SIS312:Information Systems Project Management

Lecture Notes

JS

Department of Computer Science
Kyambogo University.

September 16, 2019

Contents

List of Figures

1 Introduction to Project Management

1.1 What is a Project?

A planned undertaking of related activities with a beginning and an end, that use limited resources to reach an objective A project is different from operations. Operations, on the other hand, is work done in organizations to sustain the business. Projects are different from operations in that they end when their objectives have been reached or the project has been terminated.

1.1.1 Examples of IT Projects

Projects can be large or small and involve one person or thousands of people. They can be done in one day or take years to complete. IT projects involve using hardware, software, and networks to create a product, service, or result. Examples of IT projects include the following:

- A team of students creates a smartphone application and sells it online.
- A company develops a driverless car.
- A small software development team adds a new feature to an internal software application for the finance department.
- A college upgrades its technology infrastructure to provide wireless Internet access across the whole campus.
- A company develops a new system to increase sales force productivity and customer relationship management that will work on various laptops, smartphones, and tablets.
- A television network implements a system to allow viewers to vote for contestants and provide other feedback on programs via social media sites.
- A government group develops a system to track child immunizations.
- A large group of volunteers from organizations throughout the world develops standards for environmentally friendly or green IT.
- A global bank acquires a smaller financial institution and needs to reconcile systems and procedures into a common entity.
- Buying and installation of an Off-the-shelf software.
- A multinational firm decides to consolidate its information systems into an integrated enterprize resource management approach.

1.1.2 Project Attributes

As you can see, projects come in all shapes and sizes. The following attributes help to define a project further:

- *A project has a unique purpose.* Every project should have a well-defined objective. An IT project can produce any number of results-a system, a software package, or a recommendation based on a study. Therefore, a project's goal must be to produce something tangible and of value to the organization. A project must have a goal to drive the project in terms of defining the work to be done, its schedule, and its budget, and to provide the project team with a clear direction.

- *A project is temporary.* A project has a definite beginning and end. Many projects begin on a specific date and the date of completion is estimated. Some projects, on the other hand, have an immovable date when the project must be completed. In this case, it is necessary to work backwards to determine the date when the project must start.

- *A project is developed using progressive elaboration.* Projects are often defined broadly when they begin, and as time passes, the specific details of the project become clearer. Therefore, projects should be developed in increments. A project team should develop initial plans and then update them with more detail based on new information.

- *A project requires resources, often from various areas.* Resources include people, hardware, software, and other assets. Many projects cross departmental or other boundaries to achieve their unique purposes.

- *A project should have a primary customer or sponsor.* Most projects have many interested parties or stakeholders, but someone must take the primary role of sponsorship. The project sponsor usually provides the direction and funding for the project.

- *A project involves uncertainty.* Because every project is unique, it is sometimes difficult to define its objectives clearly, estimate how long it will take to complete, or determine how much it will cost. External factors also cause uncertainty, such as a supplier going out of business or a project team member needing unplanned time off. This uncertainty is one of the main reasons project management is so challenging, especially on projects involving new technologies.

- *A project has roles.* Today, IT projects require different individuals with different skill sets. Although these skills may be different on different projects, a typical project may include the following:

  - Project Manager-The project manager is the team leader and is responsible for ensuring that all of the project management and technical development processes are in place and are being carried out within a set of specific requirements, defined processes, and quality standards.
  - Project Sponsor-The project sponsor may be the client, customer, or organizational manager who will act as a champion for the project and provide organizational resources and direction when needed.
  - Subject Matter Expert(s)-The subject matter expert may be a user or client who has specific knowledge, expertise, or insight in a specific functional area needed to support the project. For example, if the organization wishes to develop a system to support tax decisions, having a tax expert on the project team who can share his/her knowledge will be more productive than having the technical people try to learn everything about tax accounting while developing the system.
  - Technical Expert(s) -Technical expertise is needed to provide a technical solution to an organizational problem. Technical experts can include systems analysts, network specialists, programmers, graphic artists, trainers, and so forth. Regardless of their job title, these individuals are responsible for defining, creating, and implementing the technical and organizational infrastructure to support the product of the IT project.

- *A project has interdependent tasks.* Project work requires many interdependent tasks. For example, a network cannot be installed until the hardware is delivered, or certain requirements cannot be incorporated into the design until a key user is interviewed. Sometimes

the delay of one task can affect other subsequent, dependent tasks. The project's schedule may slip, and the project may not meet its planned deadline.

- *Organizational Change.* Projects are planned organizational change. Change must be understood and managed because implementation of the IT project will change the way people work. The potential for resistance, therefore, exists, and a system that is a technical success could end up being an organizational failure.

An effective project manager is crucial to a projects success. Project managers work with the project sponsors, the project team, and the other people involved to meet project goals.

1.1.3 Project Constraints

Every project is constrained in different ways, often by its scope, time, cost and quality goals. To create a successful project, a project manager must consider scope, time, cost and quality and balance these four often-competing goals:

- *Scope:* What work will be done as part of the project? What unique product, service, or result does the customer or sponsor expect from the project? How will the scope be verified?
- *Time:* How long should it take to complete the project? What is the projects schedule? How will the team track actual schedule performance? Who can approve changes to the schedule?
- *Cost:* What should it cost to complete the project? What is the projects budget? How will costs be tracked? Who can authorize changes to the budget?
- *Quality:* The project deliverables (i.e., end products from a project) should meet quality standards and satisfy the sponsor.

A **deliverable** is a product or service, such as a technical report, a training session, a piece of hardware, or a segment of software code, produced or provided as part of a project.

1.1.4 Types of Information Systems Projects

The distinct types of Information Systems projects are:

Software development Essentially we have a group of people working together to specify, design, develop, test and implement a new system for a customer (either internal or external).

Package implementation This involves buying a pre-existing software package and installing it. It represents an alternative, and usually quicker and cheaper, way of meeting customers system requirements. In principle, package implementation is simple: the package is bought, installed, switched on and used.

System enhancement This type of project arises when the users, or owners, of an existing system want it enhanced to provide new features or functions or perhaps to meet some external demand, like compliance with legislation or regulations. Many such projects are not recognized or managed as such, but are just handled as business as usual by a support and maintenance team. However, large-scale enhancements need to be managed as real projects because, often, the amount of work, and thus of time and cost, is considerable and so should be subject to proper project-management discipline.

Consultancy and business analysis assignments Some IS projects do not involve developing or installing anything tangible at all. Sometimes, they are about investigating a business issue and proposing solutions using information technology. Such consultancy and business analysis assignments are nevertheless projects.

Systems migration This type of project is one where an existing operational system has to be moved to a new operating environment perhaps because the current one is now longer supported or supportable. There may be some software development involved, because the new platform does not work exactly like the old one, and it may be necessary to create interfaces with other systems. There may also be infrastructure implications to consider. It might also be necessary to carry out some limited retraining of users to enable them to utilize the new environment. From the point of view of the systems users, the projects success will be judged by the smoothness of the transition and the lack of interruption to their workload.

Infrastructure implementation This type of IS project includes ones to introduce or replace hardware, servers or PCs, for example, to put in place communications infrastructures and also sometimes the physical construction of things like computer suites or the fitting out and equipment of a new office building. General project management principles are all applicable to this type of project and it does have the advantage, usually, that the outcomes of the project are nicely tangible unlike, as we have seen, some other IS projects.

Outsourcing (and in-sourcing) When an organization has troubles managing one of their projects, they can contract another company to manage it for them. Outsourcing is a common trend in information technology and other industries. Businesses outsource for services that are seen as intrinsic to managing a business and serving internal and external customers. Products, such as computer parts, and services, such as payroll and bookkeeping, can be outsourced. In some cases, the entire information management of a company is outsourced, including planning and business analysis as well as the installation, management, and servicing of the network and workstations.

Insourcing is the commencement of performing a project function that could be contracted out internally: either with the help of a third-party provider who performs the task on-site, or by conducting said task independently.

Some reasons for outsourcing IT projects are:

- You lack in-house expertise.
- You have in-house expertise but workloads are too demanding.
- You need temporally project management services.
- Cost savings.
- Value of efficiency.

Disaster recovery This is a project which may be executed when there has been a large scale failure and the organization needs to get its systems back up and running as soon as possible.

1.2 What is Project Management?

Project management is "the application of knowledge, skills, tools, and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project." Project managers must strive not only to meet specific scope, time, cost, and quality goals of projects, they must also facilitate the entire process to meet the needs and expectations of people involved in project activities or affected by them.

1.2.1 Project Stakeholders

Stakeholders are the people involved in or affected by project activities, and include the project sponsor, project team, support staff, customers, users, suppliers, and even opponents of the project. These stakeholders often have very different needs and expectations.

1.2.2 Project Management Knowledge Areas

Project management knowledge areas describe the key competencies that project managers must develop. Project managers must have knowledge and skills in all 10 of these areas:

1. Project scope management involves defining and managing all the work required to complete the project successfully.
2. Project time management includes estimating how long it will take to complete the work, developing an acceptable project schedule, and ensuring timely completion of the project.
3. Project cost management consists of preparing and managing the budget for the project.
4. Project quality management ensures that the project will satisfy the stated or implied needs for which it was undertaken.
5. Project human resource management is concerned with making effective use of the people involved with the project.
6. Project communications management involves generating, collecting, disseminating, and storing project information.
7. Project risk management includes identifying, analyzing, and responding to risks related to the project.
8. Project procurement management involves acquiring or procuring goods and services for a project from outside the performing organization.
9. Project stakeholder management includes identifying and analyzing stakeholder needs while managing and controlling their engagement throughout the life of the project.
10. Project integration management is an overarching function that affects and is affected by all of the other knowledge areas.

1.2.3 Project Management Tools and Techniques

Project management tools and techniques assist project managers and their teams in carrying out work in all 10 knowledge areas. For example, some popular time-management tools and techniques include Gantt charts, project network diagrams, and critical path analysis. The table in Figure 1 lists some commonly used tools and techniques by knowledge area.

1.2.4 Project Success

How do you define the success or failure of a project? The list that follows outlines a few common criteria for measuring the success of a project:

1. The project met scope, time, and cost goals.

Knowledge Area/Category	Tools and Techniques
Integration management	Project selection methods, project management methodologies, stakeholder analyses, work requests, project charters, project management plans, project management software, change requests, change control boards, project review meetings, lessons-learned reports
Scope management	Scope statements, work breakdown structures, statements of work, requirements analyses, scope management plans, scope verification techniques, scope change controls
Time management	Gantt charts, project network diagrams, critical path analysis, crashing, fast tracking, schedule performance measurements
Cost management	Project budgets, net present value, return on investment, payback analysis, earned value management, project portfolio management, cost estimates, cost management plans, cost baselines
Quality management	Quality metrics, checklists, quality control charts, Pareto diagrams, fishbone diagrams, maturity models, statistical methods, test plans
Human resource management	Motivation techniques, empathic listening, responsibility assignment matrices, project organizational charts, resource histograms, team building exercises
Communications management	Communications management plans, kick-off meetings, conflict management, communications media selection, status and progress reports, virtual communications, templates, project Web sites
Risk management	Risk management plans, risk registers, probability/impact matrices, risk rankings
Procurement management	Make-or-buy analyses, contracts, requests for proposals or quotes, source selections, supplier evaluation matrices

Figure 1: Common project management tools and techniques by knowledge area

2. The project satisfied the customer/sponsor. Even if the project met initial scope, time, and cost goals, the users of the computers or their managers might not be satisfied. Perhaps the project manager or team members never returned calls or were rude. Perhaps users had their daily work disrupted during the upgrades or had to work extra hours due to the upgrades. If the customers were not happy with important aspects of the project, it would be deemed a failure. Conversely, a project might not meet initial scope, time, and cost goals, but the customer could still be very satisfied. Perhaps the project team took longer and spent more money than planned, but they were very polite and helped the users and managers solve several work-related problems.

3. The results of the project met its main objective, such as making or saving a certain amount of money, providing a good return on investment, or simply making the sponsors happy. Even if the project cost more than estimated, took longer to complete, and the project team was hard to work with, the project would be successful if users were happy with the upgraded computers, based on this criterion. As another example, suppose that the sponsor approved the upgrade project to provide a good return on investment by speeding up work and therefore generating more profits. If those goals were met, the sponsor would deem the project a success, regardless of other factors involved.

1.2.5 Essential Factors for IT Project Success

Why do some IT projects succeed and others fail? The factors that contribute most to the success of IT projects are listed below in order of importance. User involvement, executive

management support, and a clear statement of requirements rank the top of the list.

- User involvement
- Management support
- Clear statement of requirements
- Proper planning
- Realistic expectations
- Smaller project milestones
- Competent staff
- Ownership
- Clear vision & objectives
- Hard-working, focused team
- Tools and infrastructure

User Involvement Client's expertise is needed to identify problems and opportunities and to define requirements. Moreover, active participation by the client keeps them interested in and excited about the project. Management is then more compelled to support the project. Lack of user input or involvement, the project team will have a difficult time understanding the goals of the project and defining the requirements.

