**BUSA2302**

**Business Management**

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**Midterm material ( 1-5) Ch**

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## Chapter 1: Overview of Project Management

- **What is the meaning of a project?**

*A **pr**oject is a f**u**lly **coo**rdinated **gr**oup **of int**erdependent **ta**sks that are c**omple**ted **by p**eople **usi**ng **re**sources a**nd** p**roc**ess**es**. P**roj**ects **ha**ve **def**inite **st**arting **a**nd **en**ding **d**ates **a**nd s**ucc**ess c**rite**ria.*

- **Full Coordinated Group & interdependent tasks:**

*This means that one task depends on another for its successful completion, and all the individual tasks must be done in the proper order for the project to be successfully completed.*

- **Resources** :*are simply assets that are needed to complete a project.*
- **Specifications**: *explain in detail how the project is supposed to turn out—what a successful project will look like.*

- **success criteria for projects are as follows:**
  - *Complete the project on time*
  - *Complete the project within budget*
  - *Complete the project according to specification*

- **the major responsibilities of project managers and describe what they do:**
  - *Initiating*
  - *Planning*
  - *Executing*
  - *Monitoring*
  - *Closing*

- **In other words, the40 plus processes recognized in the PMBOK Guide fall into five process groups and nine knowledge areas. These knowledge areas are as follows:**

  - ***Integration** management ( like charter, contract)*
  - ***Scope** management*
  - ***Time** management*
  - ***Cost** management*
  - ***Quality** management*
  - ***Human resource** management*
  - ***Communications** management*
  - ***Risk** management*
  - ***Procurement** management*

- **All projects require the following**:

(1) charter/scope/plan,(2) schedule, (3) resources, and (4) leadership.

- **external projects—***those originated by a customer*

- **For internal projects**—*those originated by an engineering and technology firm to end hance its competitiveness in some way***.**

- **Scope:** *The scope of a project is the entirety of all work that must be accomplished to complete the project.*

**Typical Outline for a Project Scope Statement**

- Project overview
- Deliverables
- Features and functions descriptions
- Acceptance criteria
- Restrictions/constraints
- Uncertainties

- ***Common constraints on engineering and technology projects*** *are time, cost/budget, personnel, material, equipment/technology, and quality expectations.*

- ***All the resources needed to complete a project on time, within budget, and according to specifications.***

- ***Leadership:*** *is the act of inspiring people to make a wholehearted commitment to the mission that brought them together*

- ***Project managers need to be skilled*** *at initiating, planning, executing, monitoring/controlling, and closing out projects as well as at building, leading, and motivating project teams.*

- ***Program*** → *A series of projects.*

- ***Objective:*** *Collection of tasks that must be completed to produce a deliverable*

- ***Deliverable:*** *The actual product or service developed and provided by the project team.*
- ***Duration:*** The time from beginning to end that is required to complete an activity.

- ***Constraint****: Any factor affects the project manager's ability to complete a project on time, within budget, and according to specifications*

- ***Goal***→ *The goal of a project is its* ***overall purpose****. The goal of an* ***ext****ernal project is defined by the* ***contract*** *the engineering and technology firm receives from the customer. The goal of an internal project is defined* by **the charter** given to the project manager by the firm's higher management team.

- ***Schedule:*** *A timetable for completing all activities, tasks, and objectives in a project.*

- ***Milestone****: A significant event or a specified point in the project.*

five distinct phases: initiation, planning, execution, monitoring/control, and closeout. People skills needed by project managers include team-building, leadership, motivation, communication, time management, change management, dealing with diversity, and leading teams during times of adversity.

| Proc Groups | Integration | Scope | Management | Management | Management | Management | Management | Management | Management |
|---|---|---|---|---|---|---|---|---|---|
| Initiating | • Project charter (Contract, drawings, and specifications) | – | – | – | – | – | • Identify stakeholders | – | – |
| Planning | • Project management plan | • Scope development<br>• Work breakdown structure development | • Estimate time and duration of activities<br>• Develop schedule | • Estimate costs<br>• Establish budget | • Plan quality | • Develop HR plan | • Develop communi-cation plan | • Identify and analyze risks<br>• Plan risk management | • Develop procurement plan |
| Executing | • Project execution | – | – | – | • Assure quality | • Establish build/lead project | • Communicate with all stakeholders regularly | – | • Procure needed resources |
| Monitoring/ Controlling | • Monitor, track progress, control<br>• Adjust as changes occur | • Control scope | • Control schedule | • Control costs | • Control quality | • Monitor team performance | • Report on progress and performance | • Monitor and control risks | • Manage the procurement process |
| Closing | • Close | – | – | – | – | – | – | – | • Close procurements |

**FIGURE 1.2** Phases and elements of the project management process.

- ***Resource:*** *A resource is any asset needed to complete a project on time, within budget, and according to specifications.*

- ***Processes:*** *The work of engineering and technology firms is completed by people using processes.*

## SUMMARY

A project is a fully coordinated group of interdependent tasks that are completed by people using resources and processes. Projects have definite starting and ending dates as well as success criteria. The broad success criteria for all projects are to complete them on time, within budget, and according to specifications. Project managers are needed in engineering and technology firms for the same reason conductors are needed in orchestras. Projects are composed of a number of separate but interdependent tasks all of which must be planned, scheduled, budgeted, staffed, and fully coordinated if they are going to be completed on time, within budget, and according to specifications. Project managers serve the same purpose as orchestra conductors in making this happen.

There are four main components of any project: scope, schedule, resources, and leadership. These four components are all interrelated and interdependent. Every project must have a project scope that summarizes everything that the members of the project team need to know to understand the project. An outline for a project scope contains the following elements: project overview, deliverables, features and functions, acceptance criteria, restrictions/constraints, and uncertainties.

The schedule for a project contains beginning and ending times for and the duration of all tasks that must be done to complete the project on time. Project resources include any and all assets necessary to complete the project on time, within budget, and according to specifications. Typical project resources are people, time, technology, facilities, and material. Internal projects are initiated by engineering and technology firms higher for the purpose of enhancing the firm's competitiveness. External projects are initiated by customers for the purpose of satisfying the need for a product or service.

Important terms and concepts in the language of project management include the following: project, program, goal, objective, deliverable, scope, task, activity, duration, constraint, schedule, resource, and processes. Every project has

## Chapter 2: Roles and Responsibilities of Project Managers

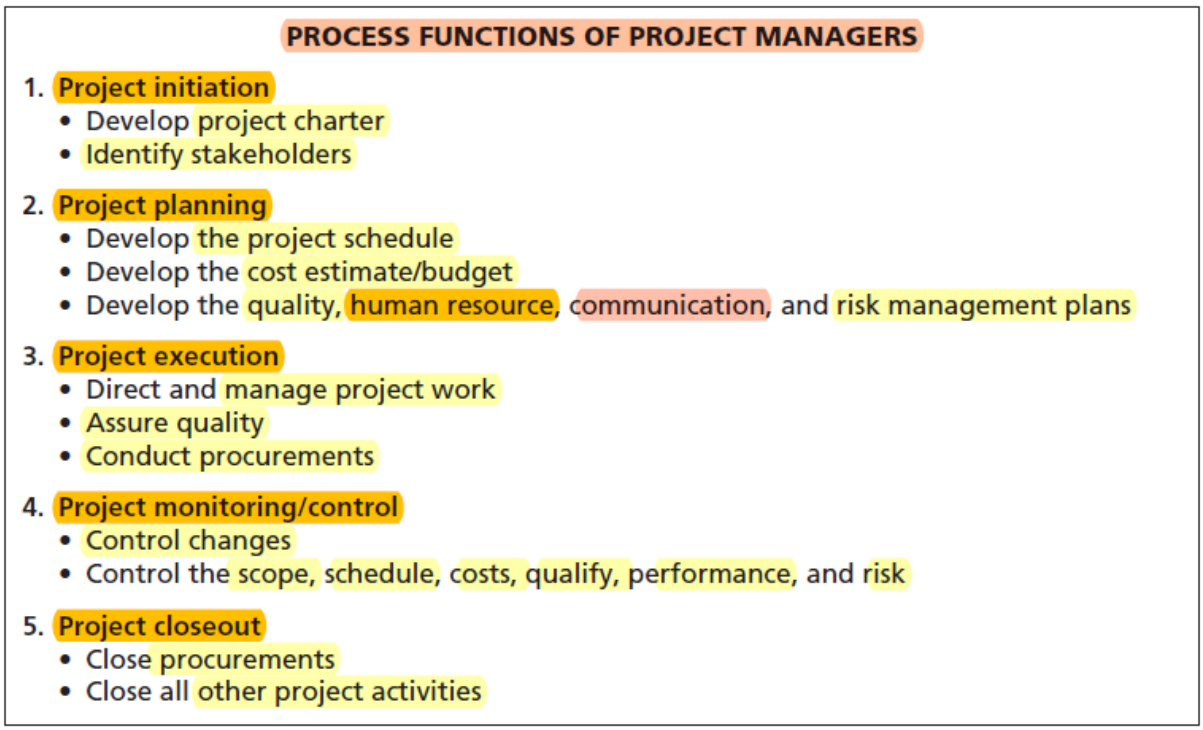
- ***The aim of this chapter is***: explains what a project manager does.
- ***Project managers must develop two important skills***:

- ***Process skills*** allow project managers to provide leadership in the initiation, planning, execution, monitoring/control, and closeout of projects.

