together.

Product layout: In this layout, machinery and equipment are arranged according to the products. This layout is also referred to as an assembly line or production line, if the equipment is dedicated to continuous production of a narrow product line.

Product testing: An objective appraisal of the product performance done on a limited scale without using the firm's brand name.

Questionnaire: A formalized set of questions for generating information. The questions can be structured or unstructured or a combination of both, depending on the requirement.

Secondary data: Data that is already available but might have been collected for some other purpose or by some other institutions.

Situational analysis: The process by which a project manager studies customer preferences and their purchasing capacity and strategies of the competing firms and intermediaries.

Structured questions: Questions followed by a fixed number of choices from which the respondent should choose an answer.

Technical analysis: It includes the study of all the relevant design and engineering aspects, reliability and sustainability of the product.

Unstructured questions: Questions that require the respondent to give descriptive answers.

3.7 Self-Assessment Exercises

1. Once project ideas are generated and screened, they are evaluated to test their marketability. How does the project manager test the marketability of a project idea? Explain in detail all the activities that are carried out by a project manager to test the marketability of a project idea.
2. An in depth study of market and demand analysis is followed by conducting the technical feasibility of the project. Describe all the aspects that need to be considered while conducting the technical analysis of projects.

3.8 Suggested Readings/Reference Material

1. Prasanna Chandra, “Projects,” McGraw Hill, Seventh Edition, 2017
2. James Wood, Kory Kogon, and Suzette Blakemore, Project Management for the Unofficial Project Manager: A FranklinCovey Title, Goodreads, 2018

3. Heagney, Fundamentals of Project Management Paperback, Amacom, September 2018
4. NA, Nagarajan, Project Management 8/ED, New Age International Publications,,2019
5. IES Master Team,,ESE 2020 - Basics of Project Management Paperback – 1 IES Master Publication, January 2019

3.9 Answers to Check Your Progress Questions

Following are the model answers to the Check Your Progress questions given in the Unit.

1. (a) Market analysis

Once project ideas have been generated and screened, they have to be evaluated for their marketability, technical feasibility, and costs involved. The market analysis estimates the size of the potential market, patterns of consumption, level of competition, and market composition. The technical analysis of a project idea includes the study of all the relevant design and engineering aspects, and the reliability and sustainability of the product. Demand analysis determines the aggregated demand for a product or service for a particular period, variations in supply, hidden demands of the customers, etc. Financial analysis involves studying the financial aspects of the project idea. To assess the financial feasibility of a project idea, the project manager has to examine the capital costs, operating costs, and revenues of the proposed project.

2. (d) Demand analysis

Demand analysis determines the aggregated demand for a product or service for a particular period, variations in supply, hidden demands of the customers, etc. The technical analysis of a project idea includes the study of all the relevant design and engineering aspects, and the reliability and sustainability of the product. Financial analysis involves studying the financial aspects of a project idea. To assess the financial feasibility of a project idea, the project manager has to examine the capital costs, operating costs, and revenues of the proposed project. Once project ideas have been generated and screened, they have to be evaluated for their marketability, technical feasibility, and costs involved. The market analysis estimates the size of the potential market, patterns of consumption, level of competition, and market composition.

3. (d) i, ii, and iii

Conducting market surveys, collecting primary and secondary data, and studying the characteristics of the market are some of the activities to test the market environment and see whether the project idea is feasible or not.

4. (d) i, ii, iii, and iv

The activities of a project manager in conducting a market and demand analysis include situational analysis and objectives specification, collection of secondary data, market survey, market description, demand forecasting, and market planning.

5. (c) Primary data can be obtained only from sources internal to the organization.

Primary data is data that is collected for a specific purpose and for the first time. Secondary data is data that is already available but might have been collected for some other purpose or by some other institutions. Primary data can be obtained from sources both internal and external to the organization. Internal primary data can be obtained from past and current sales of the firm, observations of employees of the firm, etc. External primary data can be obtained from the opinions of the dealers, feedback of the sales personnel, and sales trends.

6. (b) Secondary data provides problem specific information.

Secondary data is data that is already available but might have been collected for some other purpose or by some other institution. It is considered to be more useful than primary data in market analysis as it is easy to obtain and is also economical. Primary data provides problem specific information, as data pertaining to a particular problem/purpose is collected. Collection of primary data requires more time and also involves higher costs.

7. (b) Personal interviews

The experimental method includes product testing, psychological techniques, and consumer panel techniques. The survey method of data collection includes personal interviews, telephonic interviews, and mail surveys of customers or middlemen.

8. (a) A researcher tests the subconscious emotions of customers.

The experimental method includes product testing, psychological techniques, and consumer panel techniques. In the psychological technique, a researcher who is trained in psychology, tests the subconscious emotions of customers. Option ‘b’ refers to the consumer panel technique, option ‘c’ refers to the survey method, and option ‘d’ to product testing.

9. (b) Consumer panel technique

The consumer panel technique is an experimental method of data collection. A group of customers are selected on a permanent basis. They are interviewed at different intervals of time in order to observe their behavioral changes. This enables the project manager to understand market trends and the changing preferences of customers.

10. (b) iii-v-ii-iv-vi-i

Following are the steps in a sample survey: defining the target market, selecting the sample, developing the questionnaire, training the surveyors, recording the information, and interpreting the information.

11. (c) Questions about the present project and its products.

Target questions are about the present project and its products. The questions have to be carefully sequenced so as to be understood by all segments of the target customers. An understanding of the end product or service of the project, its usage, and knowledge of human psychology are essential in developing the questionnaire.

12. (b) Production + Trade Surplus/Deficit – Changes in Stock Level

In a perfect market, effective demand for a particular product or service is nothing but apparent consumption. Apparent consumption is calculated as the sum of production and trade surplus/deficit minus changes in stock level. Due to exchange restrictions and government controls, effective demand is usually less than apparent consumption. Apparent consumption takes into account only the desire and ability of the buyers while effective demand also considers the willingness of the buyers. The project manager analyzes the present and past effective demand for the product or service.

13. (c) Willingness of the buyers

In a perfect market, effective demand for a particular product or service is nothing but apparent consumption. Apparent consumption takes into account only the desire and ability of the buyers. But effective demand also considers the willingness of the buyers.

14. (b) The type of organizational structure.

The project manager can determine the total demand for the product by dividing it into various segments on the basis of nature of the product, type of customers, or geographical location. The market cannot be divided based on the type of organizational structure.

15. (d) i, ii, and iii

The project manager forecasts the demand for a particular product or service using information obtained from secondary sources, market surveys, and market description. Statistical techniques like trend projections are useful in forecasting the demand for a particular product. These methods extrapolate past trends into the future to forecast future demand, revenues, or sales.

16. (b) Chain ratio technique

The chain ratio technique is a simple technique that applies a series of factors to forecast the demand for a particular product or service. The method seems simple to use, but the applicability of this method mainly depends on the

accuracy of the ratios used. The project manager should carefully estimate these ratios to estimate the demand for a particular product or service.

17. (c) Consumption level technique

The consumption level technique estimates the demand for a particular product or service on the basis of income and price elasticities of demand. Both the income and price elasticities of demand are useful in estimating the sensitivity of demand to changes in income and price levels, respectively.

18. (b) $e_i = \frac{Q_2 \quad Q_1}{I_2 \quad I_1} \times \frac{I_2 + I_1}{Q_2 + Q_1}$ Income elasticity represents the effect of the change in the demand as a proportion to change in the income. It is calculated as $e_i = \frac{Q_2 - Q_1}{I_2 - I_1} \times \frac{I_2 + I_1}{Q_2 + Q_1}$

where,

e_i = Income elasticity of demand

Q_1 = Quantity demanded in the base year

Q_2 = Quantity demanded in the following year

I_1 = Income level in the base year

I_2 = Income level in the following year

19. (c) Leading indicator technique

The leading indicator technique assumes that a change in the value of a particular variable will lead to a change in the value of another variable. There are two steps involved in using this technique: identifying the appropriate leading indicators and establishing a relationship between the leading variables and lagging variables to find the demand. For instance, an improvement in the level of literacy of a country may lead to an increase in the demand for paper. Here, a change in the level of literacy is the leading variable while the change in the demand for paper is the lagging variable.

20. (b) Econometric technique

The econometric technique explains the behavior of the economic variables as per the equations developed. This technique is useful in understanding complex cause and effect relationships and in judging the sensitivity of certain variables. In the end use technique, the project manager estimates the consumption coefficient of the product for various uses for all users in the country. The leading indicator technique assumes that a change in the value of a particular variable will lead to a change in the value of another variable. The chain ratio technique applies a series of factors to forecast the demand for a particular product or service.

21. (b) $a_0 + a_1P_t + a_2I_t$

The econometric technique used to forecast demand explains the behavior of the economic variables as per the equations developed. The equation may be a single equation or multiple equations. In a single equation model, the dependent variable is explained by several other independent variables. With variations in population and income, the demand for a product can be explained through the use of the following formula:

$D_t = a_0 + a_1 P_t + a_2 I_t$

where,

D_t = demand for wheat in year 't'

P_t = population in year 't''

I_t = income in year 't'

a_0, a_1, and a_2 are the constants.

22. (d) i, ii, iii, and iv

Statistical techniques and causal methods are prone to errors because of the many uncertainties involved in the process of forecasting demand. The major sources of uncertainty are techniques of forecasting, past and present market data, and environmental change.

23. (c) Technical analysis

The technical analysis of a project idea includes the study of all the relevant design and engineering aspects and the reliability and sustainability of the product. An in depth market and demand analysis followed by a technical analysis reveals the probability of success of a project idea. Financial analysis involves studying the financial aspects of a project idea. To assess the financial feasibility of a project idea, the project manager has to examine the capital costs, operating costs, and revenues of the proposed project. This is taken up in the end after the market analysis, demand analysis, and technical analysis have been conducted.

24. (c) Technical evaluation

Technical evaluation of a project idea is a very crucial aspect of project evaluation and any wrong decision at this stage will have far-reaching implications on the viability of the project. This is because technical decisions are irreversible and they require high investments. The bank should conduct a technical evaluation for the project idea submitted by Samarth. Such an evaluation could include an evaluation of the main products, the by-products, scrap, plan outline, building outline, layout structure, vendors' list for critical equipment, soil testing, socio-economic conditions of the project site, off-site facilities, import licenses, installed capacity, inspection and expediting, guarantee period, cost, availability, quality, organization chart, HR policies, training facilities, etc.

25. (d) i, ii, and iii

Plant capacity is the ability of the firm to produce certain volumes or a certain number of units in a given time period. It represents the production capacity of the firm under normal working conditions. It is determined on the basis of installed capacity, machinery, and availability of infrastructure and labor.

26. (d) i, ii, iii, and iv

Plant capacity is the ability of the firm to produce certain volumes or a certain number of units in a given time period. It represents the production capacity of the firm under normal working conditions. Factors like input constraints, investments, market conditions, government policies, technological upgradations, and financial resources play an important role in determining plant capacity. For instance, the company would decide on the plant capacity to be installed based on the financial resources available and the investment to be made. Government policies or restrictions would also affect the company's decision in this regard as also market conditions such as the competitive scenario; demand scenario, etc.

27. (a) Product layout

In product layout, the machinery and equipment are arranged according to the products. If the equipment is dedicated to continuous production of a narrow product line, this layout is also referred to as an assembly line or production line.

28. (b) Process layout

In process layout, all similar equipment or functions are grouped together. For instance, all lathes are grouped in one area and all drilling machines in another.

29. (c) Fixed layout

A fixed layout is used when the product is bulky, large, heavy, and remains stationary. For example, all manufacturing and construction firms select a fixed position for construction and all materials, machines, sub-contractors, and workers are taken to that place. The best examples of such layouts are ship building, aircraft assembling, and satellite assembling.

30. (b) iii-v-ii-iv-i

The procedure followed to make a location decision: defining multiple location objectives, identifying relevant decision criteria, relating the objectives to the criteria, generating relevant data to evaluate the alternative locations, and selecting the best location.

31. (b) Making the location decision

Making the location decision is a part of technical evaluation of the project idea. Market and demand analysis covers aspects like specification of

objectives, making a situational analysis, conducting a market survey, forecasting demand, etc.

32. (a) Collection of data.

Collection of data is a part of the market and demand analysis. Technical evaluation of the project idea includes aspects such as selecting an appropriate technology, location of the project, availability and utility of the inputs, study of required machinery and equipment to run the project, etc.

Unit 4

Financial Analysis of Projects

Structure

4.1 Introduction

4.2 Objectives

4.3 Project Cost

4.4 Means of Financing the Project

4.5 Working Capital Requirements and Financing

4.6 Time Value of Money

4.7 Costs of Different Sources of Finance

4.8 Evaluation of Project Investments

4.9 Risk Analysis of Project Investments

4.10 Social Cost Benefit Analysis (SCBA)

4.11 Summary

4.12 Glossary

4.13 Self-Assessment Exercises

4.14 Suggested Readings/Reference Material

4.15 Answers to Check Your Progress Questions

4.1 Introduction

In the previous unit, we have discussed how to conduct the market analysis and technical analysis of projects. In this unit, we will discuss how to conduct the financial analysis of projects. Once the commercial and technical aspects of a project idea have been evaluated and approved, the project manager must examine the financial feasibility of the project. Since the primary objective of any firm is to maximize profits, the financial aspects of a project idea must be studied carefully. Even if the project is marketable and technically feasible, it cannot be implemented if it is not financially viable. To assess the financial feasibility of a project idea, the project manager must examine the capital costs, operating costs and revenues of the proposed project.

To conduct a financial analysis, the project manager must collect information about all the costs pertaining to the project, different ways of financing the project, working capital requirements, profitability projections and projected cash flows of the project. On the basis of this data, the project manager can appraise all the functions of the project and decide whether a particular project idea is worth implementing or not. This chapter discusses the various appraisal techniques used by the project managers to evaluate the financial viability of a project.

This unit will introduce you to the means of financing a project. We will discuss the working capital requirements and financing. We shall then discuss the concepts of time value of money, cost of capital, project appraisal criteria, and risk analysis in capital investment decisions. Finally, we would also be discussing social cost benefit analysis.

4.2 Objectives

This unit will help you understand:

- Define project cost.
- Identify the means of financing a project.
- Analyze working capital requirements and financing.
- Discuss the time value of money.
- Determine the costs of different sources of finance.
- Evaluate project investments.
- Perform risk analysis for project investments.
- Explain social cost benefit analysis.

4.3 Project Cost

The project cost is the sum of all the costs of activities associated with the project. It includes all costs under the following heads: building and civil works, land and site development, plant and machinery, expenses on foreign technicians, miscellaneous fixed assets, margin money for working capital, provision for contingencies, pre-operative expenses and initial cash losses.

4.4 Means of Financing the Project

The project manager can finance the project in a number of ways: share capital, term loans, debenture capital, deferred credit, and other miscellaneous sources. Any one or a combination of two or more of these methods can be chosen to finance the project.

4.4.1 Share Capital

Share capital is of two types: *equity capital* and *preference capital*. Equity capital is the capital contributed by the owners of the firm. Equity holders enjoy the profits and bear the risks of the firm. Preference capital refers to the contribution made by preference shareholders by investing in a firm's preference shares.

4.4.2 Term Loans

Term loans are secured borrowings provided by financial institutions and commercial banks. These loans help firms take up expansion, modernization, and renovation projects. Term loans are available in both rupees and foreign

currencies. Companies take foreign currency term loans to meet their foreign currency expenditures e.g. import of machinery, or consultation fees of foreign technicians.

4.4.3 Debenture Capital

Debentures are issued by firms to raise debt capital, normally for a period of 5 to 10 years. The debentures are secured against the assets of the issuing firm. There are three types of debentures: non - convertible debentures, partially convertible debentures, and fully convertible debentures. A fixed interest is paid for non - convertible debentures. In the case of Partially Convertible Debentures (PCDs), only a part of them are converted into equity shares; but in the case of fully convertible debentures, all the debentures are fully converted into equity shares as per pre-determined terms.