Smaller Project Milestones Technology, business models and cycle times are changing too quickly to develop systems that take much more than a year to complete. There is need to break up large projects into smaller, more manageable ones that can be completed in less than a year.

1.2.6 The Role of a Project Manager

A **project manager** is a systems analyst with a diverse set of skills management, leadership, technical, conflict management, and customer relationshipwho is responsible for initiating, planning, executing, and closing down a project.

The most important skills and competencies for project managers are:

1. People skills
2. Leadership
3. Listening
4. Integrity, ethical behavior, consistency
5. Strength at building trust
6. Verbal communication
7. Strength at building teams
8. Conflict resolution, conflict management
9. Critical thinking, problem solving
10. Understanding

2 The Project Management Process

The project management process involves four phases:

1. Initiating the project - The first phase of the project management process in which activities are performed to assess the size, scope, and complexity of the project and to establish procedures to support later project activities.

2. Planning the project - The second phase of the project management process that focuses on defining clear, discrete activities and the work needed to complete each activity within a single project.

3. Executing the project - The third phase of the project management process in which the plans created in the prior phases (project initiation and planning) are put into action.

4. Closing down the project - The final phase of the project management process that focuses on bringing a project to an end.

Several activities must be performed during each of these four phases. Following this formal project management process greatly increases the likelihood of project success.

2.1 Initiating a Project

The first phase of the project management process in which activities are performed to assess the size, scope, and complexity of the project and to establish procedures to support later project activities The types of activities you will perform when initiating a project are:

1. Establishing the Project Initiation Team : This activity involves organizing an initial core of project team members to assist in accomplishing the project initiation activities.

2. Establishing a Relationship with the Customer : A thorough understanding of your customer builds stronger partnerships and higher levels of trust.

3. Establishing the Project Initiation Plan : This step defines the activities required to organize the initiation team while it is working to define the goals and scope of the project.

4. Establishing Management Procedures : Develop team communication and reporting procedures

5. Establishing the Project Management Environment and Project Workbook : Collect and organize the tools that you will use while managing the project and construct the project workbook. A project workbook is an online or hard-copy repository for all project correspondence, inputs, outputs, deliverables, procedures, and standards that are used.

6. Developing the Project Charter :The project charter is a short, (typically one page) high-level document prepared for both internal and external stakeholders to formally announce the establishment of the project and to briefly describe its objectives, key assumptions, and stakeholders. The project charter ensures that both you and your customer gain a common understanding of the project. It is also a very useful communication tool; it helps to announce to the organization that a particular project has been chosen for development.

Project initiation is complete once these six activities have been performed. Before moving on to the next phase of the project, the work performed during project initiation is reviewed at a meeting attended by management, customers, and project team members. An outcome of this meeting is a decision to continue, modify, or abandon the project.

2.1.1 Establishing the Project Management Environment and Project Workbook

Project workbook: An online or hard-copy repository for all project correspondence, inputs, outputs, deliverables, procedures, and standards that is used for performing project audits, orienting new team members, communicating with management and customers, identifying future projects, and performing post-project reviews.

The project workbook is used by all team members. The establishment and diligent recording of all project information in the workbook are two of the most important activities you will perform as project manager.

The project workbook contains the following key documents:

1. Project overview
2. Initiation plan and SSR (System Service Request)
3. Project scope and risks
4. Management procedures
5. Data descriptions
6. Process descriptions
7. Team correspondence
8. Project Charter
9. Project schedule

SSR - a standard form for requesting or proposing systems development work within an organization

2.2 Planning the Project

Project planning involves defining clear, discrete activities and the work needed to complete each activity within a single project. It often requires you to make numerous assumptions about the availability of resources such as hardware, software, and personnel. It is much easier to plan nearerterm activities than those occurring in the future. In actual fact, you often have to construct longer-term plans that are more general in scope and nearer-term plans that are more detailed. The repetitive nature of the project management process requires that plans be constantly monitored throughout the project and periodically updated (usually after each phase) based upon the most recent information.

The types of activities that you can perform during project planning are:

1. Describing Project Scope, Alternatives, and Feasibility :The purpose of this activity is to understand the content and complexity of the project.
    - What problem or opportunity does the project address?
    - What are the quantifiable results to be achieved?
    - What needs to be done?
    - How will success be measured?
    - How will we know when we are finished?

After defining the scope of the project, your next objective is to identify and document general alternative solutions for the current business problem or opportunity. You must then assess the feasibility of each alternative solution and choose which to consider during subsequent System Development Life Cycle (SDLC) phases. In some instances, off-the-shelf software can be found. It is also important that any unique problems, constraints, and assumptions about the project be clearly stated.

2. Dividing the Project into Manageable Tasks : This is a critical activity during the project planning process. Here, you must divide the entire project into manageable tasks and then logically order them to ensure a smooth evolution between tasks.

3. Estimating Resources and Creating a Resource Plan :The goal of this activity is to estimate resource requirements for each project activity and to use this information to create a project resource plan. The resource plan helps assemble and deploy resources in the most effective manner. For example, you would not want to bring additional programmers onto the project at a rate faster than you could prepare work for them.

4. Developing a Preliminary Schedule : During this activity, you use the information on tasks and resource availability to assign time estimates to each activity in the work breakdown structure. These time estimates will enable you to create target starting and ending dates for the project. Target dates can be revisited and modified until a schedule is produced that is acceptable to the customer.

5. Developing a Communication Plan : The goal of this activity is to outline the communication procedures among management, project team members, and the customer.

6. Determining Project Standards and Procedures : During this activity, you will specify how various deliverables are produced and tested by you and your project team. For example, the team must decide on which tools to use, how the standard SDLC might be modified, which SDLC methods will be used, documentation styles (e.g., type fonts and margins for user manuals), how team members will report the status of their assigned activities, and terminology. Setting project standards and procedures for work acceptance is a way to ensure the development of a high-quality system. Also, it is much easier to train new team members when clear standards are in place. Organizational standards for project management and conduct make the determination of individual project standards easier and the interchange or sharing of personnel among different projects feasible.

7. Identifying and Assessing Risk : The goal of this activity is to identify sources of project risk and to estimate the consequences of those risks. Risks might arise from the use of new technology, prospective users resistance to change, availability of critical resources, competitive reactions or changes in regulatory actions due to the construction of a system, or team member inexperience with technology or the business area. You should continually try to identify and assess project risk.

8. Creating a Preliminary Budget : During this phase, you need to create a preliminary budget that outlines the planned expenses and revenues associated with your project. The project justification will demonstrate that the benefits are worth these costs.

9. Developing a Project Scope Statement : An important activity that occurs near the end of the project planning phase is the development of the Project Scope Statement. Developed primarily for the customer, this document outlines work that will be done and clearly describes what the project will deliver. The Project Scope Statement is useful to make sure that you, the customer, and other project team members have a clear understanding of the intended project size, duration, and outcomes.

10. Setting a Baseline Project Plan : Once all of the prior project planning activities have been completed, you will be able to develop a Baseline Project Plan. This baseline plan provides an estimate of the projects tasks and resource requirements and is used to guide the next project phaseexecution. As new information is acquired during project execution, the baseline plan will continue to be updated.

2.2.1 Identifying Alternative Solutions

Since no single solution generally exists for most organizational problems, it is imperative to identify several alternatives before dealing directly with a given business opportunity. Options to consider may include:

- Changing the existing business processes without investing in IT
- Adopting or adapting an application developed by a different area or department within the organization
- Reengineering the existing system
- Purchasing an off-the-shelf application package from a software vendor
- Custom building a new application using internal resources or outsourcing the development to another company

2.2.2 Dividing the Project into Manageable Tasks

The definition of tasks and their sequence is referred to as the work breakdown structure. Some tasks may be performed in parallel whereas others must follow one another sequentially. Task sequence depends on which tasks produce deliverables needed in other tasks, when critical resources are available, the constraints placed on the project by the client, and the process outlined in the SDLC.

For example, suppose that you are working on a new development project and need to collect system requirements by interviewing users of the new system and reviewing reports they currently use to do their job. A work breakdown for these activities is represented in a Gantt chart in Figure 2. A Gantt chart is a graphical representation of a project that shows each task as a horizontal bar whose length is proportional to its time for completion. Different colors, shades, or shapes can be used to highlight each kind of task. For example, those activities on the critical path (defined later) may be in red and a summary task could have a special bar. Note that the black horizontal bars rows 1, 2, and 6 in Figure 2-represent summary tasks. Planned versus actual times or progress for an activity can be compared by parallel bars of different colors, shades, or shapes. Gantt charts do not (typically) show how tasks must be ordered (precedence), but simply show when an activity should begin and end. In Figure 2, the task duration is shown in the second column by days, d, and necessary prior tasks are noted in the third column as predecessors. Most project management software tools support a broad range of task durations, including minutes, hours, days, weeks, and months. As you will learn in later chapters, the SDLC consists of several phases that you will need to break down into activities. Creating a work breakdown structure requires that you decompose phases into activitiessummary tasksand activities into specific tasks. For example, Figure 2 shows that the activity Interviewing consists of three tasks: design interview form, schedule appointments, and conduct interviews. Defining tasks in too much detail will make the management of the project unnecessarily complex. You will develop the skill of discovering the optimal level of detail for representing tasks through experience. For example, it may be very difficult to list tasks that require less than one hour of time to complete in a final work breakdown structure. Alternatively, choosing tasks that are too large in scope (e.g., several weeks long) will not

provide you with a clear sense of the status of the project or of the interdependencies between tasks. What are the characteristics of a task? A task

- Can be done by one person or a well-defined group
- Has a single and identifiable deliverable (The task is, however, the process of creating the deliverable.)
- Has a known method or technique
- Has well-accepted predecessor and successor steps
- Is measurable so that percent completed can be determined

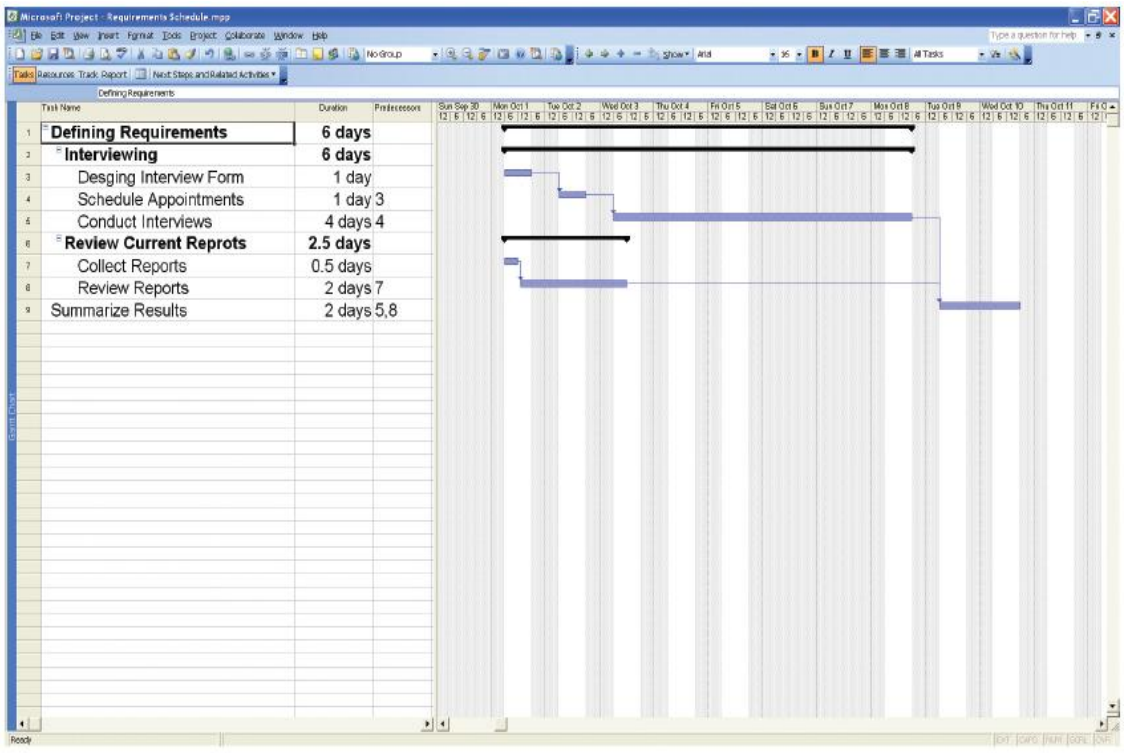


Figure 2: Gantt chart showing project tasks, duration times for those tasks, and predecessors

2.2.3 Some Estimating Methods

Analogy method A technique for estimating a variety of project parameters and measures of scale. The project parameters that can be measured include those of project cost, project budget, scope of the project, and expected project duration. The project measures that can be estimated using this technique can range from the size of the project, to the project weight, to the complexity. The estimates are made by comparing the current activity to that of a similar activity that took place previously and drawing comparisons in proportion to that.