- ***People skills*** allow project managers to mold disparate groups of individuals into effective project teams and lead them to peak performance in carrying out projects.

- **Process Function the project manger is responsible about:**





**PROCESS FUNCTIONS OF PROJECT MANAGERS**

1. **Project initiation**
   - Develop project charter
   - Identify stakeholders
2. **Project planning**
   - Develop the project schedule
   - Develop the cost estimate/budget
   - Develop the quality, human resource, communication, and risk management plans
3. **Project execution**
   - Direct and manage project work
   - Assure quality
   - Conduct procurements
4. **Project monitoring/control**
   - Control changes
   - Control the scope, schedule, costs, qualify, performance, and risk
5. **Project closeout**
   - Close procurements
   - Close all other project activities

**FIGURE 2.1** Project managers provide the leadership in carrying out these process functions.

- ***PROJECT CHARTER****. The project charter is a document that authorizes the project. It also summarizes the general requirements of the project. A project charter should contain at least the following information:*

  • ***Purpose*** *of the project.*
  • *Project* ***objectives*** *and* ***success criteria.***
  • ***General requirements.***
  • *General project* ***description*** *and* ***product/service characteristics.***
  • ***Summary*** *schedule showing project* ***milestones.***
  • *Project* ***approval requirements*** *(how success is defined and who decides)*
  • ***Project manager*** *(including responsibilities and authority)*
  • ***Name*** *and responsibility* ***of the individual(s)*** *authorizing the project*

- ***PROJECT STAKEHOLDERS:*** *Stakeholders are all individuals and/or organizations that have a stake (interest) in the project.*

- ***stakeholder register****: should contain the names and positions of all stakeholders as well as their interest in and expectations of the project.*

- ***SCOPE OF THE PROJECT****:* if it *was not developed as part of the initiation process for the project, it must be developed at planning part, and it must contain these things,*

- *(1)* ***project overview,***
- *(2)* ***deliverables,***
- *(3)* ***features and functions of the product or service to be provided,***
- *(4)* ***acceptance criteria including who has the authority to approve work as being acceptable,***
- *(5)* ***restrictions,***
- *(6)* ***uncertainties.***

- ***Work Down Structure (WDS):*** *this process—known as decomposition breaks the deliverables down into smaller components.*

- *It results in a group* ***of work packages*** *that* ***represent the activities and tasks*** *that must be accomplished to complete the project****. (The lowest level of activity in a work breakdown structure).***

- *Work packages become the* ***basis for estimating*** *the* ***duration and cost of the project****.*

- ***PROJECT SCHEDULE:*** *project managers must be able* ***to develop and interpret*** *Gantt charts and PERT charts,* ***identify critical*** *paths and dependencies in WBSs,* ***develop network*** *logic diagrams, and understand the types and amounts of resources that must be allocated to project activities*

- ***COST ESTIMATE AND BUDGET:*** *The first step toward arriving at a realistic budget is to accurately estimate the duration and cost of all the activities in the work breakdown structure.*

- **COMMUNICATION PLAN:** *Communication is critical to project managers.*

- *The most common risk factors associated with engineering and technology projects:*

**PROJECT RISK FACTORS**

**TECHNICAL FACTORS**
- Specifications that are difficult to comply with
- Technology requirements that are difficult to meet
- Quality expectations that might exceed current capabilities

**EXTERNAL FACTORS**
- Supplies that might be difficult to obtain
- Government regulations that are difficult to comply with
- Market forces that change quickly

**INTERNAL FACTORS**
- Priority the firm gives the project
- Availability of the necessary resources: human, financial, and technical
- Quality of project management (i.e., planning, executing, monitoring/controlling, and closing)

- **PEOPLE FUNCTIONS OF PROJECT MANAGERS:** applying people skills in ways that encourage peak performance from the members of project teams while also motivating them to improve continually.
- **Leadership function:** Project managers must be able to inspire.
- **Teambuilding function**: Effective project teams do not just happen. They must be built.

**These are the people functions for the project manager.**

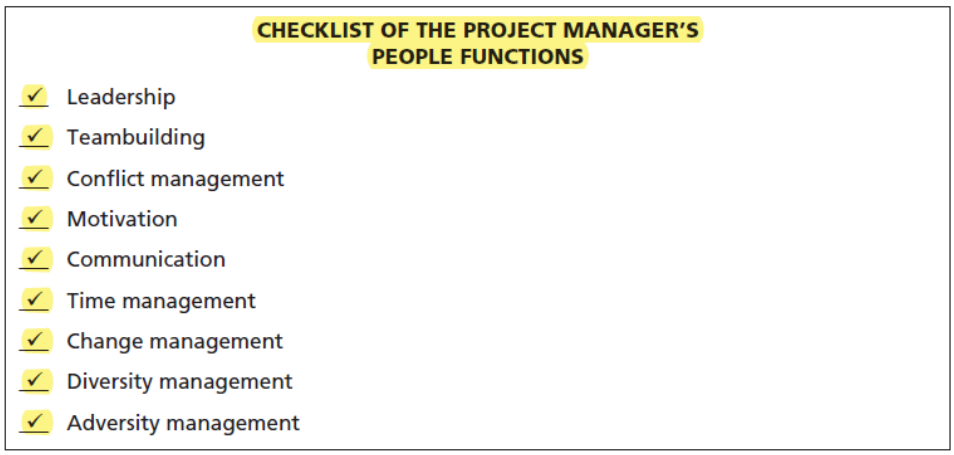



**FIGURE 2.5** People functions are half of a project manager's job.

- **CHARACTERISTICS OF AN <u>EFFECTIVE PROJECT MANAGER</u>:**

- *Strong process skills*
- *Strong people skills*
- *Intellectual curiosity*
- *Commitment*
- *Vision and insight*
- *People orientation*
- *Character*

***( added)***

- ***Focus on solution***
- ***Participative and decisive***
- ***Focus on the customer***
- ***Focus on win-win outcome***
- ***Lead by example***
- ***Get the best form the stakeholders***

- ***The three most common organizational structures.***

*1) FUNCTIONAL, 2) MATRIX, 3) AND PROJECT-BASED*

1) ***Function Structure:*** *The company is subdivided into four broad functional areas: engineering, manufacturing, sales/marketing, and accounting/finance. Each of these functional areas is led by a vice president who reports to the firm's chief executive officer.*

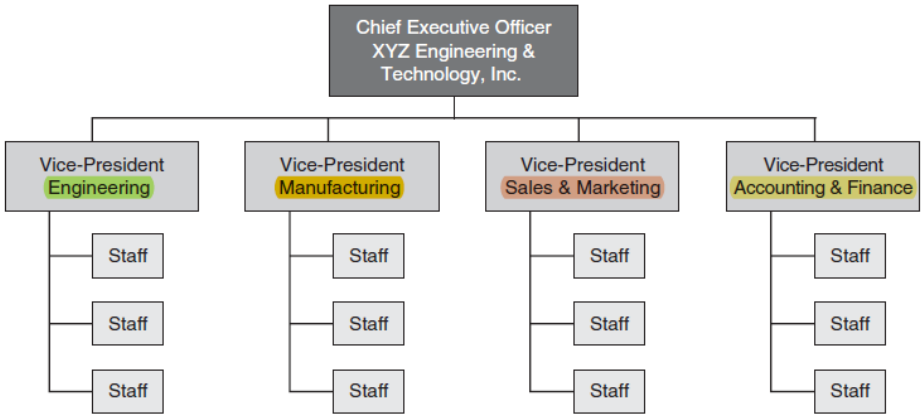



**FIGURE 2.6** Functionally structured firm.

*** ***<u>in organizations with the functional structure</u>****, project managers may be called upon to lead teams of personnel who report to other managers or supervisors. the project manager* ***might have*** *line authority over the members of the project team.*

- ***The matrix structure*** *is one in which people from* ***similar backgrounds****—engineering, manufacturing, sales/marketing, accounting/finance—are grouped into their own departments and report to a manager in that department.*