4.4.4 Deferred Credit

Machinery and equipment suppliers often provide credit facilities to firms. This is referred to as deferred credit. This credit is repaid over a period of time, depending on the value of the machinery and the credit standing of the buyer. Normally, suppliers demand a bank guarantee equivalent to the value of the machinery.

4.4.5 Miscellaneous Sources

Miscellaneous sources include unsecured loans, public deposits (as per the rules of Central Government and RBI), incentive sources form government agencies, and leasing and hire purchase finance. But these sources contribute only a small part of the total project capital.

4.5 Working Capital Requirements and Financing

The project manager considers the following points when estimating the working capital requirements of a project:

- Raw materials and components
- Work-in-process
- Stocks of finished goods
- Operating expenses

The important sources of working capital are

- Working capital advances from commercial banks
- Long-term sources of financing
- Trade credit
- Accruals and provisions

The project manager should be aware of the limits for obtaining working capital advances from commercial banks:

- The aggregate permissible bank finance, as per the norms of lending, prescribed by the Tandon Committee.
- The amount of margin money a firm can provide against each current asset.

Banks were instructed to evolve their own methods to assess working capital requirements of projects.

The margin requirement varies with the type of current asset. The ranges within which margin requirements lie for various types of current assets are raw materials – 10-25%, work-in-process – 20-40%, finished goods – 30-50%, and debtors – 30-50%. However, there is no standard formula for determining the margin amount.

Check Your Progress - 1

1. Identify the **correct** sequence of steps in which a project manager evaluates project ideas.
   a. Technical analysis – Market analysis – Financial analysis.
   b. Market analysis – Technical analysis – Financial analysis.
   c. Financial analysis – Technical analysis – Market analysis.
   d. Market analysis – Financial analysis – Technical analysis.
2. Which of the following options is **not** required to assess the financial feasibility of a project idea?
   a. Capital costs
   b. Operating costs
   c. Price elasticity of demand
   d. Revenues
3. About which of the following aspects should information be collected in order to conduct a financial analysis of a project?
   i. Costs pertaining to the project and the various ways of financing it
   ii. Working capital requirements of the project
   iii. Profitability projections and projected cash flows of the project
   a. Only i and ii
   b. Only i and iii
   c. Only ii and iii
   d. i, ii, and iii

4. A project can be financed in a number of ways – through share capital, term loans, issue of debentures, etc. Which of the following sources of financing do the owners of the firm contribute?

   a. Term loans

   b. Equity capital

   c. Deferred credit

   d. Debentures

5. Which of the following statements is **not true** regarding debentures?

   a. Debentures are issued by firms to raise debt capital, normally for a period of 5 to 10 years.

   b. Debentures are secured against the liabilities of the issuing firm.

   c. A fixed interest is paid for non-convertible debentures.

   d. None of the above

6. Machinery and equipment suppliers often provide credit facilities to firms. This credit is repaid over a period of time, depending on the value of the machinery and the credit standing of the buyer. What is this form of financing known as?

   a. Equity capital

   b. Preference capital

   c. Deferred credit

   d. Term loans

7. Identify the factors that the project manager needs to consider to estimate the working capital requirements of a project.

   i. Raw materials and components

   ii. Work-in-process

   iii. Stocks of finished goods

   iv. Operating expenses

   a. Only i, ii, and iii

   b. Only i, iii, and iv

   c. Only ii, iii, and iv

   d. i, ii, iii, and iv

8. Match the following current assets with the range in which the margin requirements fall for each of them.

   i. Debtors

   ii. Work-in-process

   iii. Finished goods

   p. 20-40%

q. 10-25%

r. 30-50%

a. i/q, ii/p, iii/r

b. i/p, ii/r, iii/r

c. i/q, ii/r, iii/p

d. i/r, ii/p, iii/r

4.6 Time Value of Money

The project manager considers the time value of money when evaluating the financial aspects of a project idea. To understand time value of money, consider the investment of one rupee. One rupee invested today would generate (1+r) a year hence, where r is the rate of return per annum. The following calculations are used to determine time value – future value of single cash flow, future value of annuity, present value of single cash flow, and present value of annuity.

4.6.1 Future Value of Single Cash Flow

The future value of a single cash flow is given by the following formula:

$$FV = PV(1 + r)^n$$

Where, FV = Future value n years hence

PV = Present value of cash flow

r = Interest rate per annum

n = Number of years

Example: Future Value of a Single Cash Flow – Compounded Annually

Suppose the investment of Rs.100 crore is made. The rate of return is 6 percent p.a., compounded annually for the next three years.

Then the future value of the investment at the end of three years is

$$FV = 100(1 + 0.06)^3 = 119.10 \text{ crore}$$

The following formula is useful for calculating the future value of money when compounding is done several times a year.

$$FV = PV\left[1 + (r/m)\right]^{mn}$$

Where, m = Number of times interest is paid

n = Time period

Example: Future Value of a Single Cash Flow – Compounded Semi-Annually

Suppose the interest rate is compounded semi-annually in the above problem. Then the future value at the end of three years is

$$FV = Rs.100\left(1 + (0.06 \div 2)\right)^{3\times 2}$$

= 119.40 crore

4.6.2 Future Value of Annuity

An annuity is a series of periodic cash flows (payments or receipts) of equal amounts. The future value of an annuity is calculated as:

$$FVA_n = \frac{A[(1+r)^n - 1]}{r}$$

Where, A = Constant periodic flow

r = Interest rate per period

n = Duration of the annuity

Example: Calculating the Future Value of an Annuity

Suppose a project incurs an amount of Rs. 200 crore every year. Assume the compound interest is 6.5 percent per annum. Then the future investment value of the project after five years is:

$$FVA_5 = \frac{200\left[\left(1+0.065\right)^5 - 1\right]}{0.065} = \text{Rs. } 1138.72 \text{ crore.}$$

Check Your Progress - 2

9. Assuming that compounding is done more frequently than annual compounding, which of the following is a generalized formula for shorter compounding periods?

   a. $FV = PV\ (1 + r)^n$

   b. $FV = A\left[\frac{(1+r)^n - 1}{r}\right]$

   c. $FV = PV\left[1+\frac{r}{m}\right]^{m\times n}$

   d. $FV = A\left[\frac{(1+r)^n - 1}{r}\right](1 + r)$

10. The future value of a regular annuity for a period of 'n' years at a rate of interest 'r' is given by the formula

    a. $FVA_n = A\left[\frac{(1+r)^n - 1}{r}\right]$

    b. $FV = PV\left[1+\frac{r}{m}\right]^{m \times n}$

    c. $FV = PV(1 + r)^n$

    d. $FVA_n = A\left[\frac{(1+r)^n - 1}{r(1+r)^n}\right]$

Self-Assessment Exercises

1. Sridhar has invested Rs. 2,000 in a bank that pays 12% interest compounded annually. How much will Sridhar get after 10 years?
2. In Consumers Bank, term deposits can be made for periods ranging from six months to 10 years. The rate of interest paid is 14% per annum for a three-year deposit and the interest is compounded every quarter. To what amount will Rs. 10,000 invested in term deposits for three years will grow to?

4.6.3 Present Value of Single Cash Flow

The formula for calculating present value is given by:

$$PV = \frac{FV}{(1+r)^n}$$

Where, PV = Present value of the cash flows

r = Annual discount rate

n = Number of years

and $1/(1+r)^n$ is called the discounting factor

When discounting is done several times, the following formula is used for calculating the present value.

$$PV = \frac{FV_n}{(1+r/n)^{mn}}$$

Where, m = Number of times per year discounting is done

n = Number of years

r = Annual discount rate

The following formula is used to find out the present value when the cash inflows occur in an uneven manner.

$$PV_n = \frac{A_1}{(1+r)} + \frac{A_2}{(1+r)^2} + \frac{A_3}{(1+r)^3} + ... + \frac{A_n}{(1+r)^n}$$

Where,

PV_n= Present value of a cash flow stream

A_t = Cash flow occurring at the end of year t

r = Annual discount rate

Example: Calculating the Present Value of a Single Cash Flow

Assume a project is expected to receive Rs. 100 crore, Rs. 200 crore and Rs. 300 crore at the end of the next one, two and three years respectively, at a discount rate of 8 percent.

Then, the present value of the cash stream to be received for the next three years is:

$$PV_3 = \frac{100}{(1+0.08)} + \frac{200}{(1+0.08)^2} + \frac{300}{(1+0.08)^3}$$

PV_3= Rs. 502.2 crore

4.6.4 Present Value of an Annuity

The following formula is used to find the present value of an annuity:

$$PVA_n = \frac{A\left[(1+r)^n - 1\right]}{r(1+r)^n}$$

Where,

PVA_n= Present value of an annuity that has a duration of n periods

A= Constant periodic flow

r = Discount rate

Example: Calculating the Present Value of an Annuity

Assume the project is expected to receive Rs.200 crore for 3 years, each payment occurring at the end of the year. Then the present value of this cash stream, if the annual discount rate is 8 percent is

$$PVA_3 = \frac{200\left[(1+0.08)^3 - 1\right]}{0.08(1+0.08)^3}$$

PVA_3 = Rs. 515.42 crore

Self-Assessment Exercises

3. Srinidhi Bank has introduced a deposit scheme for all individuals and organizations. A deposit amount is remitted and the principal is received with an interest of 14% per annum in 12 installments. Find out the amount of initial deposit in order to receive a monthly installment of Rs. 100 for 12 months.
4. The annuity deposit scheme of Swaraj Bank provides for a fixed monthly income for suitable periods based on the choice of the depositor. After the first month of the deposit, the depositor receives monthly installments depending on the number of months he/she has chosen as the annuity period. The rate of interest is 9% per annum. If an initial deposit of Rs. 5,000 is made for an annuity period of 60 months, calculate the value of the monthly annuity.

4.7 Costs of Different Sources of Finance

A project can be carried out only after the necessary finance has been collected from different sources. Identifying the right kind of source is crucial because each source of finance will have its own cost. The project manager has to assess these costs.

The cost of capital is the minimum rate of return the firm must earn on its investments in order to satisfy the various categories of investors who have made investments in the form of shares, debentures, term loans, etc. A firm's cost of capital is the weighted arithmetic average of the post-tax cost of various sources of long-term finance used by it.

Example: Calculating the Cost of Capital

Suppose a firm's capital base is Rs. 100 crore, of which Rs. 75 crore is equity and Rs. 25 crore is debt. Assume the cost of equity is 12 percent and the post-tax cost of debt is 8 percent. Then, the cost of capital of the firm is = (proportion of equity × cost of equity) + (proportion of debt × cost of debt).

$$= \left(\frac{75}{100} \times 12\%\right) + \left(\frac{25}{100} \times 8\%\right) = 11\%.$$

4.7.1 Cost of Debt

It is the rate of discount that equates the present value of post-tax interest and principal repayments with the net proceeds of the debt issue. The cost of debt is represented by 'K_d'. If the interest on debt is payable annually, following formula is used to calculate the cost of debt.

$$P = \sum_{t=1}^{n} \frac{I(1-T)}{(1+K_d)^t} + \frac{R}{(1+K_d)^n}$$

Where P = Net amount realized on debt issue

I = Annual interest payable

T = Tax rate

R = Redemption price

n = Maturity period of debt

t = a parameter whose value ranges from 1 to n.

To obtain a quick estimate, the following approximated formula is used to calculate the cost of capital.

$$K_d = \frac{I(1-T) + (R-P)/n}{(R+P)/2}$$

Example: Calculating the Cost of Debt

Indhra Limited has issued Rs. 20 crore worth of non-convertible debentures, each at a face value of Rs. 100, at a rate of 12 percent. Each debenture is redeemable at a premium of 5 percent, after 10 years. If the net amount realized is Rs. 95, what is the cost per debenture? Assume the tax rate is 40%.

Given, I = 12, T = 0.4 P = Rs. 95,

n = 10 years, R = Rs. 105,

$$K_d = \frac{12(1-0.4) + (105-95)/10}{(105+95)/2} = 8.2 \text{ percent.}$$

4.7.2 Cost of Preference Capital

It is the discount rate that equates the net proceeds from preference capital issue to the payments associated with the same i.e., dividend payment and principal payments. It is represented by 'K_p'. The cost of preference capital is calculated by using the following formula

$$P = \sum_{t=1}^{n} \frac{D}{(1+K_p)^t} + \frac{R}{(1+K_p)^n}$$

Where, P = Net amount realized per share

D = Preference dividend per share payable annually

R = Redemption price

n = Maturity period.

Following is the approximated formula to find the cost of preference capital;

$$K_p = \frac{D + (R-P)/n}{(R+P)/2}$$

Example: Calculating the Cost of Preference Capital

The terms of the preference share issue made by ELV Industries are as follows: each preference share has a face value of Rs. 100 and carries a rate of dividend of 12% payable annually. The share is redeemable after 12 years at par. If the net amount realized per share is Rs. 95, calculate the cost of preference capital.

$$K_p = \frac{12 + (100 - 95)/12}{(100 + 95)/2}$$

= .127 or 12.7%

Check Your Progress - 3

11. Which of the following is the minimum rate of return that a company must earn on its investments in order to satisfy the various categories of investors who have made investments in the form of shares, debentures or term loans?
    a. Return on investment
    b. Cost of capital
    c. Capital recovery factor
    d. Effective rate of interest
12. A company's cost of capital is the _____ of the cost of various sources of finance.
    a. compounded value
    b. weighted average
    c. simple arithmetic average
    d. All of the above

Self-Assessment Exercises

5. Tushaar Manufacturing Limited issued preference shares of Rs. 100 face value carrying a 15% dividend repayable at par after 12 years. The net amount realized per share is Rs. 95. Find the cost of preference capital.
6. Sacred Enterprises has a total capital base of Rs. 50 million in the ratio of 1:1 of debt-equity. The post-tax costs of debt and equity are 6% and 9%, respectively. Calculate the cost of capital of the company.

4.7.3 Cost of Equity Capital

Equity capital can be raised by issuing of external equity (allotment of shares) and through retention of earnings. The project manager estimates the rate of return required by equity shareholders before determining the cost of equity capital.

Several approaches are available to estimate the rate of returns required by the equity shareholder. They are:

- Dividend capitalization approach
- Capital asset pricing model approach
- Realized yield approach
- Bond yield plus risk premium approach
- Earnings-price approach

Dividend Capitalization Approach

In this approach, the market price per share is equal to the present value of the expected dividends, discounted at the return required by the equity shareholders. The rate of return required by the equity shareholders is represented as 'K_S'. In symbols,

$$P_O = \sum_{t=1}^{n} \frac{D_t}{(1 + K_s)^t}$$

Where, P_O = Current market price per share of the equity stock

D_t = Expected dividend per share at the end of year, t

If equity shareholders expect a constant dividend every year, then

$$K_S = \frac{D}{P_O}$$

If equity shareholders expected the dividend to grow annually at a rate of g% forever, then,

$$K_S = \frac{D_1}{P_O} + g$$

Where, D_1 = Dividend Expected at the End of Year 1. That is, $D_1 = D_0 (1 + G)$.

Capital Asset Pricing Model (CAPM)

According to this approach, the cost of equity is reflected by the following equation,

$K_i = r_f + \beta_i (k_m - r_f)$

K_i = Required rate of return on a security i

r_f = Risk free rate of return

k_m = Rate of return on market portfolio.

β_i = Beta of security i (Beta is a measure of volatility of a security or portfolio of securities in comparison with the market as a whole. A beta of 1 indicates that the security's price will move with the market. A beta greater than 1 indicates that

the security's price will be more volatile than the market. A beta less than 1 means that it will be less volatile than the market).

Example: Calculating the Cost of Equity

The beta factor of RK Industries shares is 1.4. The risk free rate of interest on government securities is 10%. The expected rate of return on equity shares is 17%. Calculate the cost of equity.