Bottom-up estimating Is an extremely helpful technique in project management as it allows for the ability to get a more refined estimate of a particular task (component) of work. In bottom-up estimating, the project is broken down into smaller tasks (components) for instance by using a work break down structure. Then, individual estimates are developed to determine what specifically is needed to meet the requirements of each of these smaller components of the work. The estimates for the smaller individual components are then

aggregated to develop a larger estimate for the entire project as a whole. In doing this, the estimate for the project as a whole is typically far more accurate, as it allows for careful consideration of each of the smaller parts of the project and then combining these carefully considered estimates rather than merely making one large estimate which typically will not as thoroughly consider all of the individual tasks of a project. In general, the smaller the scope, the greater the accuracy.

Top-down estimating involves estimating the schedule and/or cost of the entire project in terms of how long it should take or how much it should cost. Top-down estimating is a very common occurrence that often results from a mandate made by upper management (e.g., Thou shalt complete the project within six months and spend no more than $500,000!). Often the schedule and/or cost estimate is a product of some strategic plan or because someone thinks it should take a certain amount of time or cost a particular amount. On the other hand, top-down estimating could be a reaction to the business environment. For example, the project may have to be completed within six months as a result of a competitor's actions or to win the business of a customer (i.e., the customer needs this in six months).

The Delphi technique Is based on the idea of obtaining estimates from suitably qualified people and then synthesizing them to produce the final estimate. Since people have differing levels of experience of estimating, and of the underlying hardware and software to be used, the approach has a number of stages:

- Each estimator is given a specification of the work activity, task or whatever and asked to provide their estimate for it. These are filled in anonymously.
- The estimates are then summarized anonymously and the summary is circulated to each estimator.
- Estimators reconsider their own estimates in the light of the summary and provide a revised estimate if they wish.

The above processes are repeated as many times as necessary to achieve a reasonable consensus.

PERT estimating One of the most difficult and most error-prone activities when constructing a project schedule is the determination of the time duration for each task within a work breakdown structure. It is particularly problematic to make these estimates when there is a high degree of complexity and uncertainty about a task. **PERT (Program Evaluation Review Technique)** is a technique that uses optimistic, pessimistic, and realistic time estimates to calculate the expected time for a particular task. This technique can help you to obtain a better time estimate when there is some uncertainty as to how much time a task will require to be completed. The optimistic (o) and pessimistic (p) times reflect the minimum and maximum possible periods of time for an activity to be completed. The realistic (r) time, or most likely time, reflects the project managers best guess of the amount of time the activity actually will require for completion. Once each of these estimates is made for an activity, an expected time (ET) can be calculated. Because the expected completion time should be closest to the realistic (r) time, it is typically weighted four times more than the optimistic (o) and pessimistic (p) times. Once you add these values together, it must be divided by six to determine the ET. This equation is shown in the following formula:

$$ET = \frac{o+4r+p}{6}$$

where
ET= expected time for the completion for an activity
o = optimistic completion time for an activity
r = realistic completion time for an activity
p = pessimistic completion time for an activity

For example, suppose that your instructor asked you to calculate an expected time for the completion of an upcoming programming assignment. For this assignment, you estimate an optimistic time of 2 hours, a pessimistic time of 8 hours, and a most likely time of 6 hours. Using PERT, the expected time for completing this assignment is 5.67 hours. Commercial project management software such as Microsoft Project assists you in using PERT to make expected time calculations. Additionally, many commercial tools allow you to customize the weighting of optimistic, pessimistic, and realistic completion times.

The main advantage of PERT is that it attempts to address the risk associated with duration estimates. Because many projects exceed schedule estimates, PERT may help in developing schedules that are more realistic.

2.2.4 Developing a Preliminary Schedule

Determining an acceptable schedule may require that you find additional or different resources or that the scope of the project be changed. The schedule may be represented as a Gantt chart, as illustrated in Figure 2, or as a network diagram, as illustrated in Figure 16. A network diagram is a graphical depiction of project tasks and their interrelationships. As with a Gantt chart, each type of task can be highlighted by different features on the network diagram. The distinguishing feature of a network diagram is that the ordering of tasks is shown by connecting tasksdepicted as rectangles or ovalswith their predecessor and successor tasks. However, the relative size of a node (representing a task) or a gap between nodes does not imply the tasks duration. Only the individual task items are drawn on a network diagram, which is why the summary tasks 1, 2, and 6the black barsfrom Figure 2 are not shown in Figure 16. We describe both of these charts later.

2.2.5 Developing a communication plan

The communication plan includes when and how written and oral reports will be provided by the team, how team members will coordinate work, what messages will be sent to announce the project to interested parties, and what kinds of information will be shared with vendors and external contractors involved with the project. It is important that free and open communication occur among all parties with respect to proprietary information and confidentiality with the customer. When developing a communication plan, numerous questions must be answered in order to assure that the plan is comprehensive and complete, including:

- Who are the stakeholders for this project?
- What information does each stakeholder need?
- When, and at what interval, does this information need to be produced?
- What sources will be used to gather and generate this information?
- Who will collect, store, and verify the accuracy of this information?
- Who will organize and package this information into a document?
- Who will be the contact person for each stakeholder should any questions arise?

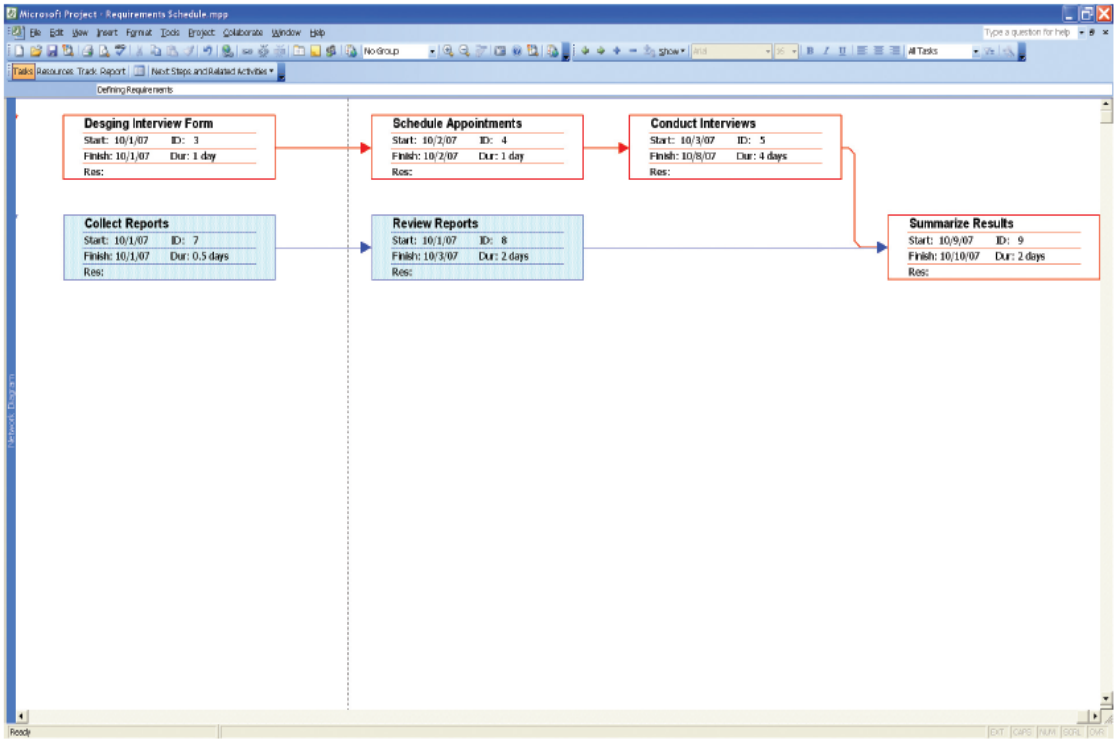


Figure 3: A network diagram illustrates tasks with rectangles (or ovals) and the relationships and sequences of those activities with arrows

- What format will be used to package this information?
- What communication medium will be most effective for delivering this information to the stakeholder?

Once these questions are answered for each stakeholder, a comprehensive communication plan can be developed. In this plan, a summary of communication documents, work assignments, schedules, and distribution methods will be outlined. Additionally, a project communication matrix can be developed which provides a summary of the overall communication plan (see Figure 4). This matrix can be easily shared among team members, and verified by stakeholders outside the project team, so that the right people are getting the right information at the right time, and in the right format.

2.3 Executing the Project

Project execution puts the Baseline Project Plan into action. Within the context of the SDLC, project execution occurs primarily during the analysis, design, and implementation phases. The activities during project execution are:

- Executing the Baseline Project Plan : As project manager, you oversee the execution of the baseline plan. This means that you initiate the execution of project activities, acquire and assign resources, orient and train new team members, keep the project on schedule, and ensure the quality of project deliverables.
- Monitoring Project Progress against the Baseline Project Plan : While you execute the Baseline Project Plan, you should monitor your progress. If the project gets ahead of (or behind) schedule, you may have to adjust resources, activities, and budgets. Monitoring project activities can result in modifications to the current plan. Measuring the time and effort expended on each activity will help you improve the accuracy of estimations

Stakeholder	Document	Format	Team Contact	Date Due
Team Members	Project Status Report	Project Intranet	Juan Kim	First Monday of Month
Management Supervisor	Project Status Report	Hard Copy	Juan Kim	First Monday of Month
User Group	Project Status Report	Hard Copy	James Kim	First Monday of Month
Internal IT Staff	Project Status Report	Email	Jackie James	First Monday of Month
It Manager	Project Status Report	Hard Copy	Juan Jeremy	First Monday of Month
Contract Programmers	Software Specifications	E-mail/Project Intranet	Jordan Kim	October 1, 2007
Training Subcontractor	Implementation and Training Plan	Hard Copy	Jordan James	January 7, 2008

Figure 4: The Project Communication Matrix provides a high-level summary of the communication plan

for future projects. It is possible, with project schedule charts such as Gantt charts, to show progress against a plan, and it is easy with network diagrams to understand the ramifications of delays in an activity. Monitoring progress also means that the team leader must evaluate and appraise each team member, occasionally change work assignments or request changes in personnel, and provide feedback to the employees supervisor.

- Managing Changes to the Baseline Project Plan : You will encounter pressure to make changes to the baseline plan. Significant changes should be made through a formal change request which must be approved by the steering committee. The request should explain why changes are desired and describe all possible impacts on prior and subsequent activities, project resources, and the overall project schedule. In addition to changes occurring through formal request, changes may also occur from events outside your control. In fact, numerous events may initiate a change to the Baseline Project Plan, including the following possibilities:

  – A slipped completion date for an activity
  – A bungled activity that must be redone
  – The identification of a new activity that becomes evident later in the project
  – An unforeseen change in personnel due to sickness, resignation, or termination

  When an event occurs that delays the completion of an activity, you typically have two choices: devise a way to get back on schedule or revise the plan. Devising a way to get back on schedule is the preferred approach because no changes to the plan will have to be made. The ability to head off and smoothly work around problems is a critical skill that you need to master.

- Maintaining the Project Workbook : As in all project phases, maintaining complete records of all project events is necessary. The workbook provides the documentation new

team members require to assimilate project tasks quickly. It explains why design decisions were made and is a primary source of information for producing all project reports.

- Communicating the Project Status : The project manager is responsible for keeping all stakeholderssystem developers, managers, and customersabreast of the project status. In other words, communicating the project status focuses on the execution of the project communication plan and the response to any ad hoc information requests by stakeholders. There are a broad variety of methods that can be used to distribute information, each with strengths and weakness. Some methods are easier for the information sender, but more difficult or less convenient for the receiver. With the maturing of digital networks and the Internet, more and more digital communication is being exchanged. Procedures for communicating project activities vary from formal meetings to informal hallway discussions. Some procedures are useful for informing others of the projects status, others are better for resolving issues, and still others are better for keeping permanent records of information and events. Two types of information are routinely exchanged throughout the project: work resultsthe outcomes of the various tasks and activities that are performed to complete the project and the project planthe formal comprehensive document that is used to execute the project; it contains numerous items including the project charter, project schedule, budgets, risk plan, and so on.

2.3.1 Executing the Baseline Project Plan

This is a formidable task, but a task made much easier through the use of sound project management techniques. For example, as tasks are completed during a project, they can be marked as completed on the project schedule. In Figure 5, tasks 3 and 7 are marked as completed by showing 100 percent in the % Complete column. Members of the project team will come and go. You are responsible for initiating new team members by providing them with the resources they need and helping them assimilate into the team. You may want to plan social events, regular team project status meetings, team-level reviews of project deliverables, and other group events to mold the group into an effective team.