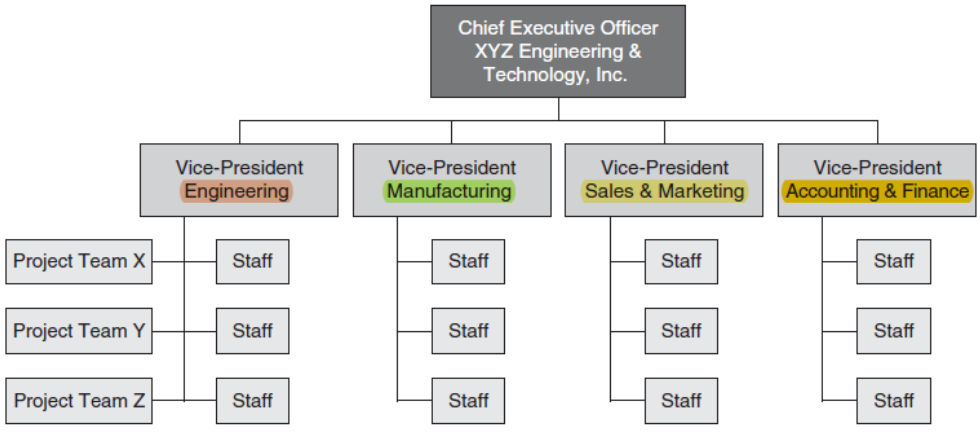



**FIGURE 2.7** Matrix structured firm.

- ***project managers*** *in matrix organizations* ***do not have line*** *authority over their team members. This means they must work cooperatively and collaboratively with the supervisors of their team members in motivating and leading project team members.*

- ***The Project – base Structure:*** *organizations will be* ***structured around project teams.***



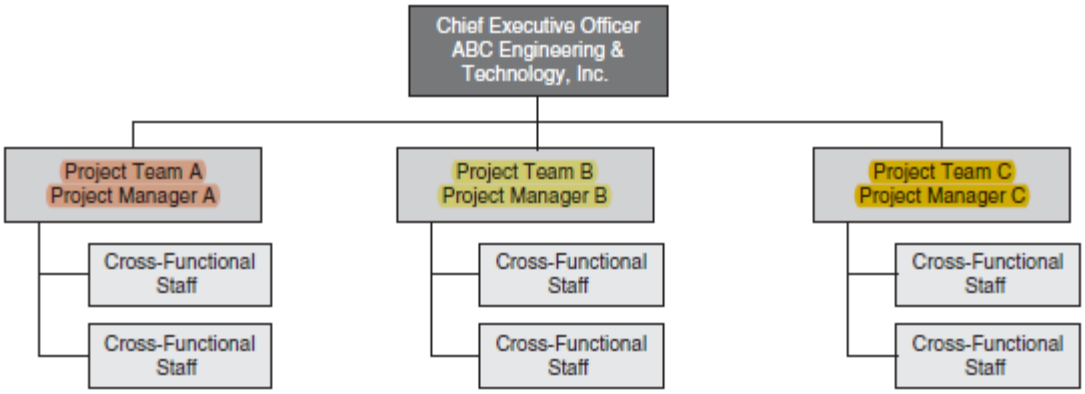



**FIGURE 2.8** Project structured firm.

- *project managers* ***have line authority*** *over their team member. In the project structure project* ***managers perform both traditional management*** *duties as well as those associated with project management.*

- **Advantages and Disadvantages of each organizational structured:**

- ***The matrix structure*** promotes cross-functional communication and cooperation but gives the project manager limited authority over team members.

- ***The project structure*** gives the project manager full authority over team members but creates internal competition for resources.

- ***The functional structure*** can replicate the advantages and disadvantages of both other structures depending on how the project teams are formed and staffed.

## SUMMARY

Project managers perform both process and people functions. Process functions fall into the following groups: initiating, planning, executing, monitoring and controlling, and closing out projects. People functions include leadership, teambuilding, motivation, communication, time management, change management, diversity management, and adversity management. To be an effective project manager an individual must have knowledge and skills in both process and people functions.

Project management can be a step up the career ladder toward higher management positions. A common career path for engineering and technology professionals is project manager, program manager, senior corporate executive, and chief executive officer.

Effective project managers have the following characteristics: advanced process skills, advanced people skills, intellectual curiosity, commitment, vision, insight, people orientation,



and character. In addition to these characteristics, Duncan Brodie of ProjectSmart adds the following: (1) focus on solutions, (2) participative and decisive, (3) focus on the customer, (4) focus on win-win outcomes, (5) lead by example, and (6) elicit the best from all stakeholders.[11]

Project managers may work in firms that have a functional, matrix, or project-oriented organizational structure. The functional structure is hierarchical. Functionally structured organizations are sometimes referred to as line organizations. In functional organizations, project managers may be called upon to lead teams that are staffed by personnel over whom they have direct line authority or teams that are cross-functional and draw their members from a number of different disciplines and/or departments. Project managers typically do not have line authority over cross-functional teams.

In a matrix organization, people of similar backgrounds are grouped together in their own departments—engineering, manufacturing, quality, sales/marketing—and supervised by the managers of their respective departments. Each department is considered a pool from which members are drawn as needed to staff project teams. Project managers in matrix organizations do not have line authority over their team members. Hence, they must be accomplished diplomats.

In organizations that adopt the project structure, everything revolves around project teams. Project managers in these types of organizational structures have complete line authority over their team members. The major challenge for project managers in project-oriented firms is competition between and among project teams for the resources needed to complete projects on time, within budget, and according to specifications.

Project management certifications are available from the Project Management Institute for individuals who meet the education and experience requirements. The various levels of certifications, candidate requirements, and examination information are available from the Project Management Institute at www.pmi.org.

## Chapter 3: Project Initiation

- **Project initiation** is the first phase of a project, The outcome of the project initiation phase is a comprehensive description of the purpose of the project.
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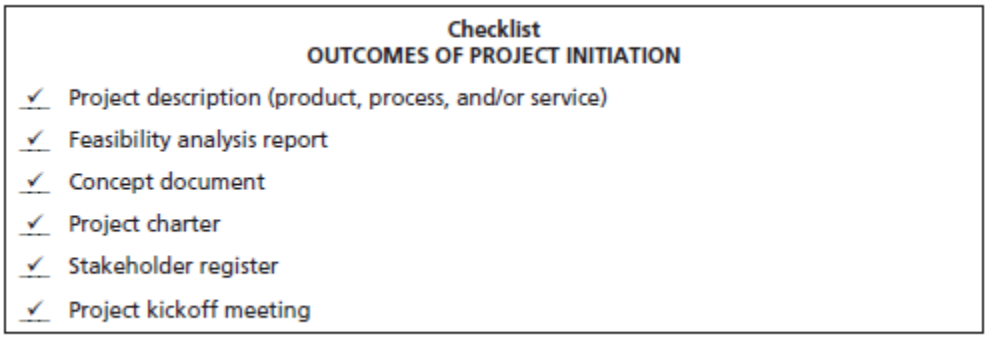



**FIGURE 3.2** Products/outcomes of the project initiation phase.

- **PROJECT DESCRIPTION**

The project description ***is a brief but comprehensive overview of the project***. The project description is a high-level description of the product, process, or service to be developed and provided by the engineering and technology firm.

- The description must contain these three points:
- **What** the project involves ( process, services … etc.)
- **Who** the project is for ? ( stakeholders like customers … )
- **Why** the project is important?

- **PROJECT FEASIBILITY ANALYSIS**

There are two sides to project feasibility, first side deals with **benefits and cost**, the other side deals with the **question of approach.**

- **This aspect of the project feasibility analysis proceeds in five steps as follows:**

• ***Analyze*** the problem the project is **supposed to solve** (business problem).
• Decide **what approach** is **best for solving the** business problem.
• ***Develop potential solutions*** to the business problem.
• Identify and **compare** the advantages and disadvantages of the **potential solutions.**
• **Make recommendations** concerning how best to proceed with the project

## PROJECT CONCEPT DOCUMENT

The project concept document is a comprehensive description of the **project in question.**

- ***Aim:*** this document will ***provide executive-level decision*** makers in the engineering and technology firm with ***sufficient information*** to make an ***informed decision concerning*** whether to **proceed** with the proposed project.

- **To develop the project document, 4 steps must be done :**
  1) Select the project Manger
  2) Select the members of the project team.
  3) Identify concept input partners.
  4) Identify the key stakeholders

## PROJECT CHARTER

At this point, because of the information contained in the project concept document, the engineering and technology firm's executive management team has decided **to move forward with the project**.