$K_i = 10 + 1.4(17 - 10) = 19.8\%$

Realized Yield Approach

In this approach, the rate of return realized by equity shareholders in the past is regarded as a proxy for the rate of returns required by them. The rate of return (yield) on an equity stock is given by the formula;

$$Y_t = \frac{D_t + P_t}{P_{t-1}} - 1$$

Where, Y_t = Yield for year t

D_t = Dividend per share, for the year t payable at the end of the year t

P_t = Price per share at the end of year t

P_{t-1} = Price per share at the end of year t -1, i.e., at the beginning of year t

$Y_t = \frac{D_t + P_t}{P_{t-1}} - 1$ is also called as wealth ratio, denoted by W_t

The yield for an n-year period is $\left(W_1 \times W_2 \times ..... W_n\right)^{1/n} - 1$

Here, $W_t = \frac{D_t + P_t}{P_{t-1}}$

Bond Yield Plus Risk Premium Approach

According to the approach, the rate of return required by the equity shareholders is based on the risk profile of a company. So, the rate of return required by the equity shareholders is calculated as, yield on the long-term bonds of the firm + risk premium.

Earnings Price Ratio Approach

According to this approach, the rate of return required by equity shareholders is equal to. $E_1 \div P_0$

Where, E_1 = Expected earnings per share for next year

P_0 = Current market price per share

E_1 is calculated by multiplying the current earnings per share by (1 + growth rate).

Check Your Progress - 4

13. According to the Dividend Capitalization approach, the cost of equity capital is given by:

    a. $K_S = \frac{D_0}{P_0} + g$

    b. $K_S = \frac{D_1}{P_0} - g$

    c. $K_S = \frac{D_0 (1+g)}{P_0} - g$

    d. $K_S = \frac{D_0 (1+g)}{P_0} + g$

14. In the Capital Asset Pricing model, to know the cost of equity we require

    i. the risk free rate of return
    ii. the return on investment.
    iii. the rate of return on market portfolio
    iv. the beta of security

    a. Only i, ii, and iii
    b. Only i, iii, and iv
    c. Only ii, iii, and iv
    d. i, ii, iii, and iv

Self-Assessment Exercises

7. The current dividend paid by LMG Limited is Rs. 15 per share and it is expected to grow at 5% infinitely. If the current market price per share of LMG is Rs. 75, calculate the cost of equity.

8. Following are the dividend per share and price per share details of an equity stock over a period of 10 years.

Year	Dividend per Share (Rs.)	Price per Share (Rs.)
1	10	10
2	10	12
3	12	14
4	13	12
5	10	10
6	12	15
7	14	10
8	15	10
9	15	12
10	15	12

Calculate the average yield of the equity stock.

4.7.4 Cost of External Equity

It is the rate of return that the firm must earn on the net funds raised by it when it issues equity capital externally so that equity investors earn the required rate of return on their subscription to the equity capital of the firm. Cost of external equity is represented by 'K_S.' The following approaches are useful to calculate cost of external equity.

Dividend Capitalization Approach

According to this approach, the cost of external equity (K_s) is calculated as

$$K_S = \frac{D_1}{P_O(1-f)} + g$$

Where, D_1 = Dividend expected at the end of year 1

f = Floatation costs (legal, printing, underwriting, brokerage, issue expenses etc.) expressed as a percentage of the current market price.

P_0 = Current market price per share

g = Dividend growth rate

Capital Asset Pricing Model and Other Approaches

The following formula is useful to calculate cost of external equity.

$$K_S = \frac{K_e}{(1-f)}$$

K_e = Rate of return required by equity investors

Example: Calculating Cost of External Equity using CAPM

Happy Homes Private Limited decided to raise some equity from the market. The issue costs are 10% of the issue amount, and the investors are expecting a return of 28% from their investment. Calculate the cost of external equity of the company.

$$K_S = \frac{K_e}{1-f}$$

K_s = cost of external equity

K_e = rate of return required by the equity investors = 28%

f = floatation costs as a percentage of the current market price = 10%

$$K_S = \frac{K_e}{1-f} = \frac{0.28}{1-0.10} = 0.3111 \text{ or } 31.11\%.$$

Cost of Retained Earnings

Two approaches are useful to determine the cost of retained earnings. They are

- Tax adjusted rate of return approach
- External yield approach

Tax-adjusted rate of returns approach

According to this approach, the cost of retained earnings is calculated as the post-tax rate of return available to the investor. So, the 'K_S' has to be adjusted for ordinary and long-term capital gains tax as expressed below:

$$K_r = K_s \frac{(1 - t_p)}{(1 - t_g)}$$

K_r = Cost of retained earnings

K_s = Rate of return required by equity investors

t_p = Ordinary personal income tax

t_g = Personal long term capital gains tax rate

This approach has two limitations: The income tax rate varies from stakeholder to stakeholder and alternative investment opportunities of the firm are not being considered as the firm reinvests its cash flows instead of paying dividends.

External yield approach

Here, the firm evaluates the possibility of purchasing shares of other companies with similar characteristics of risk. So, the opportunity cost of retained earnings is considered equal to the rate of return that can be earned on such investment.

4.7.5 Weighted Average Cost of Capital

The Weighted Average Cost of Capital is the sum of the weighted values obtained by multiplying the cost of each source of financing by its proportion in the capital structure.

The Weighted Average Cost of Capital is calculated as:

$$k_a = w_d k_d + w_p k_p + w_e k_e$$

where k_a = Weighted average cost of capital

k_d = Cost of long-term debt capital

k_p = Cost of preference capital

k_e = Cost of equity

w_d= Proportion of long-term debt in the capital structure

w_p = Proportion of preference capital in the capital structure

w_e= Proportion of equity in the capital structure

Here, the value of ($w_d + w_p + w_e$) is equal to 1.

Check Your Progress - 5

15. If 'K_e' is the cost of equity and 'f' is the floatation cost as percent of the amount raised, cost of external equity, 'K_s' is given by

    a. $K_S = \frac{K_e}{1+f}$

    b. $K_s = K_e + f$

    c. $K_S = \frac{K_e}{1-f}$

    d. $K_s = K_e - f$

Self-Assessment Exercises

9. The cost of retained earnings of a company is 21%. If the issue expenses as a percentage of the issue amount are 7%, calculate the cost of external equity of the company.

(Questions i-v)

Happy Home Needs Private Limited has the following capital structure.

(Rs. in millions)

Equity Capital (10 million shares at par value)	100
12% Preference Capital (1 million shares at par value)	100
Retained Earnings	100
15% Non-convertible Debentures (1 million debentures at par value)	100
16% term loan from SBI	100
Total	**500**

Following are the other details provided by the company.

- The market price per equity share is Rs. 50. The next expected dividend is Rs. 10 per share and it is expected to grow at a constant rate of 8%.
- The preference shares are redeemable after seven years at par and are currently quoted at Rs. 80 per share in the stock exchange.
- The debentures are redeemable after five years at par and their current market price is Rs. 95 per debenture. The tax rate is 40%.

Based on the given data, answer the following questions.

i. Calculate the cost of equity capital.
ii. Calculate the cost of retained earnings.
iii. Calculate the cost of debentures.
iv. Calculate the cost of preference capital.
v. Calculate the weighted average cost of capital of the company.

4.8 Evaluation of Project Investments

The project manager uses the following criteria to evaluate returns from project investments. They are:

- Non-discounting criteria
- Discounting criteria

4.8.1 Non-Discounting Criteria

The non-discounting criterion does not consider the time value of money. Following are the two methods in non-discounting criteria:

- Average Rate of Return (ARR)
- Payback period

4.8.2 Average Rate of Return (ARR)

This method estimates the relationship between the average annual profits earned by a project and the investments made in the project. This is expressed in percentage form.

$$\text{Average Rate of Return} = \frac{\text{Average Annual Profit}}{\text{Initial Investments}} \times 100$$

4.8.3 Accept - reject criterion

A project is accepted when the actual ARR is higher than the minimum desired ARR. The project manager can also rank all the alternative options in descending order and choose the project with the highest ARR.

4.8.4 Advantages of ARR

- The method is simple to calculate, as it uses readily available accounting information.
- A quick decision can be taken comparing the ARR values of various projects.

4.8.5 Disadvantages of ARR

- It Ignores The Time Value Of Money.

Example: Evaluation of Projects – Using the ARR Method

Assume there are two investment options. For Investment 1, the initial investment is Rs.10,000 and the average profit is Rs. 1250; for Investment 2, the initial investment is Rs.10,000 and the average profit is Rs. 1800. Using the ARR method, the two proposals can be evaluated in the following manner.

Investment 1:

Average profit = Rs.1,250

Initial investment = Rs.10,000

$$ARR = \frac{Rs.1,250}{Rs.10,000} \times 100 = 12.5\%$$

Investment 2:

Average profit = Rs.1,800

Initial investment = Rs. 10,000

$$ARR = \frac{Rs.1800}{Rs.10,000} \times 100 = 18\%$$

According to the ARR method, Investment 2 is better as it generates a higher average rate of return than Investment 1.

Payback Period Method

Payback period is the time period in which a firm can recover its investments made in a project.

4.8.6 Accept-Reject criterion

The actual payback period of a project is compared with a pre-determined payback set by the firm's management. If the actual payback period is less than the predetermined payback period, the project can be accepted; otherwise, the project is rejected. The project manager can also rank alternative project proposals according to their payback period and the project with shortest payback period is chosen.

Advantages of payback method

- The method favors the projects with substantial cash inflows in earlier years.
- The method is easy to understand and does not require complex calculations.

Disadvantages of payback period

- It measures only the capital recovery of the projects, not their profitability.
- The method ignores cash flows beyond the payback period.

Example: Evaluation of Projects – Using the Payback Period Method

Suppose a firm has two options, Option A and Option B. The initial outlay for both the options is Rs.10,000. The expected cash flows for both options are as follows:

Option A:

Year	Cash Flow
1	4000
2	6000
3	4000
4	1000

The payback period for Option A is two years: Rs. 4000 (year 1) + Rs.6,000 (year 2)

In two years, the total investment is recovered. Hence, the payback period is two years.

Option B:

Year	Cash Flow
1	1000
2	2000
3	5000
4	5000
5	6000

The payback period for option B is 3.4 years:

1000 (year 1) + 2000 (year 2) + 5000 (year 3) + 2000/5000 (40% of year 4)

For option B, the total investment is recovered in 3.4 years.

- Hence, option A is accepted.

4.8.7 Discounted Cash Flow Criteria

In this criteria, the time value of money is considered when evaluating the costs and cash flows of a project. There are three methods:

- Net present value method (NPV)
- Internal rate of return (IRR)
- Profitability Index

Net Present Value Method (NPV)

The net present value of a project is equal to the sum of all the cash flows associated with the project. In this method, all the future cash flows are converted into their present values, using the required rate of return. The difference between the present value of cash outflows and the present value of all cash inflows gives the net present value.

The net present value of a project is calculated by the following formula:

$$NPV = \sum \frac{A_t}{(1+k)^t}$$

Where t= Time period

k= Required rate of return

A= Cash flows

Accept-reject criterion

In the NPV method, the project is accepted if the NPV is positive and rejected if it is negative.

Advantages of NPV

- This method considers the time value of money.
- It considers the total benefits accruing out of the option over its life -time.

Disadvantages of NPV

- It is difficult to calculate and understand, compared to the earlier methods.
- The NPV may not give satisfactory results when the project manager has to choose between projects of different duration. In general, the one with a shorter economic life is preferred, other things remaining same.

Example: Evaluation of Projects – Using the NPV Method

Suppose a firm has two options; each of them costing Rs.10,000 and having a life period of 5 years. Assume a required rate of return of 8%, after taxes. The net cash flows for both the projects are shown below. Which option should be accepted?

Option-1:

Year	Net cash flows
1	5000
2	5000
3	4000
4	3000
5	500

Option-2:

Year	Net cash flows
1	4000
2	5000
3	4500
4	3500
5	3000

For Option-1, the NPV is:

$$-10000+\frac{5000}{(1.08)}+\frac{5000}{(1.08)^2}+\frac{4000}{(1.08)^3}+\frac{3000}{(1.08)^4}+\frac{500}{(1.08)^5} = \text{Rs. } 4{,}636.$$

For Option-2, the NPV is:

$$-10000+\frac{4000}{(1.08)}+\frac{5000}{(1.08)^2}+\frac{4500}{(1.08)^3}+\frac{3500}{(1.08)^4}+\frac{3000}{(1.08)^5} = \text{Rs. } 6{,}177.$$

- Since the NPV of Option-2 is higher, it is accepted.

Internal Rate of Return (IRR)

The internal rate of return is the discount rate at which the present values of cash outflows and cash inflows are equal. In other words, it is the discount rate that makes the NPV of the project equal to zero.

Mathematically, it is expressed as:

$$\sum_{t=0}^{n} \frac{A_t}{(1+r)^t} = 0$$

Where r = Internal rate of return

A = Cash flows

t = Time period

Accept-reject criterion

The actual IRR value is compared with the cut-off rate (set by the project firm). The project is accepted if the IRR exceeds the cut-off rate.

Advantages of IRR

- The IRR indicates the profitability of a proposal.
- It is consistent with the overall objective of maximizing shareholders wealth.

Disadvantages of IRR

- It involves complex calculations.
- The method assumes that all intermediate cash flows are reinvested at the IRR rate.

Example: Evaluating of Projects – Using the IRR Method

Consider the earlier example given in the NPV method, for Option 1,

$$-10000 + \frac{4000}{(1+r)} + \frac{5000}{(1+r)^2} + \frac{4000}{(1+r)^3} + \frac{3000}{(1+r)^4} + \frac{500}{(1+r)^5} = 0$$

To solve this, we consider interest rates on a trial and error basis and find the rate that makes sum of cash flows equal to zero.

Here r = 28.7%.

For Option 2:

$$-10000 + \frac{4000}{(1+r)} + \frac{5000}{(1+r)^2} + \frac{4500}{(1+r)^3} + \frac{3500}{(1+r)^4} + \frac{3000}{(1+r)^5} = 0$$

r = 30.63%

So, we select Option-2 as it has the higher IRR.

Profitability Index or Benefit-Cost Ratio (B/C ratio)

The ratio of future cash benefits to the initial outflows is called as profitability index.

It is calculated as:

$$\text{Profitability Index (PI)} = \frac{\text{PV of future cash flows}}{\text{Initial Investments}}$$

$$\text{PI} = \frac{\sum_{t=1}^{n} \frac{A_t}{(1+r)^t}}{C_o}$$

Where, r = Required rate of return on the proposal

Accept-reject criterion

The PI gives the ratio of benefits to costs. If PI<1, the project should be rejected. If PI >1, it means the benefits of the project exceed its costs and so it can be accepted.

Advantages of PI

- Considers the time value of money.
- Enables comparison of various alternatives.

Disadvantages of PI

- The concept is similar to NPV.

Example: Evaluation of Projects – Using the PI Method

Consider the earlier example given in the NPV method,

For Option 1, $\text{PI} = \frac{14,636}{10,000} = 1.46$

For Option 2, $\text{PI} = \frac{16,177}{10,000} = 1.6177$

- Since the PI of Option 2 is higher, it is accepted.

Self-Assessment Exercises

10. A company is considering an investment option. The initial investment is Rs. 200,000 and the average annual profit is Rs. 25,000. Calculate the average rate of return of the proposal.
11. Project Z requires an investment of Rs. 20 million. The cash flows generated by the project are given below. What is the payback period for the project?

End of Year	1	2	3	4	5	6
Cash flow (in Rs. million)	1	2	4	5	8	5

(Questions i-iv)

A firm has two options; each of them costing Rs. 50,000 and having a life period of 5 years. Assume a required rate of return of 7%, after taxes. The net cash flows for both the projects are shown below.

Option 1:

Year	Net cash flows
1	20000
2	20000
3	15000
4	10000
5	9000

Option 2:

Year	Net cash flows
1	15000
2	20000
3	15000
4	10500
5	8000

Based on the data given above, calculate the following.

i. The NPV of Option 1.
ii. The NPV of Option 2.
iii. PI of Option 1.
iv. PI of Option 2.

4.9 Risk Analysis of Project Investments

Every project is exposed to a certain amount of risk and the extent of risk varies from project to project. So, the project manager should attempt to estimate the possible level of risk his project is likely to be exposed to.