2.4 Closing Down the Project

The focus of project closedown is to bring the project to an end. Projects can conclude with a natural or unnatural termination. A natural termination occurs when the requirements of the project have been met, the project has been completed and is a success. An unnatural termination occurs when the project is stopped before completion. Several events can cause an unnatural termination of a project. For example, it may be learned that the assumption used to guide the project proved to be false, that the performance of the systems or development group was somehow inadequate, or that the requirements are no longer relevant or valid in the customers business environment. The most likely reasons for the unnatural termination of a project relate to running out of time or money, or both. Regardless of the project termination outcome, several activities must be performed: closing down the project, conducting postproject reviews, and closing the customer contract. Within the context of the SDLC, project closedown occurs after the implementation phase.

Project closedown activities are:

1. Closing Down the Project : During closedown, you perform several diverse activities. For example, if you have several team members working with you, project completion may signify job and assignment changes for some members. You will likely be required to assess each team member and provide an appraisal for personnel files and salary determination. You may also want to provide career advice to team members, write letters to superiors

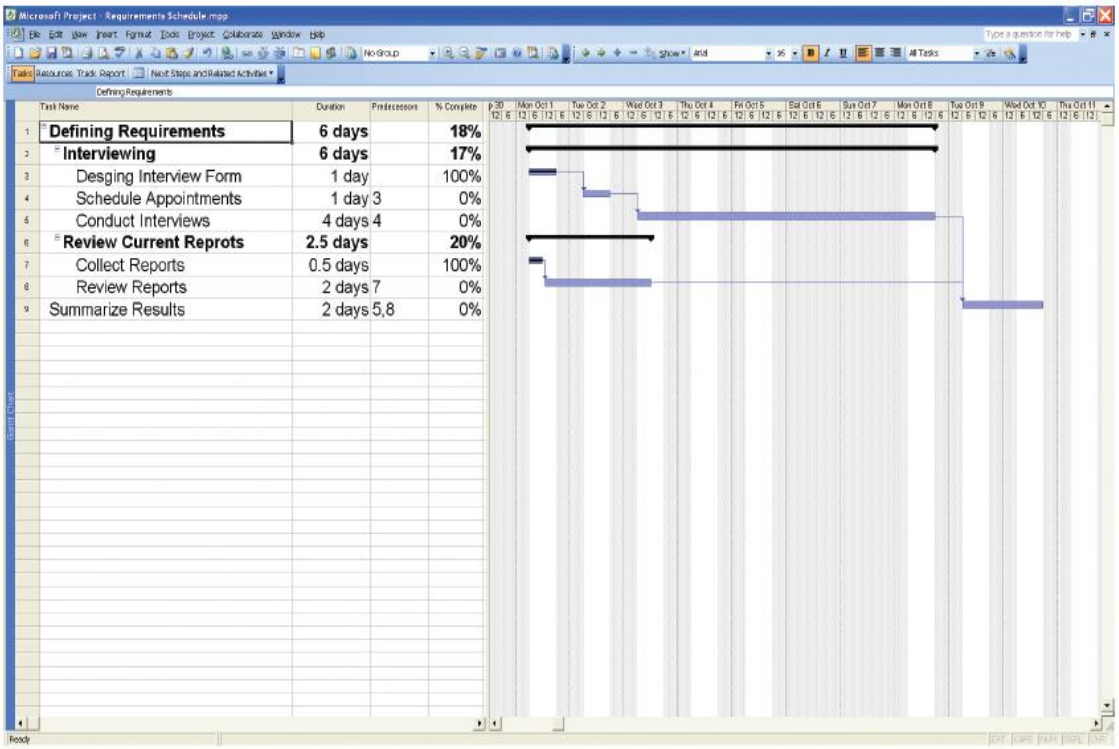


Figure 5: Gantt chart with tasks 3 and 7 completed

praising special accomplishments of team members, and send thank-you letters to those who helped but were not team members. As project manager, you must be prepared to handle possible negative personnel issues such as job termination, especially if the project was not successful. When closing down the project, it is also important to notify all interested parties that the project has been completed and to finalize all project documentation and financial records so that a final review of the project can be conducted. You should also celebrate the accomplishments of the team. Some teams will hold a party, and each team member may receive memorabilia (e.g., a T-shirt with I survived the X project). The goal is to celebrate the teams effort to bring a difficult task to a successful conclusion.

2. Conducting Postproject Reviews : Once you have closed down the project, final reviews of the project should be conducted with management and customers. The objective of these reviews is to determine the strengths and weaknesses of project deliverables, the processes used to create them, and the project management process. It is important that everyone understands what went right and what went wrong in order to improve the process for the next project. Remember, the systems development methodology adopted by an organization is a living guideline that must undergo continual improvement.

3. Closing the Customer Contract : The focus of this final activity is to ensure that all contractual terms of the project have been met. A project governed by a contractual agreement is typically not completed until agreed to by both parties, often in writing. Thus, it is imperative that you gain agreement from your customer that all contractual obligations have been met and that further work is either their responsibility or covered under another SSR or contract.

4. Evaluating the project deliverable: The project must be evaluated in order to determine whether the project provided value to the organization. The goal of the project should be defined in the first phase of the project. In general, the value an IT project brings to the

organization may not be clearly identified immediately after the project is implemented. Therefore, it may be weeks or even months before that value is known. However, time and resources should be allocated for determining whether the project met its intended goal or not. For example, the goal of a project to develop an electronic commerce site should be to make money-not to build or install hardware, software, and web pages on a particular server platform. The technology and its subsequent implementation are only a means to an end. Therefore, the goal of the electronic commerce site may be to produce $250,000 within six months. As a result, evaluating whether the project met its goal can be made only after the system has been implemented.

3 Project Scope Management

3.1 What is Project Scope Management

One of the most important and most difficult aspects of project management is defining the scope of a project. Scope refers to all the work involved in creating the products of the project and the processes used to create them.

Project scope management includes the processes involved in defining and controlling what work is or is not included in a project. It ensures that the project team and stakeholders have the same understanding of what products the project will produce and what processes the project team will use to produce them. There are five main processes involved in project scope management:

1. *Collecting requirements* involves defining and documenting the features and functions of the products for the project as well as the processes used for creating them.

2. *Defining scope* involves reviewing the scope management plan, project charter, requirements documents, and organizational process assets to create a scope statement, adding more information as requirements are developed and change requests are approved.

3. *Creating the Work Break-down Structure (WBS)* involves subdividing the major project deliverables into smaller, more manageable components.

4. *Validating scope* involves formalizing acceptance of the project deliverables.Key project stakeholders, such as the customer and sponsor for the project, inspect and then formally accept the deliverables during this process. If the deliverables are not acceptable, the customer or sponsor usually requests changes.

5. *Controlling scope* involves controlling changes to project scope throughout the life of the projecta challenge on many IT projects. Scope changes often influence the teams ability to meet project time and cost goals, so project managers must carefully weigh the costs and benefits of scope changes.

3.2 Creating a Work Break-down Structure

After collecting requirements and defining scope, the next step in project scope management is to create a work breakdown structure. A WBS is a deliverable oriented grouping of the work involved in a project that defines its total scope. Because most projects involve many people and many different deliverables, it is important to organize and divide the work into logical parts based on how the work will be performed. The WBS is a foundation document in project management because it provides the basis for planning and managing project schedules, costs, resources, and changes. Because the WBS defines the total scope of the project, some project management experts believe that work should not be done on a project if it is not included in

the WBS. Therefore, it is crucial to develop a good WBS. An example of a WBS is as shown in Figure 6.

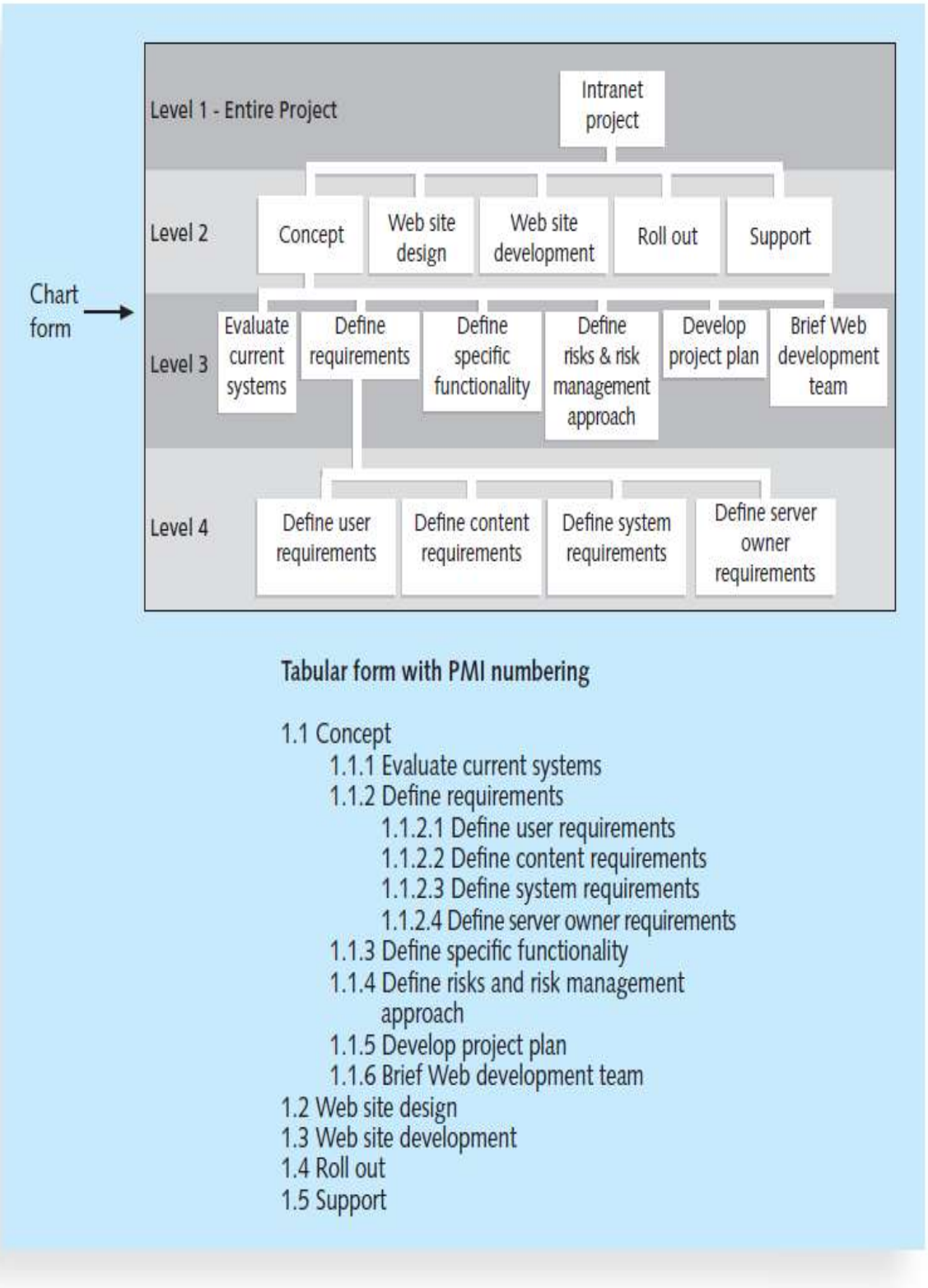


Figure 6: Work Break-down Structure

Figure 7 shows the phase-oriented intranet WBS, using the Microsoft Project numbering scheme from Figure 7 in the form of a Gantt chart created in Microsoft Project. You can see from this figure that the WBS is the basis for project schedules. Notice that the WBS is in the left part of the figure under the Task Name column. The resulting schedule is in the right part of the figure.