- **The project charter** is the first official document that says there is a project, and our firm is going to undertake it.

**Project Charter Format**

- General information
- Project overview (business problem and project objectives)
- Project scope, milestones, and deliverables
- Authority and responsibility
- Project organization
- Disaster recovery methodology
- Resources and funding
- Signatures

**General Information:**

- This section of the project charter contains **general information** including the **project title** and **contact information**.

**Project Overview**

- The project overview provides a **snapshot of the project** including the project **description developed earlier for the project concept document**, the **business problem** the project will solve, a **summary of feasibility information**, and the **objectives of the project**.

**Project Scope Statement**

- The scope of any project is the **totality of the work to be done** on the project.
- ***A well-written scope statement*** can **prevent disputes** between the engineering and technology firm and the customer concerning who is responsible for bearing the cost of change orders. If the work that is requested in a change order is part of the project scope, the engineering and technology firm is responsible for performing the work and bearing its cost. However, if a change order asks for work that is not part of the project scope, the customer is responsible for the cost.

- **well-written project scope statement will contain the following information**

• **Product/service description** lists **the characteristics of** the product(s) or service(s) to be produced or provided.

• **Acceptance criteria** lists **the criteria** for determining if the product produced or the service provided is acceptable to the customer.

• **Deliverables** lists **all products** and/or services to be delivered.

• **Exclusion** lists **all activities** that are excluded from the project—work the engineering and technology firm is not responsible for performing.

• **Constraints** lists **all factors** that must be complied with by the engineering and technology firm.

• **Assumptions** lists **all assumptions** the engineering and technology firm makes in agreeing to complete the project on time, within budget, and according to specifications.

**Milestones/Critical Success Factors:**

**To ensure** that these expectations are met, project milestones are established and deadlines for achieving the **milestones are established**. For example, it is common to set deadlines for 25, 50, 75, and 100 percent completion of the project. **These milestones represent specific success criteria for the project.**

**Disaster Recovery Methodology:**

- This element in the project charter **explains how the firm is prepared to recover from a major IT problem.**
- The disaster recovery element of the project charter **should describe how the firm is prepared to affect an IT disaster recovery.**

- **The following domains of concern should be included in this element:**
  • Servers
  • Storage
  • Software and automation
  • Networking and physical infrastructure
  • Skills needed to operate the other domains of concern

## STAKEHOLDER REGISTER

The stakeholder register is **a directory of all individuals who have a stake** in the project (directly involved, indirectly involved).

- **The overall purpose** of the stakeholder register *is* ***to help the project manager understand which relationships are most important to maintain for the benefit of the project*** and where he or she might need to exert more effort in terms of building and maintaining relationships.
- ***Influence*** is the ability to shape decisions, without exercising power ( like critical internal support)
- **Hidden Stakeholders:** stakeholders who have either power or influence over the outcome of the project that the project manager or the project team members may not be aware of.
- **Hidden Stakeholders →** can be identified by **asking known stakeholders** to identify others who might be able to affect the project in a positive or negative way

## PROJECT KICKOFF MEETING

The purpose of the project kickoff meeting is to **formally begin** the project. The project manager uses the kickoff meeting to **get all members of the team oriented** to the project so that they understand the project's big picture as well as their individual and respective roles in it.

- **The agenda for the kickoff meeting should contain at least the following items**
  • Welcome
  • Introductions
  • Distribution and discussion of the project charter
  • Discussion of stakeholders

## SUMMARY

The products/outcomes of the initiation phase of a project are a project description, feasibility analysis report, concept document, project charter with scope, stakeholder register, and the project kickoff meeting. The project description summarizes what the project involves, who the project is for, and why the project is important. The feasibility analysis should answer several questions: (1) Is the firm already operating at capacity? (2) Does the project fall within the firm's core competencies? (3) Is the potential return on investment sufficient? (4) Is the customer financially able to meet its contractual obligations?

The project concept document is a comprehensive summary of the project in question. Before developing the project concept document, engineering and technology firms should: (1) select the project manager, (2) select the members of the project team, (3) identify concept input partners, and (4) identify key stakeholders. The project concept document should contain the following information: overview of the project, purpose statement, goals and objectives, selected approach and strategies for implementing it, success factors, financial information and resource requirements, schedule information, and risk information.

The project charter is a more detailed document than the project concept document. It encompasses the information in the concept document and includes additional information. Regardless of the specific format used by a given firm, the following information should be included in a project charter: general information, project overview, assumptions, project scope, milestones, deliverables, authority and responsibility, project organization, roles and responsibilities of all stakeholders, disaster recovery methodology, resources and funding, signatures.

The project stakeholder register is a directory of all individuals who have a stake in the project. The registry contains information on all stakeholders who can be identified in the following manner: names, contact information, relationship to the project, and annotations concerning how each stakeholder might affect the team's ability to complete the project on time, within budget, and according to specifications. The project kickoff meeting should cover the following agenda items at a minimum: welcome, introductions, distribution and discussion of the project charter, discussion of the stakeholder, discussion of next steps, and questions/concerns from the team.

## Chapter 4: Project Planning (The Schedule)

- **Introduction:** Once a project has been initiated and the kickoff meeting completed, it is time to move into the next major phase: **planning and scheduling.**
- **What is the output of the planning phase?**

**1) WBS ( Work Breakdown Structure)**

- WBS is a visual representation of the project's deliverables broken down into more finite tasks and activities.

**2) Project schedule**

- shows the starting and ending dates and duration for the project as well as for all the tasks and activities in the WBS. shows project milestones and the critical path for the tasks and activities

**3) Project Management Plane**

is the compilation of the various subsidiary plans that are developed by the project manager and project team (e.g., schedule, cost management/budget, quality management, human resource, communications, procurement, and risk management plans).

- **The most important tool in making all the moving parts fit together properly and at the right time is a comprehensive, → *well-planned schedule.***

- There are several other formats that can be used for developing a WBS for a project. The more commonly used of **these other formats include the following**:

**1) Verb-oriented WBS**: This type of WBS format is ***action-oriented rather than deliverables- oriented.*** The WBS consists of the actions that must be completed to produce or provide each deliverable for the project.

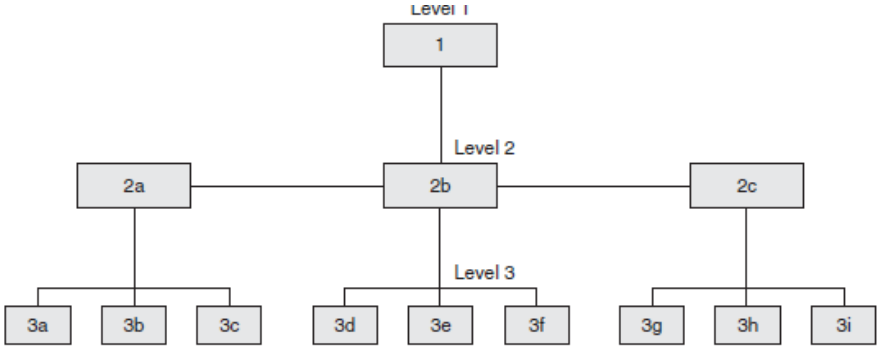



**FIGURE 4.2** Typical format for a deliverables-oriented WBS.

the first word in each element of the WBS **is an action verb** (e.g., plan, design, test, manufacture).

2) **Noun-oriented WBS:** ***This type of WBS is deliverables-oriented*** in which project work is defined in terms of the components that make up a deliverable. The first word in each element of the WBS **is a noun that names that component of a larger deliverable (e.g., Subassembly A, Component B, Part C).**

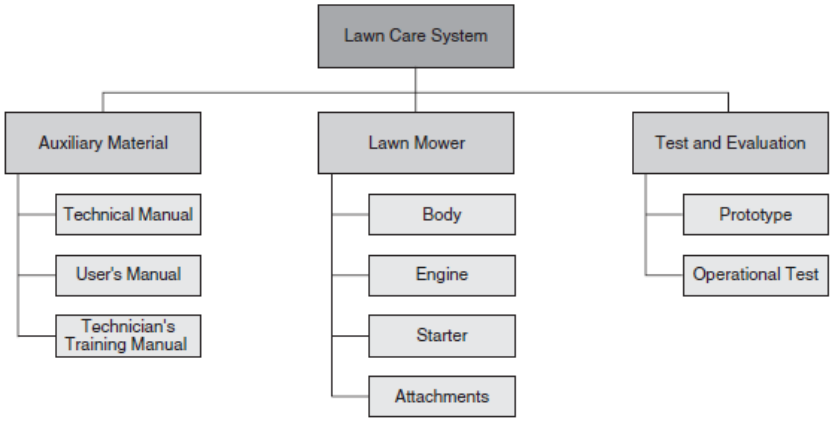



**FIGURE 4.3** WBS based on major deliverables for a project.

3) **Time-phased WBS:** This type of WBS breaks a project ***down into phases,*** it is used for projects that **are uncommonly long in duration**. The first phase of the project is planned **in detail to begin the project.**