Suppose the project manager has a choice two between two alternatives, X and Y, each involving the same investment, but offering different outcomes as given below:

The expected outcome of Proposal X is (10,000 x 0.5 + 0 x 0.5) = 5,000; Therefore, the expected outcome of both proposals are equal. If the project manager does not want to take any risk, he prefers Proposal Y. The project manager can also take up Proposal X, if he wants to take up some risk.

Proposal	Possible Outcome	Probability
X	10000	0.5
	0	0.5
Y	5000	1

Normally, three types of project risks are studied for each project idea. They are stand alone risk, corporate risk, and systematic risk.

Stand Alone Risk

Stand alone risk refers to the risk a project faces when it is considered in isolation.

Corporate Risk

This refers to the risk a firm faces because of a project.

Systematic Risk

This risk is caused by the existing market situation. This risk is also called market risk.

4.9.1 Techniques of Risk Analysis

Firms follow different techniques to protect their projects from risks. Some of the techniques used by firms are Sensitivity Analysis, Scenario Analysis, etc.

Sensitivity Analysis

This technique is used to find out how sensitive the results of a particular financial model are to changes in input variables. For example, the net present value of a project depends on several factors like selling price of the product, annual sales, project life period, income tax etc. Sensitivity analysis aims at examining how net present value changes with changes in the above factors. To carry out this analysis, the project manager establishes a relationship between the net present value and factors that affect the net present value. Then he studies the range of net present values with variations in each of the factors affecting it. By understanding the affect of several factors, the project manager estimates the possibility of achieving the project objectives.

Scenario Analysis

In sensitivity analysis, we can study the changes in the NPV with changes in one of the variables. But most of the time in real life projects, two or more variables change at the same time and the changes may be interrelated. In such situations, scenario analysis is used. If the variables are interrelated, then it is helpful to look at some plausible market scenarios or market conditions where each scenario represents a consistent combination of variables. This type of analysis is called scenario analysis.

In scenario analysis, different scenarios are generated and the desirability of the project is studied in each scenario. The objective of such scenario analysis is to get a feel of what happens under the most favorable or the most adverse combination of key variables, without bothering much about the internal consistency of such combinations. Therefore, it is considered to be the most suitable technique for analyzing the fate of a project in different scenarios or market conditions.

Check Your Progress - 6

16. The risk that a project faces when it is considered in isolation is termed
    a. Systematic risk
    b. Stand alone risk
    c. Market risk
    d. Corporate risk
17. If you want to analyze the fate of a project under different market conditions, then the most appropriate analysis would be a
    a. sensitivity analysis.
    b. scenario analysis.
    c. Monte Carlo simulation.
    d. All of the above
18. Sensitivity analysis
    a. is one of the tools of technical appraisal.
    b. examines the impact of change in the net present value with changes in one of the project variables.
    c. studies the impact of changes in multiple variables at a time on the internal rate of return.
    d. involves imitating the behavior of some situation or process by using a similar situation in order to study the characteristics of the variables in the situation.

4.10 Social Cost Benefit Analysis (SCBA)

Since projects affect society, they should also be studied from the point of view of society. So the project manager has to analyze the social and economic benefits generated by the project and also the social costs of the project.

Social costs refer to the harmful effects of a project to society like air pollution, water pollution, soil erosion, deforestation, production of harmful products, etc.

Social benefit refers to the positive impact of a project on society like increase in employment opportunities, rise in per capita income etc. The objective of a Social Cost Benefit Analysis is to assess the positive and negative effects of a project on society. The project manager finally chooses the project that is socially beneficial.

4.10.1 Indicators of Social Desirability of a Project

There are several evaluation methods for testing the social desirability of a project. Some of the important indicators of the social desirability of a project are discussed below.

Employment Opportunities

Unemployment is a major problem in developing countries like India. So, a project with high employment potential is desirable. Since there is surplus labor in these countries, labor intensive projects would generate more employment opportunities.

Foreign Exchange Benefits

Countries that are experiencing a foreign exchange crunch give preference to projects that earn foreign exchange. An import substitution project that saves the country's foreign exchange is thus a desirable project.

Output per Unit of Capital

In countries where there is a dearth of capital, a project that gives a higher output per unit of capital employed is preferred.

Value Addition Criterion

The 'Value addition' of a project refers to the difference between the market price of a project's output and the costs/price of the goods and services bought from other firms for carrying out the project. According to this approach, the value added per unit of capital is ascertained so that the project that gives higher value can be chosen.

Cost Benefit Ratio

The social costs and social benefits associated with a project are calculated and the project that provides more benefits than costs is selected and implemented. Here, costs and benefits are ascertained based on the shadow prices. The shadow price is the real price that would have prevailed had there been no imperfections in the market. Then these costs and benefits are discounted to the present value of social costs and benefits and the ratio of benefits to the costs gives the cost benefit ratio. Following Exhibit 4.1 shows the social benefits of HMR Project.

Exhibit 4.1: Social Benefits of Hyderabad Metro Rail (HMR) Project

(A) Direct benefits

- With an estimated average time savings of 20 minutes and value of time saving is Rs 16 per hour, the average value of time savings was Rs 5.4 per rail trip.
- Consumer surplus due to better comfort in rail transport which was estimated at Rs 1.62 per rail trip per passenger.

(B) Indirect User Benefits

- Construction of RoWs would increase average speed from 25 to 45 kmph with average time saving of Rs 15.4 per minute per vehicle, annual benefits were about Rs 174 crores (that may increase with traffic growth).
- The transfer of 350 million or more passengers annually from buses, two wheelers, three wheelers and cars (currently used) to proposed rail will lead to significant reduction in road accidents to transferees and road users.
- Based on the incidence of traffic accidents across various junctions (fatal, serious, and minor) and unit cost of them under each such accident category, the accident cost where estimated at Rs 764.98 crores.
- There would be net improvement in air quality after metro (in terms of reduction in CO, Nox, HC and PM), leading to savings in health damage costs.
- Health benefits were estimated at Rs 19.25 crores per annum.
- Estimated loss of 10 working days of close to 1 million of the population of the city with cost of Rs 19.25 per person affected.

Source: https://www.researchgate.net/publication/292919220_Economic_Analysis_of_Hyderabad_Metro_Rail_Project

4.10.2 UNIDO Approach

Social Cost Benefit Analysis is a useful tool for selecting a project. However, it is not easy to quantify the social costs and social benefits. The United Nations Industrial Development Organization (UNIDO) has therefore developed a method for measuring social costs and social benefits.

The method consists of five steps:

- Calculating financial profitability at market prices
- Calculating net benefits at economic prices
- Adjustment for project's impact on savings and investment
- Adjustment for project's impact on income distribution
- Adjustment for impact of project on merit and demerits goods

4.10.3 Calculation of Financial Profitability at Market Prices

In this step, the project manager assesses the net profitability of the project on the basis of the market prices of all inputs and outputs. The profit is obtained by subtracting the expenditure incurred from the firm's revenues. The project manager calculates the profitability of the project as the percentage of profit to the capital employed.

4.10.4 Calculation of Net Benefits at Economic Prices

In this step, the project manager measures the net benefits of the project in terms of economic prices (also called shadow prices). These are calculated on the basis of impact of the project on the national economy.

If the project's product has an impact on consumption, then the price that the consumer is willing to pay for the product becomes the shadow price of the product. If the impact is on production, shadow price is the cost of production. If the impact of the product is on international trade, then the shadow price is the foreign exchange value of the product. In the case of pure tradable goods, the shadow price of a good is the international price of the good since there exists no opportunity cost in the country. Taxation makes it difficult to calculate shadow prices.

4.10.5 Adjustment for Project's Impact on Savings and Investment

In this step, the project manager estimates the impact of the project on the savings of different social groups like the customers, government and other private businesses.

The impact on savings is measured as: $\sum \Delta_i MPS_i$

Where, Δ_i is the net income change because of the project and MPS_i is the marginal propensity to save. The marginal propensity to save is the fraction of each extra rupee of income that goes to saving.

Example: Marginal Propensity to Save

Assume three groups were affected by the project and their net income gains were;

Group 1: Rs. 10,000;

Group 2: (Rs. 8,000); and

Group 3: Rs. 7,500

$MPS_1 = 0.03$, $MPS_2 = 0.15$ and $MPS_3 = 0.42$.

The impact of the project on the savings of these groups is:

$(10{,}000 \times 0.03) + (-8{,}000 \times 0.15) + (7{,}500 \times 0.42)$ = Rs. 2,250.

4.10.6 Adjustment for Project's Impact on Income Distribution

Projects that increase the income of weaker sections of society must be preferred. The project manager considers the elasticity of marginal utility of income to understand the redistribution of income. The elasticity of marginal utility of income is defined as the rate at which the marginal utility of income falls with an increase in income level.

Suppose the marginal utility of income decreases by 5% with a 5% increase in income, then the elasticity of marginal utility of income is 1. In other words, a gain of Rs. 10 to a person earning Rs. 1,000 a year is the same as a gain of Rs. 1,000 to a person earning Rs. 1,00,000 a year. So the project manager assigns weights to each income group on the basis of income levels. More weight is given to low income groups and less weight is assigned to high income groups.

4.10.7 Adjustment for Project's Social Value

In this step, the project manager considers the social and economic value of the project's goods. Goods are divided into merit goods and demerit goods on the basis of their social and economic value. Merit goods are those goods whose social value is more than their economic value. For example, petroleum products are merit goods as the production of petroleum products reduces the country's dependence on foreign supplies. Goods such as alcohol are, however, demerit goods as they produce negative effects on society.

The procedure for adjustment of social values is given below. Suppose the economic value of the project output is Rs. 20 million. And suppose that the social value of the project output exceeds its economic value by 20%. So, the adjustment factor is 0.2 (120 percent/ 100 percent -1). By multiplying the adjustment factor with the economic value of the project output, we obtain an adjustment of Rs. 4 million. The social value of the project will therefore be Rs. 20 million (economic value) plus Rs. 4 million, i.e. Rs. 24 million.

Check Your Progress - 7

19. Which of the following techniques assesses the positive and negative effects of a project on society?
    a. Scenario analysis
    b. Sensitivity analysis
    c. Social cost benefit analysis
    d. None of the above
20. Which of the following institutions has developed a method for measuring social costs and social benefits?
    a. Project Management Institute
    b. American National Standards Institute
    c. United Nations Industrial Development Organization
    d. Federation of Indian Chambers of Commerce and Industry

21. The United Nations Industrial Development Organization (UNIDO) has developed a method for measuring social costs and social benefits. Arrange the following steps into the sequence in which they should be carried out in that method.
    i. Adjust for impact of the project on merit and demerit goods
    ii. Adjust for the project's impact on savings and investment
    iii. Calculate financial profitability at market prices
    iv. Adjust for the project's impact on income distribution
    v. Calculate net benefits at economic prices
    a. iii-ii-v-i-iv
    b. iii-v-ii-iv-i
    c. iii-iv-v-i-ii
    d. iii-i-ii-v-iv
22. Profitability of the project is the
    a. sum of profit and capital employed.
    b. percentage of profit to the capital employed.
    c. percentage of capital employed to the profit.
    d. difference between profit and capital employed.
23. Which of the following options would be the **best** to use in order to understand the redistribution of income?
    a. Price elasticity of demand
    b. Income elasticity of demand
    c. Elasticity of marginal utility of income
    d. All of the above
24. Identify the statements that are **not correct** with regard to the elasticity of marginal utility of income.
    i. Elasticity of marginal utility of income is used to understand the redistribution of income.
    ii. Elasticity of marginal utility of income is the rate at which the marginal utility of income increases with an increase in income level.
    iii. The project's impact on income distribution is adjusted by assigning weights to each income group on the basis of income levels.
    iv. Weights are given based on the income levels, i.e., less weight is given to low income groups and more weight is assigned to high income groups.
    a. Only i and ii
    b. Only i and iii
    c. Only ii and iv
    d. Only iii and iv

25. Goods whose social value is more than their economic value are called
    a. merit goods.
    b. veblen goods.
    c. demerit goods.
    d. giffen goods.

Self-Assessment Exercises

12. The net income gains of Group P, Group Q, and Group R because of execution of a project are Rs. 10,000, Rs. 9,000, and Rs. 12,000. The marginal propensity to save (MPS) of P, Q, and R is 0.02, 0.12, and 0.03, respectively. Calculate the net impact of the project on th savings of the three groups.
13. The net income gains of Group X, Group Y, and Group Z because of execution of a project are Rs. 15,000, Rs. 12,000, and Rs. 17,000. The marginal propensity to save (MPS) of X and Y is 0.05 and 0.10, respectively. The net impact of the project on the savings of these three groups is Rs. 2,630. Calculate the MPS of Z.

4.11 Summary

- The primary objective of any project is to earn reasonable returns for the investment made.
- The project manager must examine the financial feasibility of projects when selecting a project for implementation.
- In this process, the project manager first estimates the total cost of the project and then identifies various means for financing the project.
- Share capital, term loans, debenture capital, deferred credit are some of the means for financing a project. Then the project manager identifies the working capital needs of the project and the means for financing the needs.
- The project manager uses two criteria to evaluate rate of returns of project investments: non-discounted criteria and discounted criteria.
- The time value of money is ignored in non-discounted criteria but is considered in the discounted criteria.
- The important methods in the non-discounted criteria are Average Rate of Return and Payback Period method.
- The time value of money is considered in the discounted criteria, and Net Present Value, Internal Rate of Return, and Profitability Index are important methods in this criteria.
- Sensitivity analysis and scenario analysis are used by the project manager to analyze the risks involved in each project investment.

- Also, the project manager studies each project proposal from the point of view of the society.
- Project managers use Social Cost Benefit Analysis to study a project's impact on the society. The United Nations Industrial Development Organization (UNIDO) has developed an approach, called UNIDO approach in this regard.

4.12 Glossary

Corporate risk: This refers to the risk a firm faces because of a project.

Cost of capital: The minimum rate of return the firm must earn on its investments in order to satisfy the various categories of investors who have made investments in the form of shares, debentures, term loans, etc. A firm's cost of capital is the weighted arithmetic average of the post-tax cost of the various sources of finance used by it.

Cost of debenture: The discount rate at which the present value of post-tax interest and principal repayments is equal to the net proceeds from the issue of debentures.

Cost of external equity capital: The rate of return that the company must earn on the net funds raised by it when it issues equity capital externally.

Cost of preference capital: The discount rate that equates the net proceeds from the preference capital issue to the payments associated with it like dividend payment and principal payments.

Deferred credit: The credit provided by the machinery and equipment suppliers is referred to as deferred credit.

Internal rate of return: The discount rate at which the present values of cash outflows and cash inflows are equal.

Net present value: The sum of the present values of all the cash inflows and cash outflows associated with the project.

Payback period: The time period during which a firm can recover the investments it has made in a project.

Profitability index: The ratio of future cash benefits to the initial outflows is called as profitability index. It is also called as benefit-cost ratio.

Project cost: The project cost is the sum of all the costs of the activities associated with the project.

Scenario analysis: In this case, different scenarios are generated and the desirability of the project is studied in each scenario. The objective of such scenario analysis is to get a feel of what happens under the most favorable or the most adverse combination of key variables, without bothering much about the internal consistency of such combinations.

Sensitivity analysis: This technique is used to find out how sensitive the results of a particular financial model are to changes in input variables.

Social benefit: It refers to the positive impact of a project on society, like increase in employment opportunities, rise in per capita income etc.

Social cost benefit analysis: It assesses the positive and negative effects of a project on society. According to this analysis, the project manager chooses the project that is socially beneficial.

Social cost: It refers to the harmful effects of a project to society like air pollution, water pollution, soil erosion, deforestation, production of harmful products, etc.

Standalone risk: It refers to the risk a project faces when it is considered in isolation.

Systematic risk: This risk arises from the existing market situation. This risk is also called market risk.

Weighted average cost of capital: The sum of weighted values obtained by multiplying the cost of each source of financing by its proportion in the capital structure.