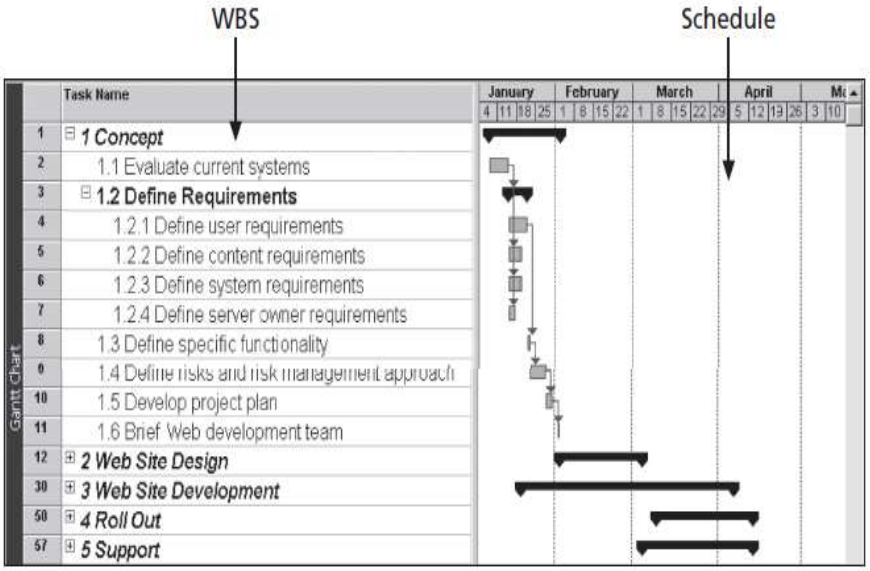


Figure 7: Intranet Gantt chart in Microsoft Project

One of the concerns when creating a WBS is how to organize it to provide the basis for the project schedule. You should focus on what work needs to be done and how it will be done, not when it will be done. In other words, the tasks do not have to be developed as a sequential list of steps. If you do want some time-based flow for the work, you can create a WBS using the project management process groups of initiating, planning, executing, monitoring and controlling, and closing as Level 2 in the WBS. By doing this, not only does the project team follow good project management practice, the WBS tasks can also be mapped more easily against time. For example, Figure 8 shows a WBS and Gantt chart for the intranet project, organized by the five project management process groups. Tasks under initiating include selecting a project manager, forming the project team, and developing the project charter. Tasks under planning include developing a scope statement, creating a WBS, and developing and refining other plans, which would be broken down in more detail for a real project. The tasks of concept, Web site design, Web site development, and rollout, which were WBS Level 2 items in Figure 7, now become WBS Level 3 items under executing. The executing tasks vary the most from project to project, but many of the tasks under the other project management process groups would be similar for all projects. If you do not use the project management process groups in the WBS, you can have a Level 2 category called project management to make sure you account for all tasks related to managing the project. Remember that all work should be included in the WBS, including project management.

3.2.1 Deliverables and Milestones

A deliverable is a tangible and verifiable product of work (i.e., project plan, design specifications, delivered system, etc.). Deliverables at the end of each phase also provide tangible benefits throughout the project and serve to define the work and resources needed for each phase. A milestone is a significant event or achievement that provides evidence that that deliverable has been completed or that a phase is formally over. Deliverables and milestones are closely related, but they are not the same thing. Deliverables can include such things as presentations or reports, plans, prototypes, and the final application system. A milestone, on the other hand, must focus on an achievement. For example, a deliverable may be a prototype of the user interface, but the milestone would be a stakeholder's formal acceptance of the user interface. Only the formal acceptance or approval of the user interface by the project sponsor would allow the project team to move on to the next phase of the project.

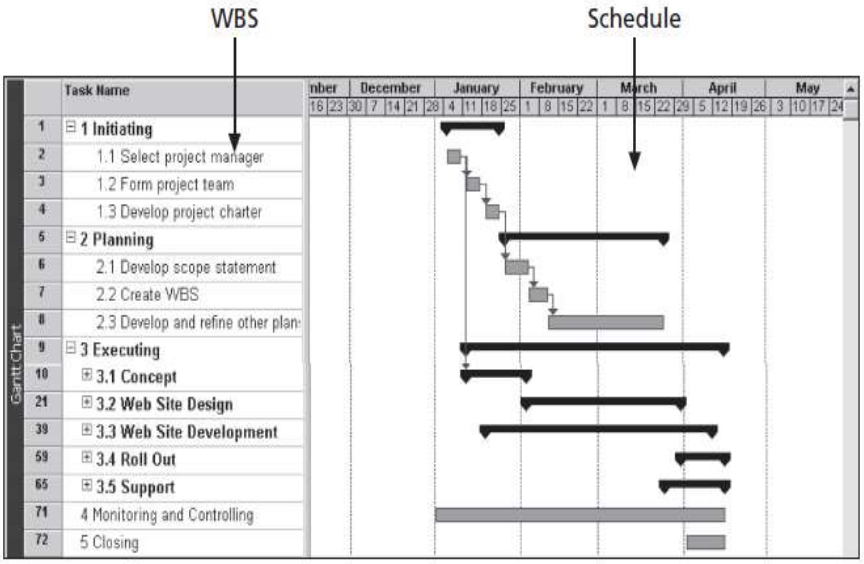


Figure 8: Intranet project Gantt chart organized by project management process groups

3.3 The WBS Dictionary

As you can see from the sample WBSs, many of the items listed on them are rather vague. For instance in Figure 9, what exactly does Update database mean? The person responsible for this task might think that it does not need to be broken down any further, which could be fine. However, the task should be described in more detail so everyone has the same understanding of what it involves. What if someone else has to perform the task? What would you tell that team member to do? What will it cost to complete the task? More detailed information is needed to answer these and other questions.

A WBS dictionary is a document that provides detailed information about each WBS item. The format of the WBS dictionary can vary based on project needs. It might be appropriate to have a short paragraph describing each work package. For a more complex project, an entire page or more might be needed for each of the work package descriptions. Some projects might require that each WBS item describe the responsible organization, resource requirements, estimated costs, and other information. Figure 10 is an example of one entry.

Figure 9: WBS for IT upgrade project

WBS Dictionary Entry March 20
Project Title: Information Technology (IT) Upgrade Project
WBS Item Number: 2.2
WBS Item Name: Update Database
Description: The IT department maintains an online database of hardware and software on the corporate intranet. However, we need to make sure that we know exactly what hardware and software employees are currently using and if they have any unique needs before we decide what to order for the upgrade. This task will involve reviewing information from the current database, producing reports that list each department's employees and location, and updating the data after performing the physical inventory and receiving inputs from department managers. Our project sponsor will send a notice to all department managers to communicate the importance of this project and this particular task. In addition to general hardware and software upgrades, the project sponsors will ask the department managers to provide information for any unique requirements they might have that could affect the upgrades. This task also includes updating the inventory data for network hardware and software. After updating the inventory database, we will send an e-mail to each department manager to verify the information and make changes online as needed. Department managers will be responsible for ensuring that their people are available and cooperative during the physical inventory. Completing this task is dependent on WBS Item Number 2.1, Perform Physical Inventory, and must precede WBS Item Number 3.0, Acquire Hardware and Software.

Figure 10: Sample WBS dictionary entry

3.4 Exercise

Use Microsoft project software to develop a WBS. Assume that the Level 1 category is called Software Project, and that the Level 2 categories are Initiating, Planning, Executing, Monitoring and Controlling, and Closing. Under the Executing section, include Level 3 categories of Analysis, Design, Prototyping, Testing, Implementation, and Support. Assume that the Support category includes Level 4 items for Training, Documentation, User Support, and Enhancements. Your results should resemble those in Figure 11.

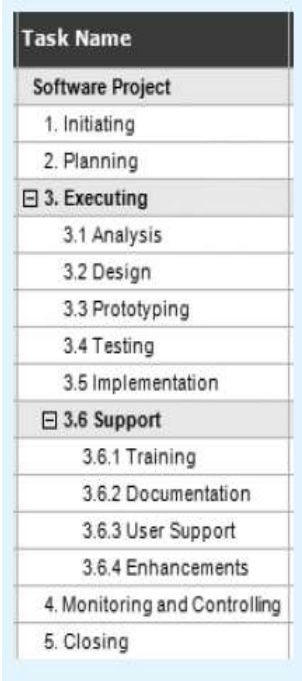


Figure 11: Sample WBS dictionary entry

4 Project Time Management

4.1 Project Time Management Processes

Project time management, simply defined, involves the processes required to ensure timely completion of a project. Seven main processes are involved in project time management:

1. *Planning schedule management* involves determining the policies, procedures, and documentation that will be used for planning, executing, and controlling the project schedule.

2. *Defining activities* involves identifying the specific activities that the project team members and stakeholders must perform to produce the project deliverables. An activity or task is an element of work normally found on the work breakdown structure (WBS) that has expected duration, cost, and resource requirements. The main outputs of this process are an activity list, activity attributes, a milestone list, and project management plan updates.

3. *Sequencing activities* involves identifying and documenting the relationships between project activities. The main outputs of this process include project schedule network diagrams and project documents updates.

4. *Estimating activity resources* involves estimating how many resources people, equipment, and materialsa project team should use to perform project activities. The main outputs of this process are activity resource requirements, a resource breakdown structure, and project documents updates. Estimating activity durations involves estimating the number of work periods that are needed to complete individual activities. Outputs include activity duration estimates and project documents updates.

5. *Developing the schedule* involves analyzing activity sequences, activity resource estimates, and activity duration estimates to create the project schedule. Outputs include a schedule baseline, project schedule, schedule data, project calendars, project management plan updates, and project documents updates.

6. *Controlling the schedule* involves controlling and managing changes to the project schedule. Outputs include work performance information, schedule forecasts, change requests, project management plan updates, project documents updates, and organizational process assets updates.

4.2 Sequencing Activities

After defining project activities, the next step in project time management is sequencing them or determining their dependencies. A dependency or relationship pertains to the sequencing of project activities or tasks. For example, does a certain activity have to be finished before another can start? Can the project team do several activities in parallel? Can some overlap? Determining these relationships or dependencies among activities has a significant impact on developing and managing a project schedule.

4.2.1 Types of Dependencies

1. Finish to Start - Predecessor must finish before Successor can start. e.g. Requirements must be gathered before system design can start

2. Start to start - Predecessor must start before Successor can start. e.g.:

- The system analyst team can't start documenting the requirements until the interviewing process of some users starts.
- Review a user manual - can't start until - Write User Manual starts

3. Finish to finish - Predecessor must finish before Successor can finish. e.g. Writing a document (predecessor) is required to finish before editing the document (successor) can finish.

4. Start to finish - Predecessor must start before Successor can finish. This is the rarest one among the other dependencies in project management. And hence it is very difficult to visualize this with an example. E.g.:

   - cannot Phase out Old Software System until you Start using New Software System

Dependencies are the relationships of the preceding tasks to the succeeding tasks. Tasks may have multiple preceding tasks and multiple succeeding tasks. The most common dependency relationship is a finish-to-start relationship. Task P (predecessor) must be finished before task S (successor) can start. The least common relationship is the start-to-finish relationship. Project Insight, project management software, supports all four dependency relationships.

4.2.2 Network Diagrams

Network diagrams are the preferred technique for showing activity sequencing. A network diagram is a schematic display of the logical relationships among project activities and their sequencing. Some people refer to network diagrams as project schedule network diagrams. Figure 12 shows a sample network diagram for Project X. Note the main elements on this network diagram. The letters A through J represent activities with dependencies that are required to complete the project. These activities come from the WBS. The arrows represent the activity sequencing or relationships between tasks. For example, Activity A must be done before Activity D, and Activity D must be done before Activity H. The format of this network diagram uses the activity-on-arrow (AOA) approach or the arrow diagramming method (ADM)a network diagramming technique in which activities are represented by arrows and connected at points called nodes to illustrate the sequence of activities. A node is simply the starting and ending point of an activity. The first node signifies the start of a project, and the last node represents the end. Assuming that you have a list of the project activities and their start and finish nodes, follow these steps to create an AOA network diagram:

1. Find all of the activities that start at Node 1. Draw their finish nodes, and draw arrows between Node 1 and each of the finish nodes. Put the activity letter or name on the associated arrow. If you have a duration estimate, write it next to the activity letter or name, as shown in Figure 12. For example, A = 1 means that the duration of Activity A is one day, week, or other standard unit of time. Be sure to put arrowheads on all arrows to signify the direction of the relationships.

2. Continue drawing the network diagram, working from left to right. Look for bursts and merges. Bursts occur when two or more activities follow a single node. A merge occurs when two or more nodes precede a single node. For example, in Figure 12, Node 1 is a burst because it goes into Nodes 2, 3, and 4. Node 5 is a merge preceded by Nodes 2 and 3.

3. Continue drawing the AOA network diagram until all activities are included.

4. As a rule of thumb, all arrowheads should face toward the right, and no arrows should cross on an AOA network diagram. You may need to redraw the diagram to make it look presentable.