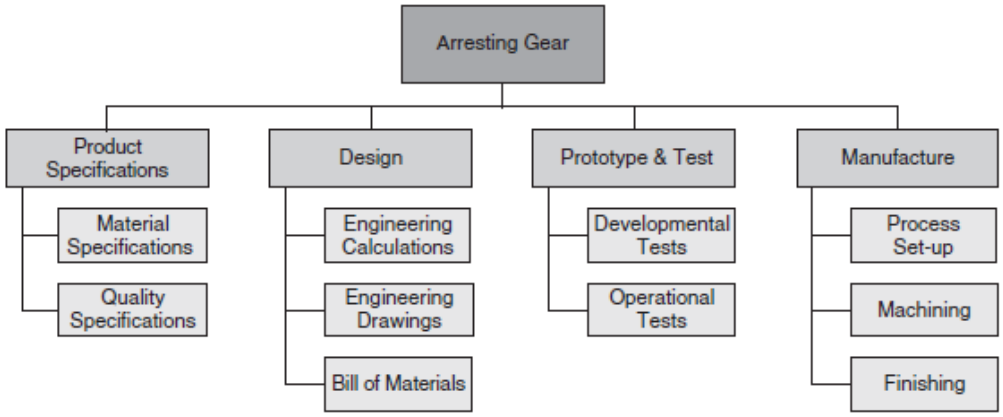



**FIGURE 4.4** WBS based on phases.

4) **Miscellaneous WBS formats** is not uncommon for a firm to develop two or more WBS formats to satisfy specific planning needs within the organization.

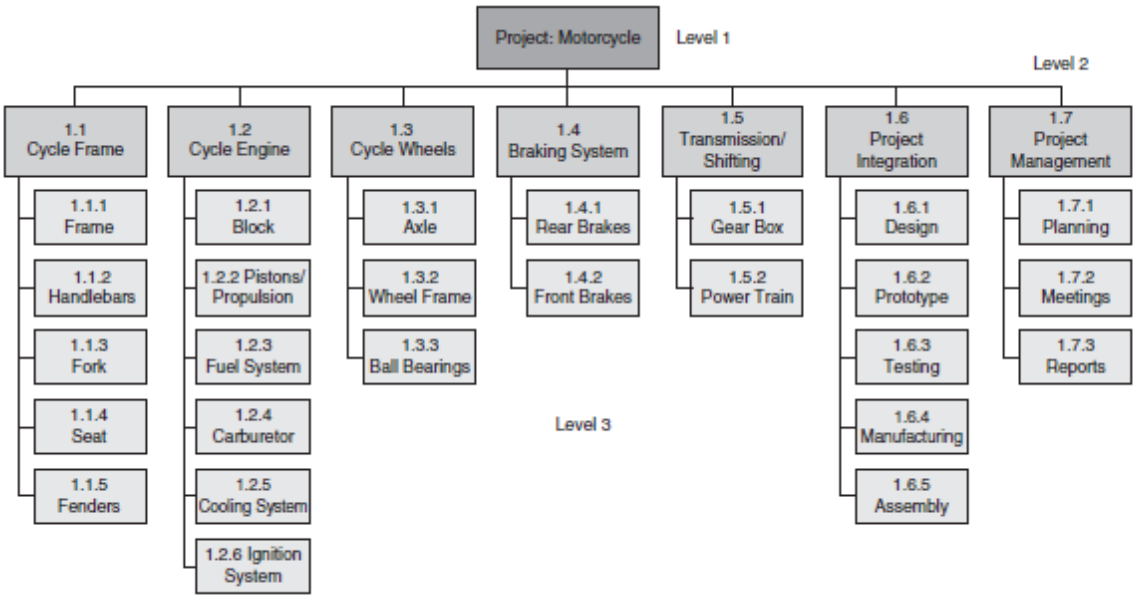



**FIGURE 4.5** WBS for producing a motorcycle with numbering.

**Critical Path:** The critical path is the longest path**.**

- **By totaling the durations of all activities along the critical path**, the overall duration of the project can be determined
- **Shorter paths** outside of the critical **path have extra time** known as **float.**

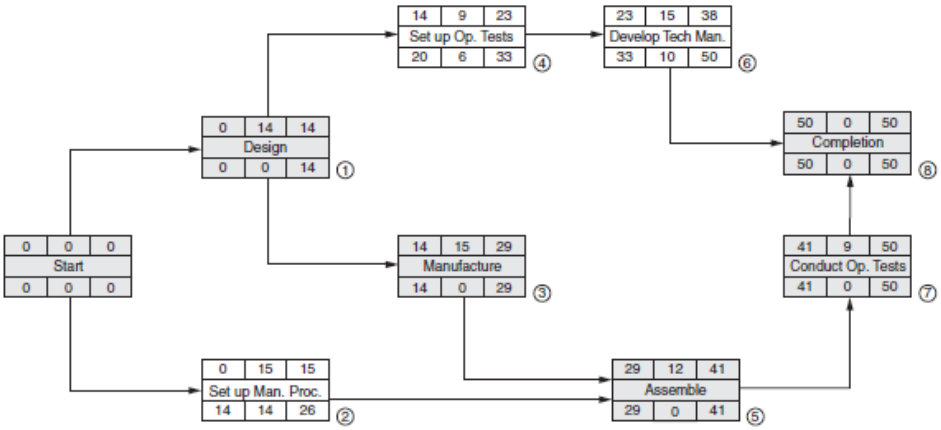
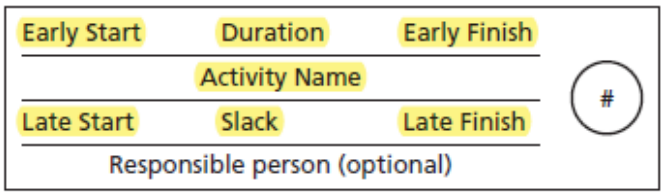


**FIGURE 4.11** Commonly used format for the activity box.




- **Rules:** 1) slack = total float = LF- EF OR LS-ES
  2) FT = ES (successor) – EF(present)
  3) Free float = ES - EF

## SUMMARY

The success criteria that apply to all projects cannot be met without thorough planning and careful scheduling. The principal output of the scheduling process is a comprehensive, detailed project schedule. Developing a well-planned schedule for an engineering and technology project can result in benefits in the critical areas of time, cost, and quality. Thus, project managers should be competent schedulers.

The scheduling process involves putting the WBS activities in sequence, computing/estimating and charting the duration of WBS activities, identifying milestones, developing the network diagram and determining the critical path, and transforming all of this information into a comprehensive schedule.

The goal for a project is a brief statement that summarizes why the project is being undertaken. Project manager uses the concept of deconstruction to break a project down into its various component parts and then identify all activities that must be performed for each component. The process is used to develop a WBS for the project. Different firms do this differently, but all should develop a WBS to use when developing the actual schedule for the project.

Sequencing involves putting the activities identified in the WBS in the order they will be completed on the job site. Once project activities have been identified and sequenced, their durations must be computed or estimated. In addition to computing activity durations on the basis of hard data, project managers can estimate them on the basis of expert judgment and relevant experience.

The bar chart is a simple and easy-to-understand tool for graphically displaying WBS activities and their respective durations. The bar chart shows all activities listed in sequence with starting and ending dates. A bar chart can also show which activities are interdependent and must be performed sequentially as well as which can be performed concurrently. The CPM network diagram is more complex than the bar chart schedule and can require both education and experience to master. The CPM network diagram offers several benefits: (1) shows how the project fits together, (2) identifies the project's critical activities, (3) gives project managers a basis for setting priorities, (4) makes it easier to see the consequences of change orders, and (5) allows the project manager to experiment with different work sequences to determine the optimum sequence. The principal disadvantage of the CPM network diagram is that becoming expert in using this method can take time.

Scheduling software has simplified somewhat the task of developing project schedules. Scheduling software such as Microsoft Project can produce a schedule that lists and numbers all tasks, displays continually updated progress percentages, the duration of each task, start and completion dates, milestones, summaries, external activities, internal activities, and other critical information about a project.

## Chapter 5: Project Planning (The Cost Estimate and Budget)

**Introduction:** it is important for the budget to **be both accurate and realistic**. Since the cost estimate is the key input for **developing a project's budget,** the budget should be more accurate and more focused than the estimate, especially on larger projects.