4.13 Self-Assessment Exercises

1. To conduct a financial analysis, the project manager must collect information about all the costs pertaining to the project and the different ways of financing a project. Explain project cost. What are various means of financing a project? Explain in detail about the importance of working capital in projects.
2. The project manager considers the time value of money when evaluating the financial aspects of a project idea. Discuss in detail the concept of the time value of money, and its related concepts.
3. The project manager uses the discounting and non-discounting criteria to evaluate returns from project investments. Explain these criteria giving details of the acceptance-rejection criterion, their advantages and disadvantages.
4. Every project is exposed to a certain amount of risk and the extent of risk varies from project to project. Explain the various techniques used by a project manager to estimate the possible level of risk a project is likely to be exposed to.
5. As projects affect society, they should be studied from the point of view of society. The project manager has to analyze the social and economic benefits generated by the project and also the social costs of the project. In this context, discuss the concept of social cost benefit analysis.

4.14 Suggested Readings/Reference Material

1. Prasanna Chandra, “Projects,” McGraw Hill, Seventh Edition, 2017
2. James Wood, Kory Kogon, and Suzette Blakemore, Project Management for the Unofficial Project Manager: A FranklinCovey Title, Goodreads, 2018
3. Heagney, Fundamentals of Project Management Paperback, Amacom, September 2018

4. NA, Nagarajan, Project Management 8/ED, New Age International Publications,,2019

5. IES Master Team,,ESE 2020 - Basics of Project Management Paperback – 1 IES Master Publication, January 2019

4.15 Answers to Check Your Progress Questions

Following are the model answers to the Check Your Progress questions given in the Unit.

1. (b) Market analysis – Technical analysis – Financial analysis.

Once project ideas have been generated and screened, they are evaluated for marketability, technical feasibility, and cost factors. The project manager first conducts a market analysis; a technical analysis of the project idea then follows. Once the commercial and technical aspects of a project idea have been evaluated and approved, the project manager examines the financial feasibility of the project.

2. (c) Price elasticity of demand

To assess the financial feasibility of a project idea, the project manager must examine the capital costs, operating costs, and the revenues of the proposed project. Price elasticity of demand is part of conducting the demand analysis of a product and is used to forecast demand.

3. (d) i, ii, and iii

To assess the financial feasibility of a project idea, the project manager must examine the capital costs, operating costs, and revenues of the proposed project. To conduct a financial analysis, the project manager must collect information about all the costs pertaining to the project, different ways of financing the project, working capital requirements, profitability projections, and projected cash flows of the project.

4. (b) Equity capital

Share capital is of two types – equity capital and preference capital. Equity capital is the capital contributed by the owners of the firm. Equity holders enjoy the profits and bear the risks of the firm. Term loans are secured borrowings provided by financial institutions and commercial banks. These loans help firms take up expansion, modernization, and renovation projects. Deferred credit refers to the amount that a firm receives but has still not reported as income. The amount is actually a liability that is realized at a future date, when the goods or services are provided. In a project, the machinery and equipment suppliers may provide credit facilities to firms. This credit amount is repaid over a period of time depending on the value of

the machinery and the credit standing of the buyer. Generally, suppliers demand a bank guarantee which is equivalent to the value of the machinery. It is repaid over a period of time, depending on the value of the machinery and the credit standing of the buyer. Debentures are issued by firms to raise debt capital, normally for a period of 5 to 10 years. The debentures are secured against the assets of the issuing firm.

5. **(b) Debentures are secured against the liabilities of the issuing firm.**

   Debentures are issued by firms to raise debt capital, normally for a period of 5 to 10 years. The debentures are secured against the assets of the issuing firm. There are three types of debentures: non-convertible debentures, partially convertible debentures, and fully convertible debentures. A fixed interest is paid on non-convertible debentures. In the case of partially convertible debentures, only a part of them are converted into equity shares. Where fully convertible debentures are concerned, all the debentures are fully converted into equity shares as per pre-determined terms.

6. **(c) Deferred credit**

   Deferred credit refers to the amount that a firm receives but has still not reported as income. The amount is actually a liability that is realized at a future date, when the goods or services are provided. In a project, the machinery and equipment suppliers may provide credit facilities to firms. This credit amount is repaid over a period of time depending on the value of the machinery and the credit standing of the buyer. Generally, suppliers demand a bank guarantee which is equivalent to the value of the machinery. Share capital is of two types – equity capital and preference capital. Equity capital is the capital contributed by the owners of the firm. Equity holders enjoy the profits and bear the risks of the firm. Preference capital refers to the contribution that preference shareholders make by investing in a firm’s preference shares. Term loans are secured borrowings provided by financial institutions and commercial banks. These loans help firms take up expansion, modernization, and renovation projects.

7. **(d) i, ii, iii, and iv**

   The project manager should consider the following factors while estimating the working capital requirements of a project -- raw materials and components, work-in-process, stocks of finished goods, and operating expenses. Working capital is the capital required to carry out the day-to-day operations of the firm. Raw materials, components, operating expenses, etc., are the items that would need capital at various points of time. Therefore, the requirements of raw materials, components, etc., are found out in order to estimate the working capital requirements of the firm.

8. (d) i/r, ii/p, iii/r

The margin requirement varies with the type of current asset. The ranges within which margin requirements lie for various types of current assets are are: raw materials – 10-25%, work-in-process – 20-40%, finished goods – 30-50%, and debtors – 30-50%.

9. (c) FV = $PV\left[1+\frac{r}{m}\right]^{m\times n}$

The generalized formula for shorter compounding periods is

FV = $PV\left[1+\frac{r}{m}\right]^{m\times n}$

where,

FV = Future value n years hence

PV = Present value of cash flow

r = Interest rate per annum

m = Number of times interest is paid

n = Number of years

10. (a) FVA_n = $A\left[\frac{(1+r)^n-1}{r}\right]$

An annuity is a series of periodic cash flows (payments or receipts) of equal amounts. The future value of an annuity is calculated as:

$$FVA_n = \frac{A[(1+r)^n-1]}{r}$$

Where, A = Constant periodic flow

r = Interest rate per period

n = Duration of the annuity

11. (b) Cost of capital

Cost of capital is the minimum rate of return that a company must earn on its investments in order to satisfy the various categories of investors who have made investments in the form of shares, debentures, or term loans. The cost of capital of a company is the weighted arithmetic average of the cost of various sources of finance that have been used by it.

12. (b) Weighted average

The cost of capital of a company is the weighted arithmetic average of the cost of various sources of finance that have been used by it. Costs of equity, retained

earnings, preference capital, debentures, and term loans are first calculated and weights are attached to them in order to calculate the weighted average cost of capital.

13. (d) $K_S = \frac{D_0(1+g)}{P_0} + g$

According to the Dividend Capitalization approach, the intrinsic value of an equity stock is equal to the sum of the present values of the dividends associated with it. It can be written as follows:

$$K_s = \frac{D_1}{P_0} + g, \text{ where, } D_1 = D_0 (1 + g).$$

14. (b) Only i, iii, and iv

According to this approach, the cost of equity is reflected by the following equation,

$K_i = r_f + \beta_i (k_m - r_f)$

Where, K_i = Required rate of return on a security i

r_f = Risk free rate of return

k_m = Rate of return on market portfolio.

β_i = Beta of security i

Therefore, in order to calculate the rate of return on security 'i' according to the capital asset pricing model, we would need risk-free rate of return, beta of security i, and rate of return on market portfolio. The return on investment is not required in the capital asset pricing model.

15. (c) $K_S = \frac{K_e}{1-f}$

According to the dividend capitalization approach, the cost of external equity can be calculated as:

$$K_S = \frac{K_e}{1-f}$$

where,

K_s = cost of external equity

K_e = rate of return required by the equity investors.

f = floatation cost

Floatation costs are included in order to adjust for the issue expenses and in case the pricing of the share in an IPO is done at less than the market value.

16. (b) Stand alone risk

Stand alone risk refers to the risk a project faces when it is considered in isolation. Corporate risk refers to the risk a firm faces because of a project. Systematic risk is caused by the existing market situation. It is also called as market risk.

17. (b) Scenario analysis.

In scenario analysis, different scenarios are generated and the desirability of the project is studied in each scenario. Therefore, it is considered to be the most suitable technique for analyzing the fate of a project in different scenarios or market conditions.

18. (b) Examines the impact of change in the net present value with changes in one of the project variables.

Sensitivity analysis is used to find out how sensitive the results of a particular financial model are to changes in input variables. In sensitivity analysis, we can study the changes in the net present value with changes in one of the variables. By understanding the affect of several factors, the project manager estimates the possibility of achieving the project objectives.

19. (c) Social cost benefit analysis

Projects affect society. Therefore, they should be studied from the point of view of their impact on society. The project manager has to analyze the social and economic benefits generated by the project and also the social costs of the project. Social cost benefit analysis is a technique that assesses the positive and negative effects of the project on society. Scenario analysis is used if the variables that affect the project output are inter-related. This analysis identifies combinations of inputs that lead to a change in output values. Sensitivity analysis is used to find out how sensitive the results of a particular financial model are to changes in input variables.

20. (c) United Nations Industrial Development Organization

The United Nations Industrial Development Organization (UNIDO) has developed a method for measuring social costs and social benefits. As projects affect society, they should be studied from the point of view of their impact on society. The project manager has to analyze the social and economic benefits generated by the project and also the social costs of the project. Social cost benefit analysis is a technique that assesses the positive and negative effects of a project on society and is a useful tool in selecting a project.

21. (b) iii-v-ii-iv-i

UNIDO has developed a method for measuring social costs and social benefits. Following are the steps involved in the method: Calculate financial profitability at market prices, calculate net benefits at economic prices, adjust for the project's impact on savings and investment, adjust for the project's impact on income distribution, and adjust for impact of the project on merit and demerit goods.

22. (b) Percentage of profit to the capital employed.

The project manager assesses the net profitability of the project on the basis of the market prices of all inputs and outputs. The profit is obtained by subtracting the expenditure incurred from the firm's revenues. The project manager calculates the profitability of the project as the percentage of profit to the capital employed.

23. (c) Elasticity of marginal utility of income

The elasticity of marginal utility of income is defined as the rate at which the marginal utility of income falls with an increase in income level. The elasticity of marginal utility of income is used by the project manager to understand the redistribution of income. It is also used to adjust the impact of the project on the distribution of income.

24. (c) Only ii and iv

The project manager uses the elasticity of marginal utility of income to understand the redistribution of income. The elasticity of marginal utility of income is defined as the rate at which the marginal utility of income falls with an increase in the income level. More weight is given to low income groups and less weight is assigned to high income groups.

25. (a) Merit goods.

Merit goods are those goods whose social value is more than their economic value. For example, petroleum products are merit goods as producing them reduces the country's dependence on foreign supplies. Veblen goods are those goods whose demand is directly related to a change in the price. Giffen goods are inferior goods, and an increase in their price would make people buy more quantities of them.

Unit 5

Project Selection

Structure

5.1 Introduction

5.2 Objectives

5.3 Criteria for Project Selection Models

5.4 Project Selection Models

5.5 Analyzing the Uncertainty of a Project

5.6 Project Proposal

5.7 Summary

5.8 Glossary

5.9 Self-Assessment Exercises

5.10 Suggested Readings/Reference Material

5.11 Answers to Check Your Progress Questions

5.1 Introduction

In the previous unit, we have discussed the financial analysis of projects. In this unit, we shall discuss project selection. Project selection is a systematic process of choosing a project idea for implementation from the available alternative project ideas. The project manager attempts to decide which idea to choose, which technology to develop, and which methodology to follow in selecting a project. The project manager has to carefully prioritize all the available options and choose the best. A wrong choice of a project may result in ineffective use of resources and project failure.

As project clients and management teams become more sophisticated, the focus of a project organization is mainly on aspects such as how to choose the right projects and how to prioritize them. Ineffective project selection is the most common reason for the failure of many projects. It may result from ambiguity in the framing of objectives, absence of planning, and lack of team coordination. The project manager has to be very careful in selecting a project. He/she should consider the objectives and policies of the organization, the availability of resources, and the selection of the right team to take up the project.

This unit will discuss the criteria for project selection models. We will discuss the various project selection models and then move on to discuss the ways and techniques used to analyze the uncertainty of a project. Finally, we shall discuss project proposal.

5.2 Objectives

By the end of this unit, students should be able to:

- Identify the criteria for project selection models.
- Explain project selection models.
- Analyze the uncertainty of a project.
- Define project proposal.

5.3 Criteria for Project Selection Models

Management of change is essential for every firm to survive in the competitive environment. Earlier, firms took up a project as part of their strategy along with their actual operations. Today, organizations are specializing in getting and executing the projects. Every project is important for the firm and each project demands separate development and implementation strategies.

It is the duty of a project manager to choose those projects that guarantee returns in the near future. Proper project selection also determines the allocation of resources which is aimed at ensuring better returns. A rational decision making process is essential to choose the right project.

Souder, a well-known author in the area of project management describes the criteria to be used while choosing a project selection model. He suggests that the project selection model should fulfill the following characteristic – realism, capability, cost, flexibility, ease of use, and easy computerization.

5.3.1 Realism

The model considered for selection of a project should consider all the relevant factors that influence the decision of a project manager. The model should explicitly state the objectives of the project manager and the firm in selecting a particular project. It should also consider the risks (technical, cost, time and performance risks) that a project may encounter.

For example, consider a firm that has three projects in hand; Project 'A', Project 'B', and Project 'C'. Project 'A' is an innovative project that improves the image of the firm, but requires lot of capital investment. Project 'B' can gain competitive edge for the firm by strengthening the capabilities of its scientists and skilled labor. Project 'C' can increase the sales of the firm by adding new features to the existing product. The project selection model should be a common measurement system that is capable of comparing different projects. Then the best project can be selected based on firm's ability to execute the project successfully.

5.3.2 Capability

The selection model that the project manager considers should be capable of providing the optimum decision taking into consideration all the risks and

constraints involved in the project. The selection model should have the capability to evaluate future project proposals based on the expected returns of each project without subjectivity.

5.3.3 Costs

The various costs incurred in obtaining the right selection model should be kept at minimum. The costs associated with designing a selection model include data generation costs, data processing and storage costs. The objective here is to identify the best selection model and optimize the costs incurred to select the decision model based on the size of the project. Firms should also ensure that the project costs do not exceed the benefits of the project.

5.3.4 Flexibility

The selection model should provide the desired results within the given conditions and taking into account the firm's interests. The model should be easy to modify or should be capable of adjusting on its own to the changes in the firm's environment.

5.3.5 Ease of Use

The selection model should be convenient to implement and easy to communicate. The model should be tested as to how best it can be used by existing employees without further interpretation to take a decision.

5.3.6 Easy Computerization

The data should be computerized for easy storage and retrieval. Software packages like MS Excel, Lotus 1-2-3, Quatro Pro. work like Decision Support Systems, and assist the project manager in data analysis and decision making.

Activity: Galaxy Constructions Ltd. is involved in various projects like the construction of domestic dwellings, commercial complexes, larger apartments, entertainment parks, etc. As the company accepts all types of projects, its resources are being over stretched. To its surprise, the management has found that the company is incurring losses because of some of its projects. So the management of Galaxy Constructions Ltd. decided to be more cautious when selecting projects. What should be the characteristics of a good project selection model for Galaxy Constructions?