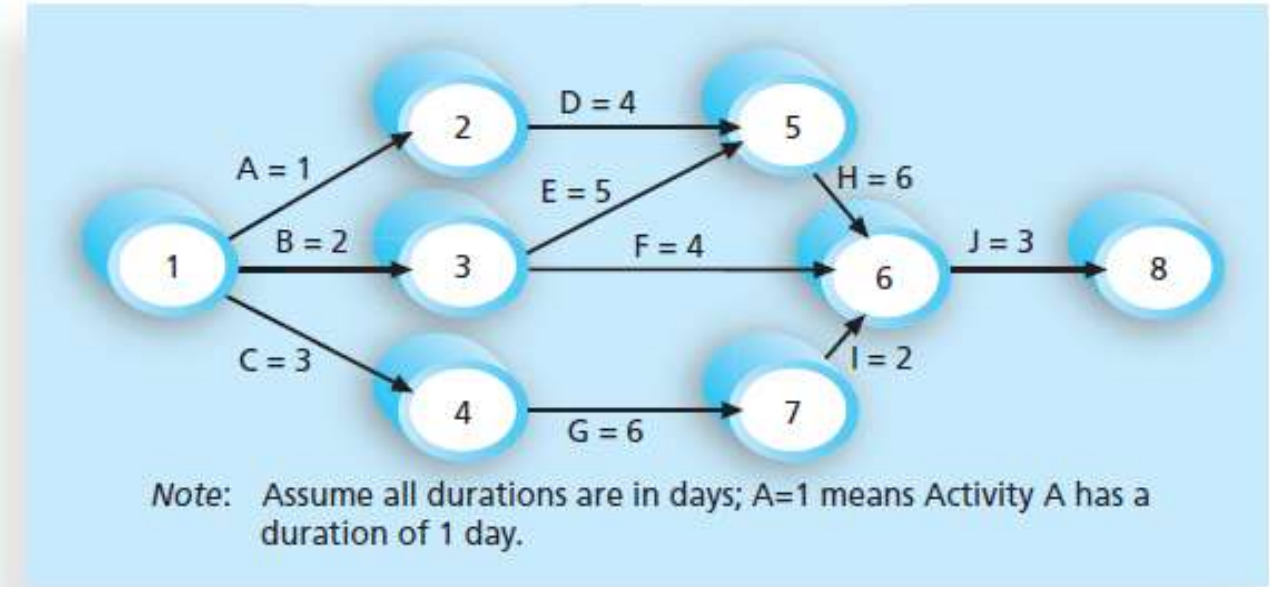


Figure 12: Network diagram for project X

Even though AOA or ADM network diagrams are generally easy to understand and create, a different method is more commonly used: the precedence diagramming method. The precedence diagramming method (PDM) is a network diagramming technique in which boxes represent activities. It is particularly useful for visualizing certain types of time relationships. Figure 13 illustrates Project X using the precedence diagramming method. Notice that the activities are placed inside boxes, which represent the nodes on this diagram. Arrows show the relationships between activities. This figure was created using Microsoft Project, which automatically places additional information inside each node. Each task box includes the start and finish dates, which are labeled Start and Finish; the task ID number, labeled ID; the tasks duration, labeled Dur; and the names of resources, if any, that are assigned to the task. These resources are labeled Res.

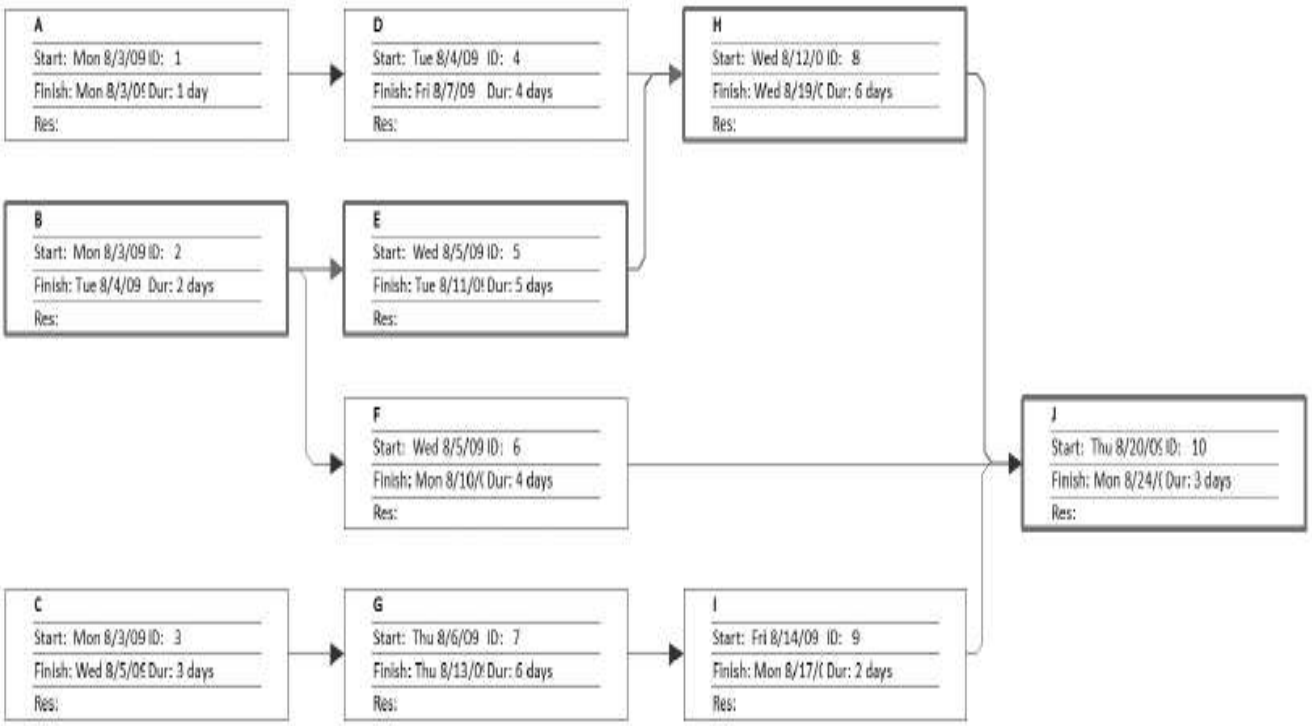


Figure 13: Precedence diagramming method (PDM) network diagram for Project X

4.3 Estimating activity resources

Before you can estimate the duration for each activity, you must have a good idea of the quantity and type of resources (people, equipment, and materials) that will be assigned to each activity.Important questions to answer when estimating activity resources include:

- How difficult will specific activities be on this project?
- Is anything unique in the projects scope statement that will affect resources?
- What is the organizations history in doing similar activities? Has the organization done similar tasks before? What level of personnel did the work?
- Does the organization have people, equipment, and materials that are capable and available for performing the work? Could any organizational policies affect the availability of resources?
- Does the organization need to acquire more resources to accomplish the work? Would it make sense to outsource some of the work? Will outsourcing increase or decrease the amount of resources needed and when they will be available?

4.4 Estimating and developing activity durations

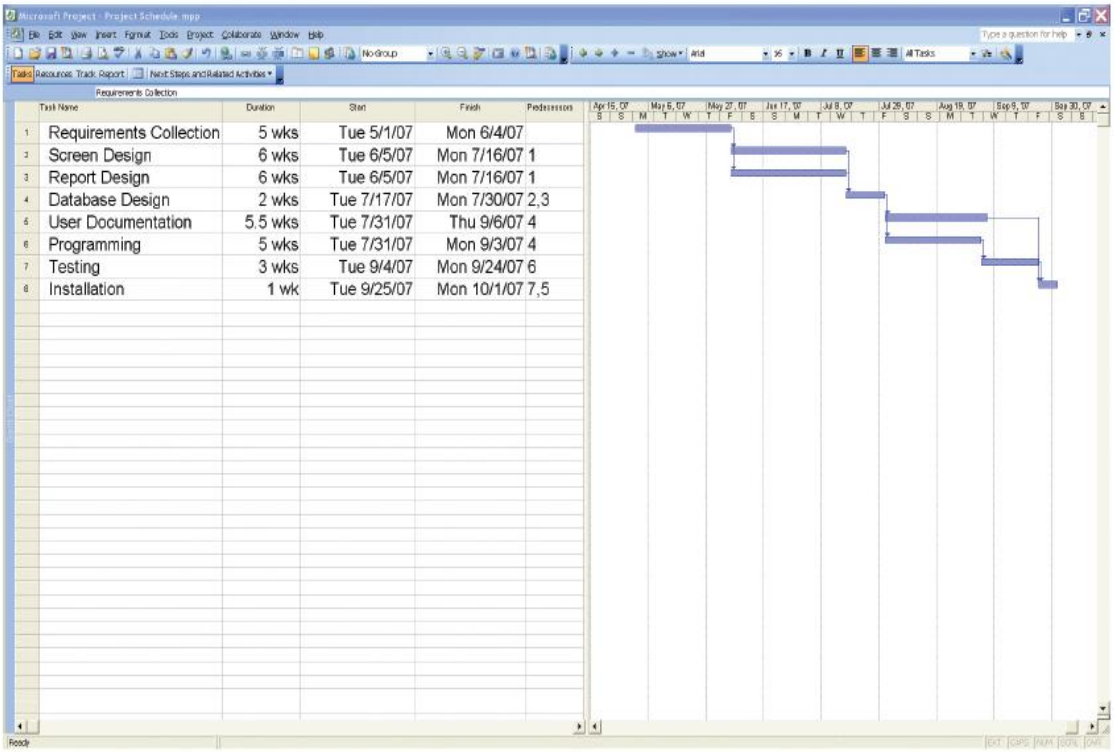
After working with key stakeholders to define activities, determine their dependencies, and estimate their resources, the next process in project time management is to estimate the duration of activities. It is important to note that duration includes the actual amount of time worked on an activity plus elapsed time. For example, even though it might take one workweek or five workdays to do the actual work, the duration estimate might be two weeks to allow extra time needed to obtain outside information. The people or resources assigned to a task will also affect the task duration estimate.

Several tools and techniques assist in schedule development, such as:

- A Gantt chart is a common tool for displaying project schedule information.
- Critical path analysis is a very important tool for developing and controlling project schedules.
- PERT analysis is a means for considering schedule risk on projects.

4.5 Gantt Chart

Gantt charts provide a standard format for displaying project schedule information by listing project activities and their corresponding start and finish dates in calendar form. Gantt charts are sometimes referred to as bar charts because the activities start and end dates are shown as horizontal bars. An example of a gantt chart is as shown in Figure 14



	Task Name	Duration	Start	Finish	Predecessors
1	Requirements Collection	5 wks	Tue 5/1/07	Mon 6/4/07	
2	Screen Design	6 wks	Tue 6/5/07	Mon 7/16/07	1
3	Report Design	6 wks	Tue 6/5/07	Mon 7/16/07	1
4	Database Design	2 wks	Tue 7/17/07	Mon 7/30/07	2,3
5	User Documentation	5.5 wks	Tue 7/31/07	Thu 9/6/07	4
6	Programming	5 wks	Tue 7/31/07	Mon 9/3/07	4
7	Testing	3 wks	Tue 9/4/07	Mon 9/24/07	6
8	Installation	1 wk	Tue 9/25/07	Mon 10/1/07	7,5

Figure 14: Graphical diagrams that depict project plans:A Gantt chart

4.6 Critical Path Method

Many projects fail to meet schedule expectations. Critical path method (CPM)also called critical path analysisis a network diagramming technique used to predict total project duration. A critical path for a project is the series of activities that determine the earliest time by which the project can be completed. It is the longest path through the network diagram.

What does it mean?

Critical path means that, the project manager do not have any luxury of delaying the project, when performing the activities on critical path. So every activity on the critical path must complete on time for the project to complete on time. A delay in any of the activities on critical path, will delay the whole project.

Critical path has the least amount of **slack or float**. Slack or float is the amount of time an activity may be delayed without delaying a succeeding activity or the project finish date. Normally, several tasks are done in parallel on projects, and most projects have multiple paths through a network diagram. The longest path or the path that contains the critical tasks is what drives the completion date for the project. You are not finished with the project until you have finished all the tasks.

4.6.1 Importance of Critical Path for The Project Manager

As project manager your main objective is to look at the activities in the project, for any slippage and to correct them as needed. Especially with respect to critical path the project manager has to understand two points.

1. Understand the critical path and make sure each activity on the critical path is completed on time. Knowing the critical path of the project will help the project manager to use any of schedule compression techniques to keep the critical path activities on track in terms of timelines.

2. Understand the activities which are not on the critical path. This will give a room for the project manager to play with the activities, if there are any delays with any of them. Meaning that this gives project manager some amount of freedom to consider the delays in one or more activities without impact the overall timelines of the project.

The following are a few benefits of the critical path method:

- It shows the graphical view of the project.
- It discovers and makes dependencies visible.
- It helps in project planning, scheduling, and controlling.
- It helps in contingency planning.
- It shows the critical path, and identifies critical activities requiring special attention.
- It helps you assign the float to activities and flexibility to float activities.
- It shows you where you need to take action to bring project back on track.

4.6.2 Managing Critical Path Tasks of a Project

- Shorten the duration or work on a task on the critical path.
- Break a critical task into smaller tasks that can be worked on at the same time by different resources.
- Revise task dependencies to enable more scheduling flexibility.
- Schedule overtime.
- Assign additional resources to work on critical path tasks.

4.6.3 Calculating the Critical Path

To find the critical path for a project, you must first develop a good network diagram, which in turn requires a good activity list based on the WBS. Once you create a network diagram, you must also estimate the duration of each activity to determine the critical path. Calculating the critical path involves adding the durations for all activities on each path through the network diagram. The longest path is the critical path.