### THE COST ESTIMATE

- A cost estimate is an informed prediction made at a given point in time based on the information available at that time of what it will cost to complete a given job.
- **Padding is** *to purposefully estimate high when estimating the cost of the personnel, materials, and overhead for a project to make sure to complete the project within budget.*
- **The ideal estimate** *is one that predicts exactly what it will cost the engineering and technology firm to complete the project in question.*

### COSTS TO BE INCLUDED IN ESTIMATES

There are direct and indirect costs associated with engineering and technology projects,

- **Direct costs include those costs**, that are ***tied directly to the project*** in question such as the cost of personnel; materials that will be required; equipment that will have to be purchased.
- **Indirect costs fall into a broad category known as overhead**. Overhead costs ***are those associated with the everyday operation*** of a firm such as utilities and other bills that apply company-wide rather than to a given project.

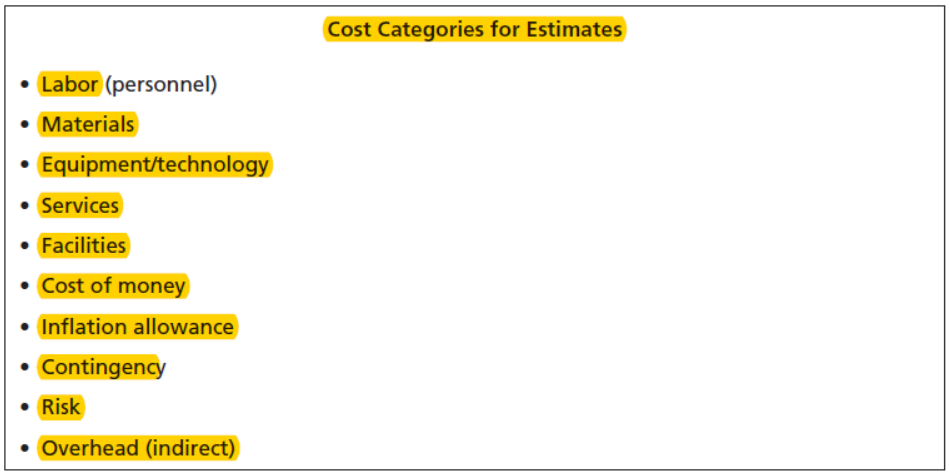



**FIGURE 5.1** Widely used cost categories for cost estimates.

**Administrative support/overhead and contingency costs** *are considered* ***indirect*** *while the other costs in the list are direct.*

- **It is common** practice to accommodate indirect costs by computing them as a predetermined percentage of the direct costs of the project

- When the firm is in difficult position of having to lower its bid price or forfeit the opportunity to win a contract, ***they chose to make its proposals and bids more competitive by leaving off indirect costs.***

- **Primary inputs for the cost estimating process:**

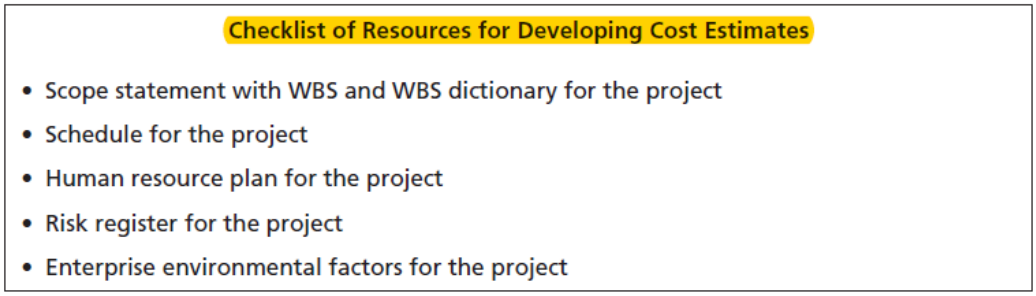



**FIGURE 5.2** Essential resources for the cost estimate.

**Scope Statement, Work Breakdown Structure, and WBS Dictionary:**

- Fundamental questions that must be answered when developing the cost estimate for a project are the following**: (1) How much work must be done?** and **(2) How many people with what types of expertise will it take to do the work?**

**Answering:**

place to start in answering these questions is **with the scope statement**, WBS, and WBS Dictionary. These tools provide a wealth of **information for the cost estimator**, including a description of the product to be produced or service to be provided and so many things.

**Schedule for the Project:** The schedule for the project will show all of the work that must be completed and the estimated duration of the work. This is invaluable information to cost estimators.

**Human Resource Plan for the Project** If the human resource plan has been completed by the time the estimate is developed, it provides invaluable information about the labor aspects of the cost estimate **(Uncommon)**

**Risk Register for the Project** The risk register can be a valuable tool for cost estimators because risk minimization strategies come with a cost

**Enterprise Environmental Factors for the Project** : Enterprise environmental factors include such things as **government regulations, industry** standards, process capabilities, process capacity, condition of the firm's project-support infrastructure, quality of human resources, marketplace conditions, and the political climate as well as other environmental factors that can **affect the cost of a project**.

**ESTIMATING METHODS:**

1) **Expert judgment**.

2) **Analogous estimating:** compares the various components of the current project with analogous components **of *previous similar projects.***

3) **Parametric estimating**: identifying all the cost components of a given project and then comparing them to historical data for the same or similar components ***using statistics.***

4) **Bottom-up estimating:** ***breaking the entire*** project down into work packages, estimating the cost of each package, and then summarizing the cost of each individual work package to determine the cost of the project.

5) **Three-point estimating:** establishing the following three different estimates: (1) most likely ***" most realistic"*** , (2) optimistic ***"best-case scenario"*** , and (3) pessimistic ***" worst-case"*** . Estimators may use any of the other methods to arrive at these three points.

6) **Reserve analysis**: **adding a** contingency to the overall estimate or separate contingencies to each component of the estimate.

7) **Vendor bid analysis:** used when the engineering and technology firm is serving as the prime contractor on a project and requesting bids from outside providers. Vendor bid analysis involves comparing the various bids received for specific components of the project.

8) **Estimating software:** Typical cost estimating software packages allow cost estimators to produce spreadsheets, use simulations, and apply a variety of helpful applications.

**ESTIMATING PRODUCTS:** result in two products:

1) **A cost estimation summary** → is a summary of the estimate for each component of the project: labor, materials, equipment, facilities, services, inflation, interest rate, contingencies, and administrative support.

2) **cost estimation notes** → provide detailed information documenting how the estimate was arrived at.

**COST ESTIMATION NOTES**

- Explanation of how the estimate was developed
- Explanation of all assumptions upon which the estimate or component elements were based
- Explanation of all constraints and how they affected the estimate
- Explanation of any room for error applied to the estimate (plus or minus a percentage)
- Explanation of the cost estimator's level of confidence in the finished estimate

## THE BUDGET

- ***BUDGET: the actual amount of money authorized for completing a project.***

- The cost estimate is developed based on the best information available at the time and used as the basis for responding to an RFP or RFQ. With small projects, ***the cost estimate often becomes the budget.***

- ***But with larger projects****, the budget is a more refined product than the cost estimate. It represents the actual amount of funds authorized for completing the project.*

- *One of the differences between the cost estimate and the budget* ***is that the estimate often contains contingencies (حالات الطوارئ)***

- *Some firms choose* ***not to budget the contingencies*** *but instead hold these funds in reserve to be* ***used only if necessary.***

## SUMMARY

Accurately estimating the cost of a project and then translating that estimate into a realistic budget are important planning activities for project managers. The extent of the project manager's involvement in developing an estimate and corresponding budget depends on a number of factors including the size and composition of the engineering and technology firm as well as timing. Preparing an accurate estimate is a matter of answering the following question: How much will it cost our firm to complete this project? An estimate that is too high will lessen the firm's chances of winning the contract. An estimate that is too low may cause the firm to lose money.

A cost estimate for an engineering and technology project is an informed prediction made at a given point in time based on the information known at the time of what it will cost to complete the project. *Padding* a cost estimate or building in contingency funds to cover unanticipated costs or estimating errors is common. However, too much padding can increase the size of the estimate to the point that the cost of the project is not feasible for the customer. An overly padded cost estimate is not likely to produce the lowest bid in a competitive bidding situation.

When developing a cost estimate, it is necessary to consider both direct and indirect costs. Direct costs are those that are tied directly to the project in question, including personnel, material, equipment, facilities, services, inflation, cost of money (interest), and contingency funds. Indirect costs consist of the firm's overhead and often are computed as a percentage of the overall cost estimate for a project.