Answer:

Check Your Progress - 1

1. Match the following criteria for choosing a project selection model with their respective characteristics.
   i. Realism
   ii. Capability
   iii. Flexibility
   p. This criterion states that the model should be easy to modify or should be capable of adjusting on its own to changes in the firm's environment.
   q. This criterion states that the project selection model should consider the technical, cost, time, and performance risks that a project may encounter.
   r. This criterion states that the selection model that the project manager considers should be able to provide the optimum decision, taking into consideration all the risks and constraints involved in the project.
   a. i/p, ii/q, iii/r
   b. i/p, ii/r, iii/q
   c. i/q, ii/r, iii/p
   d. i/r, ii/p, iii/q
2. _____ is a systematic process of choosing a project idea for implementation from among the available alternatives.
   a. Project control
   b. Project selection
   c. Project screening
   d. Project risk analysis
3. From the following, identify the criterion that was **not** proposed by Souder to choose a project selection model.
   a. Cost
   b. Capability
   c. Rigidity
   d. Ease of use
4. Identify the costs that a firm might incur while designing a project selection model.
   i. Data generation costs
   ii. Data processing costs
   iii. Storage costs
   a. Only i and ii
   b. Only i and iii
   c. Only ii and iii
   d. i, ii, and iii

5. Ineffective project selection is the most common reason for the failure of many projects. This may be the outcome of
   i. ambiguity in the framing of objectives.
   ii. absence of planning.
   iii. lack of team coordination.
   a. Only i and ii
   b. Only i and iii
   c. Only ii and iii
   d. i, ii, and iii
6. Which of the following statements are **true** regarding a project selection model?
   i. The selection model should explicitly state the intentions of the project manager and the firm in selecting a particular project.
   ii. It should have the capability to evaluate future project proposals without subjectivity, based on the expected returns of each project.
   iii. The selection model should provide the desired results within the given conditions, taking into account the firm's interests.
   iv. It should be convenient to implement and easy to communicate.
   a. Only i, ii, and iii
   b. Only i, iii, and iv
   c. Only ii, iii, and iv
   d. i, ii, iii, and iv
7. Which of the following options should the project manager consider in order to select an effective project?
   i. Objectives and policies of the organization
   ii. Availability of resources
   iii. Number of new employees
   iv. Selection of the right team to take up the project
   a. Only i, ii, and iii
   b. Only i, ii, and iv
   c. Only i, iii, and iv
   d. Only ii, iii, and iv

5.4 Project Selection Models

Broadly, project selection models are of two types: *numeric* and *non-numeric*. Numeric models use numbers as inputs and non-numeric models use discussions, suggestions to select a project. The project manager uses either one model or a combination of the two models, to help him select the best model, although they

do not provide a complete decision. Even though the task of selecting a project is delegated to a specific person or team, the ultimate responsibility to choose a right project lies with project manager.

In order to construct a project selection model, the project manager generates a list of objectives. The list includes the goals and interests of the firm such as improving the brand image, generating employment for certain categories of workers, expanding the business etc. The list of objectives can also be refined by assigning specific weights to each objective. This prioritizes the firm's objectives and is useful in understanding the relationship between the project's expected results and organizational goals. With the availability of new technologies, the project manager can create a Decision Support System (DSS) for evaluating and selecting a project.

5.4.1 Non-numeric Models

These models use inputs other than numerical data to select a project. These models are constructed based on the subjective evaluation, ideas and opinions of the project manager and the project team. Although these models seem simple to use, they require the team to understand the practical use of these models.

Sacred Cow

In this model, the firms select projects that enjoy support of the higher officials. The project is considered 'sacred' as everyone in the firm tries to make the project a success. These projects do not face any resource constraints generally and they are persisted with, until a satisfactory product is delivered. Most of these projects are successful because of the ability and experience of the key executive who gave the project idea, and also because of the top management's interest in making the project a success. These projects are terminated only when the top management is convinced that the project is a failure.

Extension of Product Line

New projects are taken up as extensions to the existing product line, in order to fill the gaps between the market offer and customer needs. This type of project is treated as a part of the organization's strategy. Therefore, it is free from establishing a selection criterion. Firms take up projects to cater to the unfulfilled needs of the customer and to strengthen their product line.

Operating Necessity

Some projects are initiated in order to cater to the operating necessity of some other existing projects. For example, a special project like building a dike is necessary for operating a project that is facing a threat of inundation. Similarly, Election Commission of India initiates the project of issuing 'Identity Cards' to new voters before taking up the project of conducting elections throughout the country.

Competitive Necessity

The competition in the market forces the management to take up new projects. For example, the need for computerizing in an organization arose out of competitive necessity to provide better services to the customers and to survive in the market. Similarly, many business schools are restructuring their courses to stay afloat and gain competitive advantage.

Comparative Benefit

When an organization has many projects in hand, the top management chooses the most beneficial project. This is because of the comparative benefit that a project has relative to other projects. Firms initiate certain projects as an attempt to construct a portfolio that best fits the firm's objectives and its capacity.

Q-Sort Technique

Q- Sort technique is a useful evaluation and selection technique used to prepare a list of priority projects. According to this technique, a project manager first collects the various project ideas and then classifies them as good, fair and poor projects based on economic and technical feasibility, market potential, organizational urgency, level of complexity and risks involved, organizational needs and expected returns of the project. In the second step, the project manager further subdivides the projects arranges them in descending order (excellent to worst). The sorting process is continued till the project manager succeeds in identifying the best project.

The sorting of project ideas is carried out by the project manager or by a team of experts. When it is carried out by different individuals, there is a possibility of deviations in assigning the ranks to the projects. But the deviations will not be drastic as experts evaluate the projects considering the broad organizational objectives and requirements. After sorting the project ideas, the best project is sent for financial analysis before implementation.

Example: Q-Sort Technique

The following are the steps in Q-Sort technique:

- Collecting Ideas and Rating

  In this step, the project manager prepares the list of all projects that are chosen for selection. Each participant is given a deck of cards, with the name and description of the project written on them. Each participant is expected to rate the project ideas on the basis of the broad organizational objectives.

- Dividing Ideas

  Based on relative merit, the project ideas are divided into high level and low level piles, which may not be equal in size.

Contd….

- Creating a Medium Level Pile
- The participants are again instructed to divide the above cards from each pile into two groups, on the basis of relative merit. This creates a new medium level pile that consists of less valued ideas from high level pile and high valued ideas from the low level pile.
- Creating a Very High and Low Level Pile

  From the available high level pile, ideas are again classified into very high level and high level ideas. Similarly, the low level pile is divided into low level and very low level pile.
- Selecting

  The participants check the ideas once again to ensure the segregation of ideas is satisfactory. With the above procedure, the project manager can select an idea that is appreciated by most participants.

Activity: The Deans Council of a university got a number of project proposals from various departments requesting for grants. Madan Sarma, the vice-chancellor of the university, wanted to use a Q-sort technique to determine the project (s) to be taken up for the next academic year? Explain why Sarma preferred the Q-sort technique.

Answer:

Check Your Progress - 2

8. Which of the following is a useful evaluation and selection technique used for preparing a list of priority projects?
   a. Sacred cow
   b. Q-Sort technique
   c. Comparative benefit
   d. Competitive necessity
9. Which of the project selection models are constructed based on subjective evaluation, ideas, and opinions of the project manager and the project team?
   a. Numeric models
   b. Non-numeric models
   c. Profitability models
   d. Scoring models

10. Which of the following options is **not** a non-numeric project selection model?
    a. Q-Sort technique
    b. Profitability index
    c. Sacred cow
    d. Comparative benefit
11. In which of the project selection models do the firms select projects that enjoy the support of higher officials?
    a. Sacred cow
    b. Competitive necessity
    c. Q-Sort technique
    d. Comparative benefit

5.4.2 Numeric Models

Firms depend on numeric models heavily while selecting a project. Most firms consider the numeric models more useful than non-numeric models which are very subjective and unscientific. Broadly, numeric models are of two types -- profit/profitability models and scoring models.

Profit/ Profitability Models

The profit/ profitability models that are followed by the project manager are -- Payback Period, Average Rate of Return (ARR), Net Present Value (NPV), Internal rate of Return (IRR), and Profitability Index.

Payback Period: The payback period method is the simplest way of looking at one or more major project ideas. Payback period indicates how long the project takes to earn back the money spent on the project. The formula to find the payback period is: Cost of Project divided by Annual Cash Inflow from Project. If a project costs Rs.50,000 and expects to earn Rs.12,000 annually, then the payback period of the project would be 50,000 ÷ 12,000 = 4.16 years. The project manager selects the project with a lower payback period.

Average Rate of Return (ARR): The project manager selects the project that gives a reasonable rate of return for the investment made. The project manager considers the Average Rate of Return of the project before selecting it as it is a simple way of gauging the return on an investment.

The Average Rate of Return (ARR) is calculated using the following formula:

$$\frac{\text{Annual Cash Inflows - Depreciation}}{\text{Initial Investment}}$$

Here, depreciation is calculated as (using the straight-line method):

$$\frac{\text{Cost} - \text{Salvage Value}}{\text{Useful Life}}$$

For example, an equipment costing Rs.7,500 is expected to return Rs.2,000 per year for five years. After five years, the equipment can be sold at Rs.500.

Then the depreciation would be = (7,500 - 500) ÷ 5 = Rs.1,400 per annum.

Therefore, ARR = (2,000 – 1,400)/ 7,500 = 8%

Thus, ARR gives a quick estimate of the project's profitability and provides a basis for comparing several different projects.

Net Present Value (NPV): NPV is the net present value of all future cash flows from the project. It is a method that compares the value of a rupee today with the value of the rupee in the future. If the NPV of a project is positive, then the project can be accepted. If the NPV for a project is negative, then it should be rejected.

Internal rate of Return (IRR): Internal rate of return is defined as the rate that discounts all of the cash flows of an investment to zero. It is the discount rate which makes the NPV of a project zero. If the IRR of the project is greater than the minimum acceptable rate of return, then the project is considered for selection.

Profitability Index: Profitability index or cost-benefit ratio is the net present value of all cash flows to the initial investment outlay. If the profitability index is greater than one, then the project is profitable. If it is less than one, the project should be rejected.

Advantages of Profit/Profitability Numeric Models

- Non-discounted models like payback period, average rate of return methods are simple to understand and use.
- These models ensure standard and clear decision making.
- In all the above models, cash flows are calculated from readily available accounting information.

Disadvantages of Profit/Profitability Numeric Models

- Except risk, the models do not consider non-monetary factors.
- Non-discounted models like Payback Period and Average Rate of Return ignore the time value of money and the timing of cash flows.
- Models that reduce cash flows to their present value are applicable in short-run.
- All the models are sensitive to errors in the data input and it is also difficult to predict the behavior of these cash inflows in the nascent years of the project.
- Payback model does not consider the cash flows after the payback period. This model cannot work on projects where the returns are high in the long- run.

Check Your Progress - 3

12. The _____ can be defined as the ratio of the net present value of all cash flows to the initial investment outlay.
    a. payback period
    b. profitability index
    c. average rate of return
    d. internal rate of return
13. Which of the following statements is **not true** regarding payback period?
    i. The payback period method is the simplest way of looking at one or more major project ideas.
    ii. Payback period indicates how long the project takes to earn back the money spent on it.
    iii. Project managers select the projects that have a higher payback period.
    iv. The payback model considers the cash flows after the payback period, and therefore, can work on projects where the returns are high only in the long run.
    a. Only i and ii
    b. Only i and iii
    c. Only ii and iii
    d. Only iii and iv
14. _____ is a profitability method that indicates how long the project takes to earn back the money spent on it.
    a. Profitability index
    b. Payback period
    c. Internal rate of return
    d. Average rate of return
15. Projects that have a _____ payback period are selected.
    a. Lower
    b. Negative
    c. Higher
    d. Positive
16. Identify the correct formula to calculate the average rate of return.
    a. $\frac{\text{Annual cash inflows}}{\text{Initial investment}}$
    b. $\frac{\text{Cost of project}}{\text{Annual cash inflow from project}}$

c. $\frac{\text{Annual cash inflows} - \text{Depreciation}}{\text{Initial investment}}$

d. $\frac{\text{Annual cash inflow from project}}{\text{Cost of project}}$

17. Net present value, payback period, etc., are
    a. Numeric models
    b. Scoring models
    c. Profitability models
    d. Both (a) and (c)
18. Which of the following options is **not** an advantage of profitability models of project selection?
    a. Profitability models are simple to understand and use.
    b. Profitability models ensure clear decision making.
    c. In profitability models, cash flows are calculated from readily available accounting information.
    d. Profitability models are applicable only in the short-run.
19. Which of the following is a profitability model of project selection?
    a. Q-Sort technique
    b. Unweighted 0-1 factor model
    c. Average rate of return
    d. Sacred cow
20. A project will be selected if the profitability index of the project is
    a. less than 1.
    b. equal to 1.
    c. equal to zero.
    d. more than 1.
21. Which of the following is also called the cost-benefit ratio?
    a. Net present value
    b. Profitability index
    c. Average rate of return
    d. Internal rate of return
22. _____ is defined as the rate that discounts all the cash flows of an investment to zero.
    a. Profitability index
    b. Average rate of return
    c. Internal rate of return
    d. None of the above

23. A project will be accepted if the net present value of the project is
    a. lower.
    b. higher.
    c. negative.
    d. positive.
24. Identify the correct formula to calculate the payback period.
    a. $\frac{\text{Annual cash inflows}}{\text{Initial investment}}$
    b. $\frac{\text{Cost of project}}{\text{Annual cash inflow from project}}$
    c. $\frac{\text{Annual cash inflows} - \text{Depreciation}}{\text{Initial investment}}$
    d. $\frac{\text{Annual cash inflow from project}}{\text{Cost of project}}$

Self-Assessment Exercises

1. Project X requires an investment of Rs. 1,000,000. It expects to earn Rs. 200,000 per annum. Calculate the payback period of the project.
2. A machine costs Rs. 15,000 and is expected to return Rs. 5,000 per year for 5 years. Depreciation for the machine is Rs. 2,500 per year. Calculate the approximate average rate of return on this investment.
3. A machine costs Rs. 10,000 and is expected to return Rs. 3,000 per year for 3 years. After 3 years, the machine can be sold at Rs. 4,000. Calculate the average rate of return of the investment.

5.4.3 Scoring Models

As all the profitability models focus on a single decision criterion, the project manager uses scoring techniques that involve multiple criterion to select a project. In these models, decisions are arrived at by the discussions of the project team with the top management. Some of the scoring models are discussed below.

Unweighted 0-1 Factor Model

The management first lists factors that can normally be considered in rating a project for selection. Management constitutes a team of raters to select the project. The people involved in the team must be familiar with goals of the organization and the firm's potential project portfolio. The list of factors is given to the team of raters and the project is selected on the basis of the score given to each project idea. The evaluators rate every project idea, and the management selects the

project with the highest factor score. The advantage of using this technique is that it gives equal weightage to the opinions of all the raters and produces an explicit final result.

Unweighted Factor Scoring Model

The disadvantage of unweighted 0-1 Factor Model is that the raters are forced to choose either 'qualified' or 'not qualified' for a particular factor. The unweighted factor scoring model overcomes this limitation by constructing a simple linear measure of scale, normally a scale from 1 to 5. The rater can choose any values from 1 to 5, where 5 is very good, 4 is good, 3 is fair, 2 is poor and 1 is very poor. The management can also include a factor, the expected future profit from a particular project in the next 3 years. This makes the management aware of the extent to which a project can be selected or rejected.

Weighted Factor Scoring Model

The two models talked about earlier are based on the assumption that every factor that is included in the list of factors is equally important. But this assumption is not true, and often impracticable. Therefore, the management considers weighted factor scoring models where the factors are weighted as per their importance. Then scoring for each factor becomes the product of the factor weight and the factor. The sum of all the factor scores gives the project score. The above calculation is done by using the formula,

$$S = \sum_{t=0}^{n} F_i W_i$$

Where, S = Project score

F_i = Factor score of factor

W_i = Weight assigned to the factor's

n = number of factors

The Delphi technique or the brainstorming technique is used to assign weights to each factor. Normally, weights are associated in the range of 0 to 1. The management can also examine the degree to which the score of a project changes for a change in the level of resources allocated.

Advantages of Numeric Scoring Models

- Consideration of weights to each factor is the most objective oriented way of selecting a project.
- These models consider the interests of all the people involved in project selection.
- These models reveal the exact objectives and policies of the company.
- These models are logical and follow a simple methodology.

Disadvantages of Numeric Scoring Models

- These models assume that all the factors involved are linear and independent, which is not practically possible.
- Project scores provide only a relative measure, but they cannot exactly reflect the utility of the project.

Other Approaches

The project manager can use the 'Iterative rating method' as an alternative to scoring models. Here, the project manager ranks all the projects based on a set of predetermined attributes. The attributes that do not differentiate the project alternatives are ignored. The project that satisfies the most number of attributes is finally selected.