Figure 15 shows the a network diagram for Project X again. Figure 15 shows all of the pathsa total of fourthrough the network diagram. Note that each path starts at the first node (1) and ends at the last node (8) on the network diagram. This figure also shows the length or total duration of each path through the network diagram. These lengths are computed by adding the durations of each activity on the path. Because path B-E-H-J has the longest duration at 16 days, it is the critical path for the project.

What does the critical path really mean? Even though the critical path is the longest path, it represents the shortest time required to complete a project. If one or more activities on the critical path take longer than planned, the whole project schedule will slip unless the project manager takes corrective action.

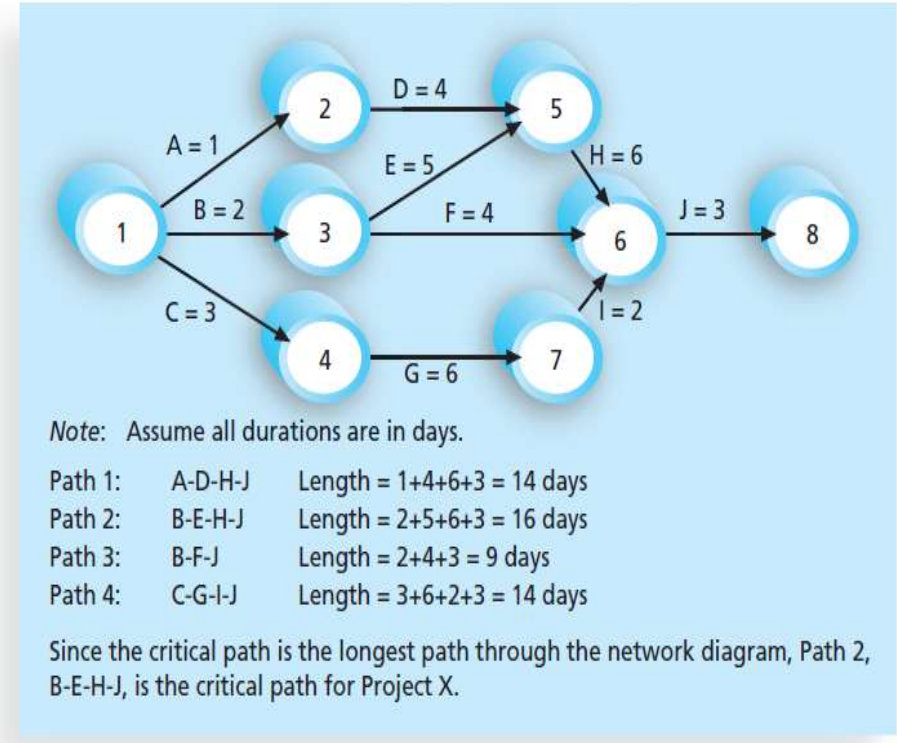


Figure 15: Determining the critical path for Project X

4.6.4 Calculating Float, Free Float, Total Float

Total Float - is the amount of time an activity can be delayed without delaying the project completion date. On a critical path, the total float is zero. Total float is often known as the **slack**.
Free float is the amount of time an activity can be delayed without delaying the Early Start of its successor activity.
Based on the below network diagram in Figure 16, identify the total paths, critical path, and float for each path.

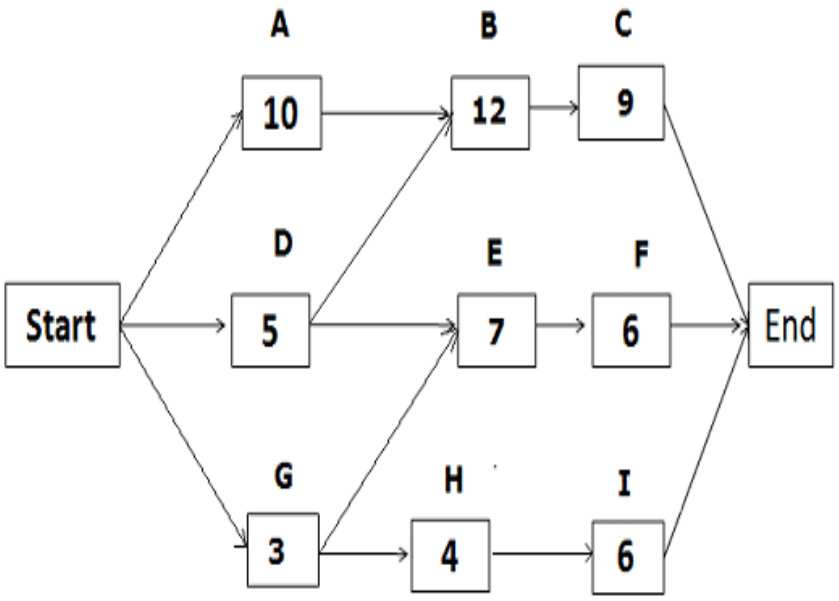


Figure 16: Network Diagram for Project X

The above network diagram in Figure 16 has five paths; the paths and their duration are as follows:

1. Start → A → B → C → End, duration: 31 days.
2. Start → D → E → F → End, duration: 18 days.
3. Start → D → B → C → End, duration: 26 days.
4. Start → G → H → I → End, duration: 13 days.
5. Start → G → E → F → End, duration: 16 days.

Since the duration of the first path is the longest, it is the critical path. The float on the critical path is zero. The float for the second path:
"Start → D → E → F → End" = duration of the critical path − duration of the path "Start → D → E → F → End" = 31 − 18 = 13
Hence, the float for the second path is 13 days.
Using the same process, we can calculate the float for other paths as well.
Float for the third path = 31 − 26 = 5 days.
Float for the fourth path = 31 − 13 = 18 days.
Float for the fifth path = 31 − 16 = 15 days.

4.6.5 Calculate Early Start (ES), Early Finish (EF), Late Start (LS), and Late Finish (LF)

In the previous subsection, we have identified the critical path, and the duration of the other paths, its time to move on to more advanced calculations, Early Start, Early Finish, Late Start and Late Finish.

Calculating Early Start (ES) and Early Finish (EF)
To calculate the Early Start and Early Finish dates, we use forward pass; we will start from the beginning of network diagram in Figure 16 and proceed to the end.
Early Start (ES) for the first activity on any path will be 1, because no activity can be started before the first day. The start point for any activity or step along the path is the end point of the predecessor activity on the path plus one.
The formula used for calculating Early Start and Early Finish dates.

- Early Start of the activity = Early Finish of predecessor activity + 1
- Early Finish of the activity = Activity duration + Early Start of activity − 1

Early Start and Early Finish Dates for the path Start → A → B → C → End
Early Start of activity A = 1 (*Since this is the first activity of the path*)
Early Finish of activity A = ES of activity A + activity duration − 1 = 1 + 10 − 1 = 10
Early Start of activity B = EF of predecessor activity + 1 = 10 +1 = 11
Early Finish of activity B = ES of activity B + activity duration − 1 = 11 + 12 − 1 = 22
Early Start of activity C = EF of predecessor activity + 1 = 22 +1 = 23
Early Finish of activity C = ES of activity C + activity duration − 1 = 23 + 9 − 1 = 31

Early Start and Early Finish Dates for the path Start → D → E → F → End
Early Start of activity D = 1 (*Since this is the first activity of the path*)
Early Finish of activity D = 1 + 5 − 1 = 5
Early Start of activity E = EF of predecessor activity + 1

Since the Activity E has two predecessor activities, which one will you select? You will select the activity with the greater Early Finish date. Early Finish of activity D is 5, and Early Finish of activity G is 3 (*we will calculate it later*).

Therefore, we will select the Early Finish of activity D to find the Early Start of activity E.
Early Start of activity E = EF of predecessor activity + 1 = 5 + 1 = 6
Early Finish of activity E = 6 + 7 1 = 12
Early Start of activity F = 12 + 1 = 13
Early Finish of activity F = 13 + 6 − 1 = 18

Early Start and Early Finish Dates for the path Start → G → H → I → End
Early Start of activity G = 1 (Since this is the first activity of the path) Early Finish of activity G = 1 + 3 − 1 = 3
Early Start of activity H = 3 + 1 = 4 Early Finish of activity H = 4 + 4 − 1 = 7
Early Start of activity I = 7 +1 = 8 Early Finish of activity I = 8 + 6 − 1 = 13
Calculating Late Start (LS) and Late Finish (LF)
We have calculated Early Start and Early Finish dates of all activities. See Figure 17. Now it is time to calculate the Late Start and Late Finish dates. Late Finish of the last activity in any path will be the same as the Last Finish of the last activity on the critical path, because you

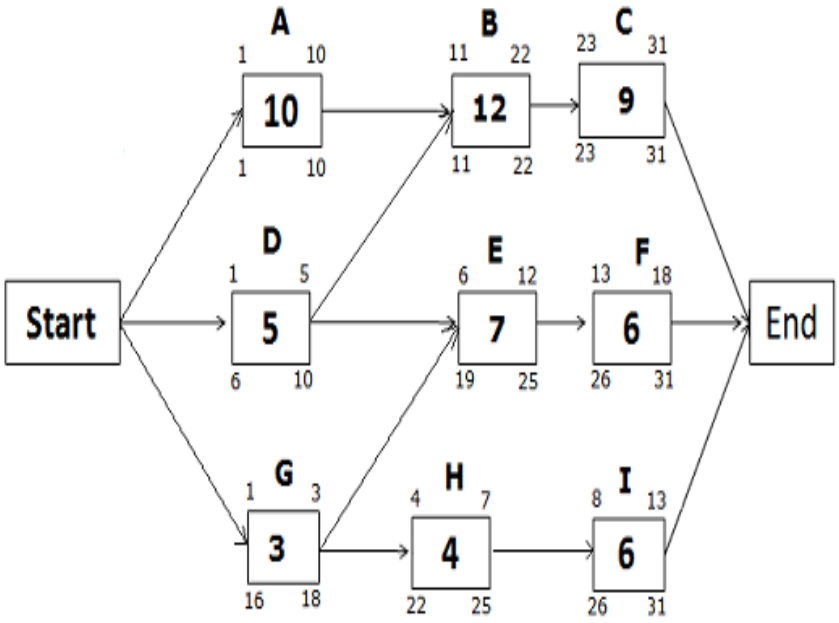


Figure 17: Network Diagram for Project X, with times

cannot continue any activity once the project is completed. The formula used for Late Start and Late Finish dates:

- Late Start of Activity = Late Finish of activity − activity duration + 1
- Late Finish of Activity = Late Start of successor activity − 1

To calculate the Late Start and Late Finish, we use backward pass; i.e. we will start from the last activity and move back towards the first activity.

Late Start and Late Finish Dates for the path Start → A → B → C → End
On a critical path, Early Start, and Early Finish dates will be the same as Late Start and Late Finish dates.

Late Start and Late Finish Dates for the path Start → D → E → F → End
Late Finish of activity F = 31 (because you cannot allow any activity to cross the project completion date)
Late Start of activity F = LF of activity F − activity duration + 1 = 31 − 6 +1 = 26
Late Finish of activity E = LS of successor activity − 1 = LS of activity F − 1 = 26 − 1 = 25
Late Start of Activity E = LF of activity E − activity duration + 1 = 25 − 7 + 1 = 19
Late Finish of activity D = LS of successor activity − 1
If you look at the network diagram, you will notice that activity D has two successor activities, B and E. So, which activity will you select?
You will select the activity with the earlier(least) Late Start date. Here, Late Start of activity B is 11, and Late Start of activity E is 19.
Therefore, you will select activity B which has the earlier Late Start date.
Hence,
Late Finish of activity D = LS of activity B − 1 = 11 − 1 = 10
Late Start of Activity D = LF of activity D − activity duration + 1 = 10 − 5 + 1 = 6

Late Start and Late Finish Dates for the path Start → G → H → I→ End
Late Finish of activity I = 31 (because you cannot allow any activity to cross the project completion date) Late Start of activity I = 31 − 6 + 1 = 26
Late Finish of activity H = 26 − 1 = 25 Late Start of activity H = 25 − 4 + 1 = 22
Late Finish of Activity G = 19 − 1= 18 (we will choose the late start of activity E, not activity H, because the Late Start of activity E is earlier than the Late Start of activity H)
Late Start of activity G = 18 − 3 + 1 = 16

Calculate the Free Float
The formula for the Free Float is:
Free Float = ES of next activity − EF of current activity − 1

4.7 Exercises

1. Using Figure 12, enter the activities, their durations (in days), and their relationships in Microsoft Project. Use a project start date of November 3, 2017. View the network diagram. Does it look like Figure 13? Return to the Gantt Chart view. Click View on the menu bar, select Table: Entry, and then click Schedule to recreate the free and total float or slack for Project X. You may need to move the split bar to the right to reveal all of the table columns. Write a few paragraphs explaining what the network diagram and schedule table show about Project Xs schedule.