Inputs for the cost-estimating process include the scope statement, schedule, human resource plan, risk register, and enterprise environmental factors. Cost estimation methods include expert judgment, analogous estimating, parametric estimating, bottom-up estimating, three-point estimating, reserve analysis, vendor bid analysis, and the use of estimating software.



Cost estimation products include a cost estimation summary and cost estimation notes.

The budget for an engineering and technology project represents the actual amount of money authorized for completing a project. The budget establishes the benchmark against which cost performance will be measured throughout the course of a project. One of the main differences between the cost estimate and the budget is that the estimate might contain contingencies while the budget typically does not. Some engineering and technology firms choose not to budget contingencies, but instead hold them in reserve to be used only if necessary. Outputs of the budgeting process are the budget summary and the cost performance baseline.

# Answer to Questions for all the Chapters:

## First Chapter:

1. **Define the term *project*.**

project can be defined as follows:

A project is a fully coordinated group of interdependent tasks that are completed by people using resources and processes. Projects have definite starting and ending dates and success criteria.

**2. What is meant by *fully coordinated interdependent tasks*?**

The extent to which a task requires interaction of the entire team.

This means that one task depends on another for its successful completion

**3. What are the three success criteria that apply to all projects?**

the success criteria for projects are as follows:

- Complete the project on time
- Complete the project within budget
- Complete the project according to specifications

**4. Explain why project managers are needed by engineering and technology firms.**

They know what to do." Cartwright's supervisor tried to explain that there would be more to the project than just making work assignments.

Regardless of whether they are cross-functional or composed of individuals from just one department, project teams, like an orchestra, need a conductor who can meld the members into one coherent, mutually supportive, well-coordinated team and keep them on task and on time. That conductor is the project manager. Without project managers who can step across departmental boundaries and transform a disparate group of people into a well-coordinated, mutually supportive team, an engineering and technology firm will tend to operate as a collection of disjointed, disconnected, autonomous departments Ensuring that a project is completed on time, within budget, and according to specifications is the job of the project manager. Without a conductor, orchestras are likely to make more noise than music. Without a project manager, project teams are likely to make more problems than progress.

**5. List and explain the main components of a project.**

(1) charter/scope/plan, (2) schedule, (3) resources, and (4) leadership

**6. Summarize the elements that should be contained in a project scope.**

**7. Distinguish between an internal and an external project.**

Projects that are initiated in this way are external projects because their source comes from outside of the firm. Projects can also be internally initiated. Internal projects are initiatives undertaken by engineering and technology firms to enhance their competitiveness.

**8. What is the difference between a program and a project**?

A project represents a single, focused endeavour. A program is a collection of projects

**9. *What is the difference between a goal and an objective in a project?***

Goals are the outcomes you intend to achieve, whereas objectives are the specific actions and measurable steps that you need to take to achieve a goal.

**10. *Give an example of a project deliverable for an engineering or technology firm.***

**11. *Give an example of a constraint that might affect a project in an engineering or technology firm.***

**12. *Explain the term* process**.

. A process is a series of standardized steps used over and over to produce a given result. A process is not an end result. Rather it is a series of events that lead to a predictable end result.

**13. *List the phases of a project and the corresponding processes associated with each of these phases.***

five distinct phases: initiation, planning, execution, monitoring/control, and closeout.

**14. *Think of an assignment you have had to complete in a college class. What were the success criteria your professor established for the project?***

**15. *List the people skills needed by project managers***

People skills needed by project managers include teambuilding, leadership, motivation, communication, time management, change management, dealing with diversity, and leading teams during times of adversity.

# Second Chapter:

**1. The project manager's process functions are initiation, planning, execution, monitoring/control, and closeout**.

**2. The overall function of a project manager with any project is to get the project done** on time, within budget, and according to specifications.

**3. Developing project charters,** identifying stakeholders, scheduling, cost estimating, budgeting, monitoring, developing plans (quality, HR, procurement, and risk management, and closing out.

**4. Strong process skills**, strong people skills, intellectual curiosity, commitment, vision/insight, people orientation, and character.

**5. The functional structure is hierarchical** (line organization). Project managers in such organization sometimes lead teams over which they have line authority and sometime lead cross-functional teams over which they do not have line authority. Project managers who do not have line authority have to be good diplomats.

**6. In a matrix organization, people of similar** backgrounds are grouped together in their departments—engineering, manufacturing, quality, etc.—and supervised by the managers of their departments. Each department is considered a pool from which members are drawn as needed to staff projects. Project managers do not have line authority over their team members. Once again, this requires project managers to be good diplomats.

**7. In organizations that adopt the project structure, everything revolves around projects. Project managers in this case have complete line aut**hority, but they have to compete with other project managers for the people and resources they need for their teams.

**8. Project management certifications are available from** the Project Management Institute (PMI). Each certification has its own education and experience requirements. The actual certifications are Project Management Professional, Certified Associate in Project Management, Program Management Professional, PMI Scheduling Professional, and PMI Risk Management Professional (all of which are registered trademarks of the Project Management Institute.

**9. Thirty-six months of experience in project management that encompasses 4,500 of project management work.**

# Third Chapter:

1. The outcomes of the initiation phase of a project are a project description, feasibility analysis report, concept document, project charter with scope, stakeholder register, and the project kick-off meeting.

2. Before developing the project concept document it is important to: 1) select the project manager, 2) select the team members, 3) identify concept input partners, and 4) identify key stakeholders.

3. The project concept document should contain: overview of the project, purpose statement, goals and objectives, selected approach and strategies for implementing it, success factors, financial information and resource requirements, schedule information, and risk information.

4. A project charter is a more detailed document than the concept document. It includes all of the information in the concept document and more.

5. The following information should be included in a project charter: general information, project overview, assumptions, project scope, milestones, deliverables, authority and responsibility, project organization, roles and responsibilities of all stakeholders, disaster recovery methodology, resources and funding, and signatures.

6. A project scope statement should contain a product/service description, acceptance criteria, deliverables, exclusions, constraints, and assumptions.

7. A milestone is a specific point in a project where a certain portion of the overall project has been completed.

8. Because the work of engineering and technology firms has become so dependent on IT systems, it is important to have a disaster recovery plan that describes how the firm will respond to a major IT problem. The domains of a disaster recovery plan are servers, storage, software and automation, networking and physical infrastructure, and skills needed to operate the other domains of concern.

9. Hidden stakeholders are people who can help or hinder a project who are not apparent or might be overlooked when identifying stakeholders.

10. The kick-off meeting is to get all team members fully knowledgeable concerning all applicable information about a project. The meeting gets the project started on the right foot. It includes the following agenda items at a minimum: welcome, introductions, distribution of the project charter, discussion of the stakeholder register, discussion of next steps, and questions/concerns from team members.

# Fourth Chapter:

## 1. What are the time and cost-related benefits of scheduling?

A well-planned schedule has the benefit of providing a yardstick for measuring progress on a project. There is a reason that yard lines are painted on a football field: They allow all stakeholders to know if progress is being made and, if so, how much. The best way to ensure that progress is being made is to measure it Another time and cost-related benefit of developing a schedule is that it encourages critical thinking A final time and cost-related benefit of a well-planned schedule is that it promotes more effective communication among the many stakeholders on a project.

## *2.* What are the quality-related benefits of scheduling?

A well-developed schedule promotes quality work. To do quality work, team members need time, resources, and support from the project manager and higher management. They also need the work that must be completed before their work can start to be completed on time and according to specifications. Ensuring that this happens requires a well-planned schedule. Without such schedule the work environment becomes disorganized and rushed. People cannot do their best work in an environment of hectic disorganization and rushed deadlines.

## *3.* What are the safety and environmental benefits of scheduling?

Just as quality goes down when work is disorganized, hectic, and rushed, safety and environmental concerns also become an issue. When team members are rushed unrealistically, they respond by taking shortcuts, cutting corners, and neglecting proper work practices. When this happens, safety and environmental concerns are put aside for the sake of making up time and getting the work completed by the deadline. One of the leading causes of accidents in the workplace is the neglect of approved safety and health procedures by individual employees who feel compelled to ignore them in order to complete the assigned work on time. Team members cannot help the team from a hospital bed. Consequently, project managers must be concerned about the safety ramifications of scheduling.

## *4.* List and briefly explain the steps in the planning and scheduling process for a project.

the process involves putting the WBS activities in sequence, computing/estimating and charting the duration of WBS activities, identifying milestones, developing the network diagram and determining the critical path, and transforming all of this information into a comprehensive schedule.

### *5.* What is a Work Breakdown Structure?

the concept of deconstruction to break the entire project down into its components parts and then identify all deliverables that must be produced or provided foreach component.