The model employed for selection of a project should be relevant, consistent and sufficient. Very few project managers use mathematical programming techniques for selection criterion and most projects are selected on the basis of convenience. Many people prefer weighted scoring model that consider the multiple objectives of the organization, are easy to modify in the changing environment and are not biased.

Check Your Progress - 4

25. Identify the project selection model in which the raters are forced to choose whether a particular project is either qualified or not qualified.
    a. The Q-Sort technique
    b. The unweighted 0-1 factor model
    c. The unweighted factor scoring model
    d. The weighted factor scoring model
26. Identify the project selection model that overcomes the limitation of the unweighted 0-1 factor model by constructing a simple linear measure of scale.
    a. The Q-Sort technique
    b. The unweighted 0-1 factor model
    c. The unweighted factor scoring model
    d. The ueighted factor scoring model
27. Identify the statements that hold **true** with regard to the iterative rating method.
    i. The project manager ranks all the projects based on a set of predetermined attributes.
    ii. The project that satisfies the most number of attributes is finally selected.
    iii. The iterative rating method is used as an alternative to the scoring models.

a. Only i and ii
b. Only i and iii
c. Only ii and iii
d. i, ii, and iii

28. Which of the following is **not** an advantage of numeric scoring models?
    a. These models are logical and follow a simple methodology.
    b. These models reveal the exact objectives and policies of the company.
    c. The project scores provide a relative measure and therefore, reflect the project's utility.
    d. These models consider the interests of all the people involved in project selection.
29. Identify the project selection model that makes use of the Delphi or brainstorming technique to assign weights to each factor.
    a. The unweighted 0-1 factor model
    b. The unweighted factor scoring model
    c. The weighted factor scoring model
    d. Both (a) and (b)
30. Which of the following is a scoring model of project selection?
    a. The Q-Sort technique
    b. The unweighted 0-1 factor model
    c. The sacred cow
    d. Average rate of return

5.5 Analyzing the Uncertainty of a Project

Although the firms try their best to come up with the best selection criterion, they rarely come out with a single best solution. This is because of the uncertainty and risk involved in carrying out the project. It is true that risk is inherent in every activity of the project and no project manager can predict the behavior and intensity of the risk. But the objective of the project manager is to reduce the impact of the risk on key aspects such as project cost and project schedule. The result of a project activity largely depends on: What the project manager does and how the business environment affects the project?

The conditions under which the decisions are made by the project manager can be classified into three categories: risk, uncertainty, and certainty. Under risk conditions, the project manager finds the chance of occurrence of different states of nature and payoff value of each state of nature. The expected value is calculated as sum of the product of payoff value and the chance of occurrence of the state of nature.

In case of uncertain conditions, the chance of occurrence of each state of nature is not known. No standard procedures are developed to make a decision under these circumstances. Therefore, the project manager assigns subjective probabilities to each state of nature to calculate the expected values of the projects. Thus the uncertain problem is converted into a risk. In certain conditions, the project manager assumes only a single state of nature (probability 1) and the expected project outcome becomes the expected value.

A majority of the decisions made in project management come under uncertain conditions and so the project manager assumes subjective probabilities for each state of nature to find the expected values of the projects. In case of R& D projects where little information is available, the uncertainties include uncertainties about timing and scheduling the project, uncertainty about the direct outcome of the project and uncertainty of side effects of the project.

The project manager therefore tries to reduce the uncertainty by preparing *proforma* documents that estimate the profit and loss of the projects. Techniques like risk assessment, simulation analysis and window-of-opportunity analysis provide useful information in dealing with uncertainty.

5.5.1 Risk Assessment

Risk assessment aims at measuring the level of uncertainty associated with the various parameters considered by decision-makers. Decision making becomes very difficult when risk is coupled with an amount of uncertainty. In such situations, the project manager carefully estimates the probability distributions for all the investments made to calculate the likely returns. The probability distribution for the expected rate of return is calculated by simulation technique.

5.5.2 Simulation Analysis

Simulation is a technique of imitating the behavior of some situation or process (whether economic, military, or mechanical) by means of a suitably analogous situation for the purpose of studying the characteristics of the variables in the situation. It is useful for solving a business problem where values of several variables are not known, or partly known. This technique coupled with sensitivity analysis gives better understanding of several project variables.

5.5.3 Window-of-Opportunity Analysis

A firm takes up a project to create a new process or a product only when it feels that there will be reasonable returns from the success of the project. In the initial stages of product development, a project manager is not too sure of returns the new product or process can bring into the firm. The only thing the project manager knows at this stage is that the product will be technically viable.

Conventionally, firms developed a product and then tested its conformity to the purpose of its creation. But this put high investments at stake as the economic viability of the new process or the product was not certain. Modern day project managers are inverting the conventional way of product development and are trying to find out the cost and performance specifications that should be achieved by the new product or process ideas before they are sent for R&D. So the project manager visualizes a window –of- opportunity for the innovation that would be the result of the project.

According to this analysis, the project manager analyzes the current production process in detail and notes down all the activities that would be improved by the added innovation. Depending on this baseline data relating to the current process and its performance, the project manager estimates the performance of the innovation as a fraction of the baseline system. This makes the process of project selection easier for the project manager.

Check Your Progress - 5

31. Identify the technique that involves imitating the behavior of some situation or process by using a similar situation in order to study the characteristics of the variables in the situation.
    a. Risk assessment
    b. Simulation analysis
    c. Window-of-opportunity analysis
    d. Delphi technique
32. The outcome of a project depends mostly on
    i. the way the project is being carried out by the project manager.
    ii. the recruitment policy of the organization.
    iii. the business environment that affects the project.
    a. Only i and ii
    b. Only i and iii
    c. Only ii and iii
    d. i, ii, and iii
33. The conditions under which decisions are made by the project manager are classified into three categories: risk, uncertainty, and certainty. Match these categories with their respective characteristics.
    i. Risk conditions
    ii. Uncertain conditions
    iii. Certain conditions
    p. The project manager assumes a single state of nature.
    q. The project manager finds out the chance of occurrence of different states of nature and the payoff value of each state of nature.

r. The chance of occurrence of each state of nature is not known and no standard procedures are developed to make a decision under these circumstances.

a. i/p, ii/q, iii/r

b. i/r, ii/p, iii/q

c. i/p, ii/r, iii/q

d. i/q, ii/r, iii/p

34. Under conditions of certainty, which of the following is **true** with regard to the expected value?

a. The expected value is calculated as the sum of the product of payoff value and the chance of occurrence of the state of nature.

b. Subjective probabilities are assigned to each state of nature in order to calculate the expected value of the project.

c. The expected project outcome becomes the expected value of the project.

d. None of the above

35. Identify the techniques that help in providing useful information in dealing with uncertainty.

i. Risk assessment

ii. Simulation analysis

iii. Black box

iv. Window-of-opportunity analysis

a. Only i, ii, and iv

b. Only i, iii, and iv

c. Only ii, iii, and iv

d. i, ii, iii, and iv

36. Which of the following techniques involves measuring the level of uncertainty associated with the various parameters considered by decision makers?

a. Attribute listing

b. Risk assessment

c. Simulation analysis

d. Window-of-opportunity analysis

37. Which of the following statements is **true** regarding window-of-opportunity analysis?

a. An analogous situation is used to imitate the behavior of some situation or process for studying the characteristics of the variables in the situation.

b. The project manager analyzes the current production process in detail and notes down all the activities that would be improved by the added innovation.

c. All the required and available inputs as well as the desired outputs are listed and it is checked whether these outputs can be produced with the available inputs.

d. This technique involves measuring the level of uncertainty associated with the various parameters considered by decision makers.

5.6 Project Proposal

Project proposal is the starting point for demonstrating the intention to initiate a project. In the case of government prokects, once a policy decision is taken to implement a project, usually a project proposal is sought from a competent agency. The Government of Telangana initiated such a project. Following Exhibit 5.1 illustrates the initiative for seeking a project proposal.

Exhibit 5.1: Proposal for the Regional Ring Road Project of Telangana

In a step towards development of the Regional Ring Road (RRR) in the State, the Central government has appointed K&J Projects to prepare a Detailed Project Report (DPR) of the project. As per the terms, the DPR is to be prepared within 10 months. It was included under Bharatmala Pariyojana Phase-I of the central government. The State government had agreed to bear 50 per cent of the land acquisition costs, besides providing government land for free as well as cost of shifting of utilities and other pre-construction activities. Once the DPR is completed, other aspects like subsequent appraisal and approval of project, the time of completion, cost and the mode of implementation will be decided.

Source: https://telanganatoday.com/centre-appoints-agency-to-prepare-dpr-for-rrr-project-in-telangana, 25th July 2021

Project proposal is the initial document that converts an idea or policy into details of a potential project, including the outcomes, outputs, major risks, costs, stakeholders and an estimate of the resourcing and time required. It is prepared after a careful evaluation of several projects and the factors influencing each project. A project proposal normally includes a summary statement, cover letter, justification section, the technical description of the proposed work, budget and key personnel involved in the project. Since the proposal is a letter aimed at convincing the authority to commence the project, it should be prepared carefully. Sometimes the management also asks the project manager to submit the project proposal in order to examine the viability of the project.

Preparation of an in-house project proposal does not require much attention as the document is prepared to send it to the top management of the firm. The document is produced only as formality and the top management normally accepts it. This is because the objectives, strategies, strengths, financial constraints of the organization were already taken care of while selecting the project. An in-house project proposal states the resource requirements of the project team. Once the

top management receives the proposal, it decides whether the project team should proceed with the project or not. Here, the objective of the project proposal is to mention the project requirements.

In the case of an outside agency, external sponsor or the government, the proposal should be properly documented. It is also the project manager's responsibility to check if the outside customer can pay for the project being proposed. During the 1980s, several European engineering companies initiated several projects in Iraq, but payments were not made because of the hostilities that broke out later. A proper project proposal plays a crucial role in getting the project approved.

The proposal document should be simple, precise and well-structured. Generally, it starts with an executive summary statement that describes the nature of the project being proposed, to the concerned authority. This statement should not be too technical to understand and it should describe scope of the project. The summary statement is followed by a cover letter, which acts as a key marketing document.

Before sending the proposal to the outside funder/agency, the following questions have to be answered.

- Which projects are to be chosen?
- How to organize the proposal documentation process?
- What strategy to be used in setting the bidding price?
- How much time and costs can be spent for preparing the proposal document?
- Every project proposal deals with four issues, namely:
- Technical nature of the project
- Plan of implementation
- Plan of administration and logistics
- Description of the group

5.6.1 Technical Nature of the Project

The major subsystems of the project and the organization's approach to each subsystem should be noted down for complex projects. The techniques to meet the special technical requirements of the client should be clearly stated in the project proposal.

5.6.2 Plan of Implementation

This part of the project proposal provides the estimates of the schedule, costs, materials used for each major subsystem. Costs and time are then aggregated to estimate the total cost and duration of the project. Gantt Charts, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT) are used to present the plan of implementation for each major subsystem. The major phases of the project and their estimated completion time are also provided to check the pace of implementation.

5.6.3 Plan of Administration and Logistics

The proposal provides a detailed description of how all the needed equipment, and routing facilities are arranged. It also describes the administration procedures of all the departments, the method of transportation of raw materials, performance measurement of subcontractors, conduction of internal and external audits, and quality checks. This section should also cover in detail how change orders are to be handled.

5.6.4 Description of the Group

A detailed list of the key project employees, their qualifications, their job descriptions and their experience is provided in the description of the group' section of the proposal. The proposal should convince the outside agency or the sponsor that the project team is capable of executing the project. In case of internal projects, the names and designations of all project members is enough.

Example: General Rules for Project Selection

No single technique is sufficient to select a project. Following are some useful rules to make better choices.

Rule 1: Be explicit about what is important in choosing projects

The process of selection should be based on well defined selection criteria. The project manager should not be distracted by what an organization can pursue – rather, he should focus on what the organization needs to pursue.

Rule 2: Identify explicit procedures and stick to them

The project manager should develop a clear cut approach to select a project and strictly adhere to it. The project manager should monitor the performance of the key members to ensure exact implementation of the decisions taken.

Rule 3: Be ready to challenge all assertions

The project manager should be prepared to face risks in any form they might arise. No activity results in profit unless there is an effort.

Rule 4: Constitute a good project selection team

An ideal team should be made up of individuals who represent the broad areas of project management like engineering, product development, finance and marketing.

Rule 5: Involve key project personnel in the selection of a project

Key project personnel should be involved while selecting a project, as they can better understand the rationale behind executing the project.

Adapted from J.Davidson Frame, "The New Project Management," Jossey-Bass publishers, San Francisco, p.191-192.

Activity: Mohan Manufacturers Ltd., manufactures machine tools that can be used in different equipment and machinery. Recently, the firm's management wanted to take up a plant expansion project to meet the growing demand for a variety of machine tools. Kishan Enterprises wanted to bid for this expansion project. The managing director of Kishan Enterprises, Kumar Chandani, asked Ranga Chary, a senior manager of the company, to prepare a project proposal to be sent to Mohan Manufacturers Ltd. What is a project proposal? How can Ranga Chary prepare it?

Answer:

Check Your Progress - 6

38. Which of the following issues are dealt with in any project proposal?
    i. The technical nature of the project
    ii. The plan of implementation
    iii. The plan of administration and logistics
    iv. A description of the project team
    a. Only i, ii, and iii
    b. Only i, iii, and iv
    c. Only ii, iii, and iv
    d. i, ii, iii, and iv
39. Which of the following options is the initial document that converts an idea or policy into details of a potential project, including the outcomes, outputs, major risks, costs, stakeholders, and an estimate of the resources and time required?
    a. Project plan
    b. Project status report
    c. Project proposal
    d. Project progress report
40. In the project proposal, which of the following sections discusses the conduct of internal and external audits and quality checks?
    a. Plan of implementation
    b. Plan of administration and logistics
    c. Technical nature of the project
    d. Both (b) and (c)

41. Identify the techniques that are used to prepare a plan of implementation for each major subsystem of the project.

    i. Gantt charts

    ii. Nominal group technique

    iii. Critical path method

    iv. Program evaluation and review technique

    a. Only i, ii, and iii

    b. Only i, iii, and iv

    c. Only ii, iii, and iv

    d. i, ii, iii, and iv

5.7 Summary

- Project selection is a systematic process of choosing a project idea for implementation from the available alternative project ideas. The project manager attempts to decide which idea to choose, which technology to develop, and which methodology to follow in selecting a project.
- Project selection models are broadly of two types: numeric and non-numeric.
- Numeric models use numbers as inputs and non-numeric models use discussions, suggestions to select a project.
- Non-numeric models use inputs other than numerical data to select a project. These models are constructed based on the subjective evaluation, ideas and opinions of the project manager and the project team.
- The project selection model should fulfill the following characteristic – realism, capability, cost, flexibility, ease of use, and easy computerization.
- The conditions under which the decisions are made by the project manager can be classified into three categories: risk, uncertainty, and certainty.
- A majority of the decisions made in project management come under uncertain conditions, and so the project manager assumes subjective probabilities for each state of nature to find the expected values of the projects.
- The project manager tries to reduce the uncertainty of a project by preparing proforma documents that estimate the profit and loss of the projects. Techniques like risk assessment, simulation analysis and window-of-opportunity analysis provide useful information in dealing with uncertainty.
- Project proposal is the initial document that converts an idea or policy into details of a potential project, including the outcomes, outputs, major risks, costs, stakeholders and an estimate of the resourcing and time required. It is prepared after a careful evaluation of several projects and the factors influencing each project.

5.8 Glossary

Average Rate of Return (or accounting rate of return): Method used to measure the relationship between the average annual profits earned by a project and the investments made in it.

Internal Rate of Return: The discount rate at which the present values of cash outflows and cash inflows are equal.

Net Present Value: It is the net present value of all future cash flows from the project. It is a method that compares the value of a rupee today with the value of the rupee in the future.

Non-numeric Selection Models: A project selection model that uses inputs other than the numerical data to select a project. The model uses discussions, suggestions to select a project.

Numeric Selection Model: A project selection model that uses numbers as inputs to select a project.

Payback Period: The time period during which a firm can recover the investments it has made in a project.

Profitability Index (or benefit-cost ratio): The ratio of future cash benefits to the initial outflows is called as profitability index.

Project Proposal: An initial document that converts an idea or policy into details of a potential project, including the outcomes, outputs, major risks, costs, stakeholders and an estimate of the resources and time required.

Project Selection: A systematic process of choosing a project idea for implementation from the available alternative project ideas.

Q-Sort Technique: A project evaluation and selection technique used to prepare a list of priority projects.

Simulation: It involves imitating the behavior of some situation or process by using a similar situation in order to study the characteristics of the variables in the situation. It can also be defined as the method of solving decision-making problems by designing, constructing, and operating a model of the real system.

5.9 Self-Assessment Exercises

1. The project manager should chose those projects that guarantee returns in the near future with the help of a proper project selection model. What are the characteristics that the project manager should look out for while choosing a project selection model?
2. The responsibility to choose a right project lies only with the project manager. So, the project manager studies various project selection models to choose the right project. What are the basic project selection models? Explain the significance of these models in choosing the project.

3. Though firms come up with the best selection criterion, they rarely come out with a single best solution due to the uncertainty and risk involved in carrying out the project. In what ways can the project manager deal with the uncertainty involved in a project?
7. The management may sometimes ask a project manager to submit a project proposal to examine the viability of the project. What is a project proposal? Explain the aspects that are covered in a project proposal.

5.10 Suggested Readings/Reference Material

1. Prasanna Chandra, "Projects," McGraw Hill, Seventh Edition, 2017
2. James Wood, Kory Kogon, and Suzette Blakemore, Project Management for the Unofficial Project Manager: A FranklinCovey Title, Goodreads, 2018
3. Heagney, Fundamentals of Project Management Paperback, Amacom, September 2018
4. NA, Nagarajan, Project Management 8/ED, New Age International Publications,,2019
5. IES Master Team,,ESE 2020 - Basics of Project Management Paperback – 1 IES Master Publication, January 2019
6. Coffee Table Book on Hyderabad Metro, L&T, 24 Novermber, 2017

5.11 Answers to Check Your Progress Questions

Following are the answers to the Check Your Progress questions given in the unit.

1. (c) i/q, ii/r, iii/p

The model considered for selection of a project should consider all the relevant factors that influence the decision of a project manager. It should also consider the risks (technical, cost, time and performance risks) that the project may encounter. The selection model that the project manager considers should be able to help in arriving at the optimum decision taking into consideration all the risks and constraints involved in the project. The model should be easy to modify or should be capable of adjusting on its own to changes in the firm's environment.

2. (b) Project selection

Project selection is a systematic process of choosing a project idea for implementation from among the available alternatives. The project manager has to be very careful in selecting the project. He/she should consider the objectives and policies of the organization, the availability of resources, and the selection of the right team to take up the project. Project control is the process of collecting information related to the performance of the project system, comparing it with the desired level of performance, and taking

corrective action to decrease the gap between the actual and the desired performance levels. Project risk analysis is the analysis of the probability of certain undesirable events happening, and their impact on achieving the project objectives. After the ideas have been collected, the project manager has to screen them. The objective of screening is to drop the poor ideas at the initial stages of new project development. It is a process of rejection rather than a process of selection. Screening helps in rejecting the ideas that cannot be considered for implementation.

3. (c) Rigidity

Souder described the criteria to be used while choosing a project selection model. He suggested that the project selection model should fulfill the following characteristics: realism, capability, minimum cost, flexibility, ease of use, and ease of computerization. The selection model should be flexible. It should be easy to modify or should be capable of adjusting on its own to the changes in the firm's environment.

4. (d) i, ii, and iii

The various costs incurred on obtaining the right selection model should be kept to a minimum. The costs associated with designing a selection model include data generation costs, data processing costs, and storage costs. The objective here is to identify the best selection model and optimize the costs incurred to select the decision model based on the size of the project. Firms should also ensure that the project costs do not exceed the revenues of the project.

5. (d) i, ii, and iii

Ineffective project selection is the most common reason for the failure of many projects. This may occur due to ambiguity in the framing of objectives, absence of planning, and a lack of team coordination. The project manager has to be very careful in selecting a project.

6. (d) i, ii, iii, and iv

Souder suggested that the project selection model should fulfill the following characteristics -- realism, capability, minimum cost, flexibility, ease of use, and ease of computerization. According to Souder, the selection model should explicitly state the intentions of the project manager and the firm in selecting a particular project; it should have the capability to evaluate future project proposals without subjectivity, based on the expected returns of each project; it should provide the desired results within the given conditions, taking into account the firm's interests; and it should be convenient to implement and easy to communicate.

7. (b) i, ii, and iv

The project manager has to be very careful in selecting a project. He/she should consider the objectives and policies of the organization, the availability of resources, and the selection of the right team to take up the project. While selecting a project, the project manager need not consider the number of new employees who have joined the organization.

8. (b) Q-Sort technique

The Q-Sort technique is a useful evaluation and selection technique for preparing a list of priority projects. A project manager collects the various project ideas and then classifies them as good, fair, or poor. The projects are then further subdivided and arranged in descending order (excellent to worst). The sorting process is continued till the project manager succeeds in identifying the best project. After sorting the project ideas, the best project is sent for financial analysis before implementation.

9. (b) Non-numeric models

Non-numeric models use inputs other than numerical data, like discussions and suggestions, to select a project. These models are constructed based on the subjective evaluation, ideas, and opinions of the project manager and the project team. Numeric models use numbers as inputs and non-numeric models use discussions and suggestions to select a project. Numeric models are broadly divided into two types, namely profit/profitability models and scoring models. Net present value, average rate of return, internal rate of return, etc., are profitability models. The unweighted 0-1 factor model, the unweighted factor scoring model, and the weighted factor scoring are scoring models.

10. (b) Profitability index

Non-numeric models use inputs other than numerical data to select a project. These models are constructed based on the subjective evaluation, ideas, and opinions of the project manager and the project team. The non-numeric models are sacred cow, extension of product line, operating necessity, competitive necessity, comparative benefit, and the Q-Sort technique. The Q-Sort technique is a useful evaluation and selection technique used to prepare a list of priority projects. In the sacred cow model, firms select projects that enjoy the support of higher officials. In the comparative benefit model, organizations have many projects in hand and the top management chooses the most beneficial one from among these.

11. (a) Sacred cow

In the sacred cow model, firms select the project that enjoys the support of higher officials. The project is selected because the suggestion came from the

top management of the firm and resources are provided in accordance with their interests. The project is considered 'sacred' as everyone in the firm tries to make the project a success.

12. (b) Profitability index

The profitability index or cost-benefit ratio is the net present value of all cash flows to the initial investment outlay. If the profitability index is greater than one, then the project is profitable. If it is less than one, the project should be rejected.

13. (d) Only iii and iv

Payback period indicates how long the project takes to earn back the money spent on it. Project managers select projects that have a lower payback period. The payback model does not consider the cash flows after the payback period. Therefore, this method cannot work on projects where the returns are high only in the long run.

14. (b) Payback period

The payback period method is the simplest way of looking at one or more major project ideas. Payback period indicates how long the project takes to earn back the money spent on it. Profitability index or cost-benefit ratio is the net present value of all cash flows to the initial investment outlay. Internal rate of return is defined as the rate that discounts all cash flows of an investment to zero. In average rate of return, the project manager selects the project that gives a reasonable rate of return for the investment made.

15. (a) Lower

The payback period method is the simplest way of looking at one or more major project ideas. Payback period indicates how long the project takes to earn back the money spent on it. Project managers select the projects that have a lower payback period.

16. (c) $\dfrac{\text{Annual cash inflows} - \text{Depreciation}}{\text{Initial investment}}$

The project manager selects the project that gives a reasonable rate of return for the investment made. The average rate of return method is simple to calculate as it uses readily available accounting information. A quick decision can be taken by comparing the average rate of return values of various projects.

$$\text{Average Rate of Return (ARR)} = \frac{\text{Annual Cash Inflows - Depreciaton}}{\text{Initial Investment}}$$

$$\text{Depreciation using the straight-line method} = \frac{\text{Cost} - \text{Salvage Value}}{\text{Useful Life}}$$

17. (d) Both (a) and (c)

Numeric models make use of numbers as inputs. Numeric models are broadly of two types --profit/profitability models and scoring models. The various profit/profitability models are payback period, average rate of return, net present value, internal rate of return, and profitability index.

18. (d) Profitability models are applicable in the short-run.

Profitability models reduce cash flows to their present value. These models are simple to understand and use, and ensure clear decision making. However, these models are applicable only in the short-run.

19. (c) Average rate of return

The profit/profitability models that a project manager follows are payback period, average rate of return, internal rate of return, net present value, and profitability index.

20. (d) More than 1.

The profitability index or cost-benefit ratio is the net present value of all cash flows to the initial investment outlay. If the profitability index is greater than one, then the project is profitable. If it is less than one, the project should be rejected.

21. (b) Profitability index

The profitability index or cost-benefit ratio is the net present value of all cash flows to the initial investment outlay. If the profitability index is greater than one, then the project is profitable. If it is less than one, the project should be rejected.

22. (c) Internal rate of return

Internal rate of return (IRR) is defined as the rate that discounts all the cash flows of an investment to zero. It is the discount rate which makes the NPV of a project zero. If the IRR of the project is greater than the minimum acceptable rate of return, then the project is considered for selection.

23. (d) Positive.

If the NPV of a project is positive, then the project can be accepted. If the NPV is negative, then the project should be rejected.

24. (b) $\frac{\text{Cost of project}}{\text{Annual cash inflow from project}}$

The payback period method is the simplest way of looking at one or more major project ideas. Payback period indicates how long the project takes to earn back the money spent on it. The formula to find the payback period is $\frac{\text{Cost of project}}{\text{Annual cash inflow from project}}$.

25. (b) The unweighted 0-1 factor model

In the unweighted 0-1 factor model, the management lists factors that are normally considered in rating a project for selection. The management then constitutes a team of raters who are familiar with the goals of the organization and the firm's potential project portfolio to select the project. The list of factors is given to the team of raters and the project is selected based on the score given to each project idea. The disadvantage with this method is that the raters can only rate a particular project as qualified or not qualified.

26. (b) The unweighted factor scoring model

The disadvantage with the unweighted 0-1 factor model is that the raters can only rate a particular factor as 'qualified' or 'not qualified'. The unweighted factor scoring model overcomes this drawback by constructing a simple linear measure of scale, normally a scale from 1 to 5. This scale enables the management to be aware of the degree to which a project qualifies or does not qualify.

27. (d) i, ii, and iii

The iterative rating method is used as an alternative to the scoring models. In this method, the project manager ranks all the projects based on a set of predetermined attributes. The attributes that do not differentiate among the project alternatives are ignored. The project that satisfies the most number of attributes is finally selected.

28. (c) The project scores provide a relative measure and therefore, reflect the project's utility.

Project scores provide only a relative measure. Such scores cannot exactly reflect the utility of the project. The other options are all advantages of numeric scoring models.

29. (c) The weighted factor scoring model

In the weighted factor scoring model, the factors are weighted as per their importance. Then scoring for each factor becomes the product of the factor weight and the factor. The sum of all the factor scores gives the project score. The Delphi or brainstorming technique is used to assign weights to each factor. Weights are usually associated in the range of 0 to 1.

30. (b) The unweighted 0-1 factor model

Scoring techniques involve multiple criteria to select a project. In this model, decisions are arrived at after discussions between the project team and the top management. Some of the scoring models are the unweighted 0-1 factor model, the unweighted factor scoring model, and the weighted factor scoring model. Q- Sort technique is a useful evaluation and selection technique used to prepare a list of priority projects. In the sacred cow model, firms select projects that enjoy the support of higher officials. In average rate of return,

the project manager selects the project that gives a reasonable rate of return for the investment made.

31. (b) Simulation analysis

Techniques like risk assessment, simulation analysis, and window-of-opportunity analysis provide useful information in dealing with uncertainty. Simulation involves imitating the behavior of some situation or process (whether economic, military, or mechanical) by means of a suitably analogous situation for the purpose of studying the characteristics of the variables in the situation. The Delphi technique is used to enhance the creativity of a group.

32. (b) Only i and iii

The result of a project activity depends largely on what the project manager does (the way the project is being carried out), and on how the business environment affects the project. It does not depend on the recruitment policy of the organization.

33. (d) i/q, ii/r, iii/p

Under risk conditions, the project manager finds out the chance of occurrence of various states of nature and the payoff value of each state of nature. Under uncertain conditions, the chance of occurrence of each state of nature is not known. No standard procedures are developed to take a decision under these circumstances. Under certain conditions, the project manager assumes only a single state of nature (probability 1) and the expected project outcome becomes the expected value.

34. (c) The expected project outcome becomes the expected value of the project.

Under conditions of certainty, the expected project outcome becomes the expected value of the project. Under conditions of risk, the expected value is calculated as the sum of the product of the payoff value and the chance of occurrence of the state of nature. Under conditions of uncertainty, subjective probabilities are assigned to each state of nature in order to calculate the expected value of the project.

35. (a) Only i, ii, and iv

Techniques like risk assessment, simulation analysis, and window-of-opportunity analysis provide useful information in dealing with uncertainty. Black box is a technique used to enhance the creativity of an individual. In the black box technique, all the required and available inputs as well as the desired outputs are listed. It is also checked whether these outputs can be produced by using the available inputs.

36. (b) Risk assessment

Techniques like risk assessment, simulation analysis, and window-of-opportunity analysis provide useful information in dealing with uncertainty. Risk assessment aims at measuring the level of uncertainty associated with the various parameters considered by the decision makers. Decision making becomes very difficult when risk is coupled with an amount of uncertainty. In such situations, the project manager carefully estimates the probability distributions for all the investments made to calculate the likely returns. The probability distribution for the expected rate of return is calculated by the simulation technique. Attribute listing is a technique used to enhance the creativity in an individual.

37. (b) The project manager analyzes the current production process in detail and notes down all the activities that would be improved by the added innovation.

According to the window-of-opportunity analysis, the project manager analyzes the current production process in detail and notes down all the activities that would be improved by the added innovation. Option 'a' discusses about simulation analysis; option 'c' discusses about black box, a technique used for enhancing individual creativity; and option 'd' discusses risk assessment.

38. (d) i, ii, iii, and iv

A project proposal is an initial document that converts an idea or policy into details of a potential project, including the outcomes, outputs, major risks, costs, stakeholders, and an estimate of the resources and time required. Every project proposal deals with four issues, namely the technical nature of the project, the plan of implementation, the plan of administration and logistics, and a description of the group.

39. (c) Project proposal

A project proposal is an initial document that converts an idea or policy into the details of a potential project, including the outcomes, outputs, major risks, costs, stakeholders, and an estimate of the resources and time required. A project plan is a formal, approved document used to manage and control project execution. A project status report is a report mentioning the status of achievements and deviations from the resources that are spent and the plans that are scheduled. A project progress report is a formal statement that gives a comparison between the accomplishments achieved as the project progresses and the project plan.

40. (b) Plan of administration and logistics

The plan of administration and logistics in the project proposal provides a detailed description of how all the needed equipment and routing facilities

are arranged. It also describes the administration procedures of all the departments, the method of transportation of raw materials, performance measurement of subcontractors, conduct of internal and external audits, and quality checks.

41. (b) Only i, iii, and iv

Gantt Charts, Critical Path Method (CPM), and Program Evaluation and Review Technique (PERT) are the techniques used to prepare a plan for implementation. Gantt charts display graphically the use of resources (machines, tanks, pipes, operators, products) over a period of time. CPM is used to predict the project duration by finding out which sequence of activities has the least amount of scheduling flexibility. PERT is used for planning and scheduling projects so that all the activities are completed in the shortest possible time. The nominal group technique is used to enhance creativity in groups.

Project & Operations Management

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