### *6.* Explain the concept of sequencing.

In sequencing activities, planners determine which activity must come first, second, third, and so on, as well as which can be accomplished simultaneously with others Sequencing involves putting the activities identified in the WBS in the order they will be completed on the job site. Once project activities have been identified and sequenced, their durations must be computed or estimated.

### *7.* Explain how a project manager can determine the duration of a project activity.

The duration of a work package must be estimated as accurately as possible. Estimating the duration of a work package involves answering the following question: *How many people working how many hours will be required to complete this work package?* Underestimating the duration of work packages will ensure that the project is not completed on time. Overestimating the duration of work packages will increase the project's budget and could price an engineering and technology firm's work too high which, in turn, will make it less competitive. Estimations should be informed by experience, records of the productivity of the firm's processes and people, the expert opinions of experienced personnel in the firm, and any other source of reliable information pertaining to the project in question. Some planners arrive at their duration estimates by averaging a best case and worse case estimate. The actual estimate for the work package in question then becomes this average. Others establish the most accurate estimate they can arrive at and then adjust it based on the enterprise environmental factors identified earlier in the planning process. For example, the quality of the workforce that will perform the work required in a given work package might lengthen or shorten the duration of that work package.

***8.*** **Describe the types of information project managers can include on a bar chart schedule.**

The bar chart is a simple and easy-to understand tool for graphically displaying Ablativities and their respective durations. The bar chart shows all activities listed in sequence with starting and ending dates. A bar chart can also show which activities are interdependent and must be performed sequentially as well as which can be performed concurrently. Bars then show the starting and finishing dates graphically as well as where activities overlap and can be accomplished simultaneously

***9.*** **What are the advantages or benefits of the CPM network diagram?**

The CPM network diagram offers several benefits: (1) shows how the project fits together, (2) identifies the project's critical activities, (3) gives project managers a basis for setting priorities, (4) makes it easier to see the consequences of change orders, and (5) allows the project manager to experiment with different work sequences to determine the optimum sequence

***10.*** **What is the major disadvantage of the CPM network diagram?**

The principal disadvantage of the CPM network diagram
is that becoming expert in using this method
can take time

***11.*** **What information is typically included on a CPM network diagram?**

- Activity number
- Activity duration in days
- Activity name
- Early start day or date
- Early finish day or date
- Late start day or date
- Late finish day or date
- Slack in days
- Name of the person responsible for the activity (optional)

# Fifth Chapter:

**1. *Define the term* cost estimate *as it relates to engineering and technology projects*.**

A cost estimate is an informed prediction made at a given point in time based on the information available at that time of what it will cost to complete a given job.

**2. *What is meant by* padding *a cost estimate?***

"Why not just purposefully estimate high when estimating the cost of the personnel, materials, and overhead for a project?" In this way, the firm is sure to complete the project within budget. As has already been explained, this is known as *padding* an estimate or building in a contingency. A pad is **an extra time and cost added to an estimate because the estimator does not have enough information**.

**4. *List the direct costs that are most widely applied in developing cost estimates.+***
**5. *What are indirect costs (give examples)?***

Direct costs include those costs that are tied directly to the project in question such as the cost of personnel; materials that will be required; equipment that will have to be purchased, updated, or leased; facilities that will have to be added, leased, or renovated; services that will have to be contracted for; allowances for inflation; the cost of borrowing money (interest); and any contingency funds that will be built into the estimate to cover unknown factors that result from incomplete information. Indirect costs fall into a broad category known as *overhead.* Overhead costs are those associated with the everyday operation of a firm such as utilities and other bills that apply company-wide rather than to a given project.

**6. *How is the scope statement for a project used in developing a cost estimate?***

To answer the questions: How much work has to be done? and (2) How many people with what types of expertise will it take to do the work? The best place to start in answering these questions is with the scope statement, WBS, and WBS Dictionary. These tools provide a wealth of information for the cost estimator, including a description of the product to be produced or service to be provided; deliverables; assumptions; constraints; and information about such pertinent concerns as health, safety, security, performance, insurance, intellectual property rights, licenses, and permits.2

**7. *How is the schedule for a project used in developing a cost estimate?***

The schedule can help cost estimators determine how long the interest will have to be paid. Another way the schedule is helpful to cost estimators is in determining the cost of

time-sensitive aspects of the project. For example, the price quoted by a material supplier is good for a prescribed time period but increases after that date, cost estimators will have to factor the increase into their estimate if there is a good chance the materials will not be ordered by the specified date.

**8. *How is the human resource plan for a project used in developing a cost estimate?***

If the human resource plan has been completed by the time the estimate is developed, it provides invaluable information about the labor aspects of the cost estimate. However, practically speaking the human resource plan is not always available when the cost estimate for a project is developed. It is not uncommon for the cost estimate to be developed in response to an RFP or RFQ even before the project initiation stage has begun. When this is the case, the human resource plan will not be available as an input for the cost estimate, although it will be ready as an input for developing the budget and is one of the best tools available to project managers who are developing budgets for their projects.

**9. *How is the risk register for a project used in developing a cost estimate?***

The risk register can be a valuable tool for cost estimators because risk minimization strategies come with a cost. The cost of the various strategies planned for minimizing project risk—purchasing insurance, building a contingency into the estimate, and other risk mitigation methods all have an associated cost that must be included in the direct costs of the project.

**10. *How are enterprise environmental factors for a project used in developing a cost estimate?***

Enterprise Environmental Factors for the Project *Enterprise environmental factors include such things as government regulations, industry standards, process capabilities, process capacity, condition of the firm's project-support infrastructure, quality of human resources, marketplace conditions, and the political climate as well as other environmental factors that can affect the cost of a project. Consequently, it is important for cost estimators to identify all applicable enterprise environmental factors and assess their potential costs as part of developing the cost estimate.*

**11. *Explain the following cost estimation methods:***
a. *Expert judgment*

judgment method of preparing cost estimates involves using historical data from similar past projects and then applying the insight, intuition, and wisdom gained through experience.

b. *Analogous estimating*

This cost estimating method compares the various components of the current project with analogous components of previous similar projects.

c. *Parametric estimating*

cost components of a given project and then comparing them to historical data for the same or similar components using statistics.

d. *Bottom-up estimating*

cost estimating methods involves breaking the entire project down into work packages, estimating the cost of each package, and then summarizing the cost of each individual work package to determine the cost of the project.

e. *Three-point estimating*

(1) most likely, (2) optimistic, and (3) pessimistic. Bla bla bla **XD**

f. *Reserve analysis*

This cost estimating method involves adding a contingency to the overall estimate or separate contingencies to each component of the estimate. Contingencies are sometimes referred to as *padding.*

g. *Vendor bid analysis*

Vendor bid analysis. *This cost estimating method is used when the engineering and technology firm is serving as the prime contractor on a project and requesting bids from outside providers. Vendor bid analysis involves comparing the various bids received for specific components of the project.*

12. *What are cost estimation notes and how are they used?*

• Explanation of how the estimate was developed
• Explanation of all assumptions upon which the estimate or component elements were based
• Explanation of all constraints and how they affected the estimate
• Explanation of any room for error applied to the estimate (plus or minus a percentage)
• Explanation of the cost estimator's level of confidence in the finished estimate

## 13. *Define the term* budget *as it relates to engineering and technology projects*

The budget for an engineering and technology project represents the actual amount of money authorized for completing a project. The budget establishes the benchmark against which cost performance will be measured throughout the course of a project.

## 14. *What are two outputs of the budgeting process?*

Outputs of the budget development process are the budget summary and the cost performance baseline.

## 15. *What is the most desirable relationship between budgeted costs and actual expenditures?*

over time.

The cost baseline curve touches each of the X and Y intersection points of the funding requirements. To complete the project within budget the actual expenditures line should remain to the right of the cost baseline throughout the project. Of course, the two lines can temporarily intersect without the project running over budget in the final analysis, provided that actual expenditures stay to the right of the cost baseline for the majority of the project. However, the ideal condition is for the actual expenditures to stay to the right of the cost baseline throughout the project.

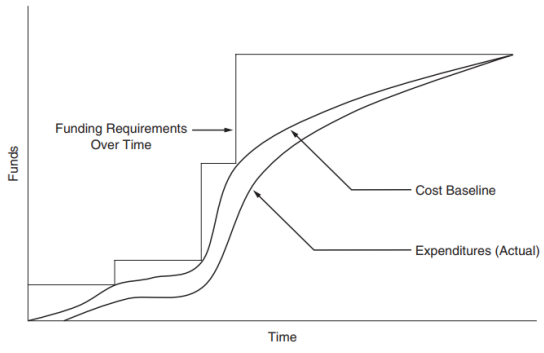



**FIGURE 5.7** Cost baseline vs. actual expenditure graph.