2. Consider Figure 18. All duration estimates or estimated times are in days, and the network proceeds from Node 1 to Node 9.

   (a) Draw an AOA network diagram representing the project. Put the node numbers in circles and draw arrows from node to node, labeling each arrow with the activity letter and estimated time.

   (b) Identify all of the paths on the network diagram and note how long they are, using Figure 15 as a guide for how to represent each path.

   (c) What is the critical path for this project and how long is it?

   (d) What is the shortest possible time needed to complete this project?

3. Enter the information from Exercise (2) above, into Microsoft Project. View the network diagram and task schedule table to see the critical path and float or slack for each activity. Print the Gantt chart and network diagram views and the task schedule table. Write a short note that interprets this information for someone unfamiliar with project time management.

4. Using the information in the table in Figure 19, assuming that the project team will work a standard working week (5 working days in 1 week) and that all tasks will start as soon as possible:

   (a) Determine the critical path of the project

   (b) Calculate the planned duration of the project in weeks

   (c) Identify any non-critical tasks and the float (free slack) on each.

5. You have been asked to determine a rough schedule for a nine-month Billing System Conversion project as part of your job as a consultant to a Fortune 500 firm. The firms old system was written in COBOL on a mainframe computer, and the maintenance costs are prohibitive. The new system will run on an off-the-shelf application. You have identified several high-level activities needed to initiate, plan, execute, control, and close

the project. Table in Figure 20 shows your analysis of the projects tasks and schedule so far.

(a) Using the information in the Table in Figure 20, use Microsoft Project to create a Gantt chart and network diagram based on this information.

(b) Identify at least two milestones that could be included under each of the process groups in the Table in Figure 20. Then write a detailed description of each of these milestones that meets the SMART criteria.

Activity	Initial Node	Final Node	Estimated Duration
A	1	2	2
B	2	3	2
C	2	4	3
D	2	5	4
E	3	6	2
F	4	6	3
G	5	7	6
H	6	8	2
I	6	7	5
J	7	8	1
K	8	9	2

Figure 18: Network diagram data for a small project

Task	Description	Duration (Working Days)	Predecessor/s
A	Requirement Analysis	5	
B	Systems Design	15	A
C	Programming	25	B
D	telecoms	15	B
E	Hardware Installation	30	B
F	Integration	10	C, D
G	System Testing	10	E, F
H	Training/Support	5	G
I	Handover and Go-Live	5	H

Figure 19: Tasks

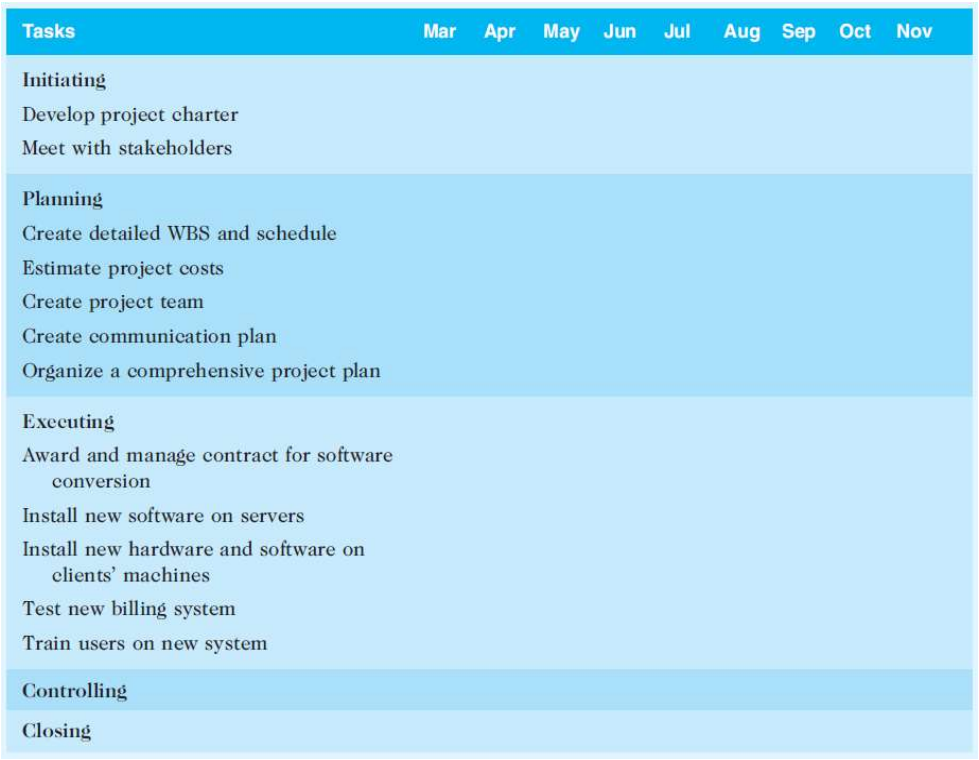


Figure 20: COBOL conversion project schedule

5 Project Cost Management

Project cost management includes the processes required to ensure that a project team completes a project within an approved budget. There are four processes for project cost management:

1. *Planning cost management* involves determining the policies, procedures, and documentation that will be used for planning, executing, and controlling project cost. The main output of this process is a cost management plan.

2. *Estimating costs* involves developing an approximation or estimate of the costs of the resources needed to complete a project. The main outputs of the cost estimating process are activity cost estimates, basis of estimates, and project documents updates.

3. *Determining the budget* involves allocating the overall cost estimate to individual work items to establish a baseline for measuring performance. The main outputs of the cost budgeting process are a cost baseline, project funding requirements, and project documents updates.

4. *Controlling costs* involves controlling changes to the project budget. The main outputs of the cost control process are work performance information, cost forecasts, change requests, project management plan updates, project documents updates, and organizational process assets updates.

5.1 Cost Management Plan

The first step in project cost management is planning how the costs will be managed throughout the life of the project. Project costs, like project schedules, grow out of the basic documents that initiate a project, like the project charter. The project manager and other stakeholders use expert judgment, analytical techniques, and meetings to produce the cost management plan.

In general, a cost management plan includes some of the following information:

- *Units of measure:* Each unit used in cost measurements, such as labor hours or days, should be defined.

- *Reporting formats:* This section would describe the format and frequency of cost reports required for the project.

5.2 Cost Estimation Tools and Techniques

Several tools and techniques are available to assist in creating one. Some of these tools and techniques are analogous cost estimating, bottom-up estimating, expert judgment, three-point estimating and project management estimating software.

5.2.1 Analogous estimates

Analogous estimates, also called top-down estimates, use the actual cost of a previous, similar project as the basis for estimating the cost of the current project. This technique requires a good deal of expert judgment and is generally less costly than other techniques, but it is also less accurate. Analogous estimates are most reliable when the previous projects are similar in fact, not just in appearance. In addition, the groups preparing cost estimates must have the needed expertise to determine whether certain parts of the project will be more or less expensive than analogous projects. For example, estimators often try to find a similar project and then customize or modify it for known differences. However, if the project to be estimated

involves a new programming language or working with a new type of hardware or network, the analogous estimate technique could easily result in too low an estimate.

5.2.2 Bottom-up estimates

Bottom-up estimates involve estimating the costs of individual work items or activities and summing them to get a project total. This approach is sometimes referred to as activity-based costing. The size of the individual work items and the experience of the estimators drive the accuracy of the estimates. If a detailed WBS is available for a project, the project manager could require each person who is responsible for a work package to develop a cost estimate for that work package, or at least an estimate of the amount of resources required. Someone in the financial area of an organization often provides resource cost rates, such as labor rates or costs per pound of materials, which can be entered into project management software to calculate costs. The software automatically calculates information to create cost estimates for each level of the WBS and finally for the entire project. Using smaller work items increases the accuracy of the cost estimate because the people assigned to do the work develop the cost estimate instead of someone unfamiliar with the work. The drawback with bottom-up estimates is that they are usually time-intensive and therefore expensive to develop.

5.2.3 Three-point estimates

Three-point estimates involve estimating the most likely, optimistic, and pessimistic costs for items. Next, project teams use a formula like the PERT weighted average described in Section 2.2.3, take a simple average.

5.3 Controlling Costs

Project cost is a major factor in measuring project success. In fact, project cost is one of three in the triple constraint, cost-schedule-scope. A project manager that can deliver a quality product or service on time and under budget will be in high demand. If cost-schedule-scope goals cannot be achieved the only resort is to make changes at the business level of authority, and that requires approval from stakeholders, e.g. project sponsors. Knowing and applying the project-level and/or business-level tools for decreasing cost is an important skill-set for any project manager.

A project manager can use the following ways to reduce cost to ensure that his project completes on or under budget.

- *Find Cheaper Contracts* - The number one best way to lower cost is to solicit proposals from not one, but several bidders. Contractors are quick to discover whether they have competition and adjust their costs accordingly. Open the contract to multiple subcontractors and select the one that is the best value for the money. Time is money, so research companies past performance completion rates and go with the company that has an on-time delivery reputation. Specialized companies that can work faster may be cheaper even at higher rates.

- *Find Cheaper Resources* -Even though they require training, companies are always hiring recent college graduates, because they are cheaper. Well, maybe the work does not require a resource with 20-years experience. Perhaps, a less experienced but cheaper resource is the way to go.

- *Shorten the Project Duration* - Again, time is money, so look to optimize your schedule by shortening the longest path. If you can shorten the duration of activities along the longest path or perform some of these activities in parallel you might be able to decrease

the overall project duration. If you can legitimately shorten the duration of activities along the longest path you may decrease the project labor expense. You definitely will lower the facility and other administrative overhead costs.

- *Prevent Overtime Work* - If you are considering overtime work than your project most likely is behind schedule. In this situation you will have to determine the higher priority cost or time, and limit overtime work accordingly.

- *Re-examine Effort Estimates* - Does your resource really need 8-hours per day to perform an activity or can they work part-time or 4-hours per day on a scheduled activity? As you would examine duration estimates to shorten the schedule look to effort estimates to reduce cost. This may require some renegotiation with your team member resource managers.

- *Reduce Product Scope* - Sometimes a project manager must make difficult decisions. Reducing scope to reduce project cost maybe one of those tough decisions. If the priority at this juncture is cost then you just might have to prune the scope to save the project. Reducing scope allows you to remove activities from the schedule and their associated resource costs. Note that scope reduction may require authorization from important stakeholders.

- *Reduce Profit Margins* - To keep your product competitively priced and to win the contract the best way you can reduce costs may be to simply reduce your companys profit margin. This, of course, is least desirable. Profit margin adjustment also requires authorization from high level managers. However, here you can reduce cost and maintain schedule and quality commitments.

6 Using Software to Assist in Project Management

Project teams can use various types of software to assist in project management. Project teams can create documents with wordprocessing software, give presentations with presentation software, track information with spreadsheets, databases, or customized software, and transmit information using various types of communication software.

Also, a wide variety of automated project management tools are available to help you manage a development project. Most of the available tools have a set of common features that include the ability to define and order tasks, assign resources to tasks, and easily modify tasks and resources.

Microsoft Project for Windows is one of the project management softwares used in project management. Project management software helps:

1. To develop a WBS, which serves as a basis for creating Gantt charts, allocating durations, assigning resources, allocating costs, and performing other tasks. You can also use the templates that come with various project management software products to help you create a WBS for your project.

2. To draw network diagrams, determine the critical path for a project and filter specific project time management information.

Some advantages of using project management software are:

- **Collaborate with team members in real-time**. Project management software commonly offers communication tools that can assist teams in discussing issues in real time. The benefit is that each team member can be kept up to date, quickly dealing with issues as they arise.

- **Document sharing**. For projects that require the use of significant documentation, document sharing tools allow individuals to edit, update the status of reports and create systems that allow for transparency and communication.
- **Manage project costs**. Controlling costs is one of the most important benefits of project management. Project management software generally includes tools that can assist in managing project costs.
- **Ability to manage risks, forecasting, and budgets**. Knowing project risks, creating forecasts and tracking budgets are some of the biggest advantages of project management software.
- **Reporting capabilities**. With flexible report formats and the ability to quickly access needed data, project management software can keep tasks on schedule.

NB: Refer to the tutorial provided in class for detailed information to use Microsoft project software.

6.1 Project Management Practice

6.1.1 Parctice 1

Identify an IT project of your choice and do the following:

1. Propose a suitable title for the project.
2. Identify a start date of the project.
3. Build a task list:
   (a) Identify the main tasks (project summary tasks) of the project.
   (b) Identify subtasks for each main task.
   (c) Identify the duration of each task. Duration may be in minutes, hours, days, weeks or months.
   (d) Identify a milestone for each main task.

   Note: Milestones are significant events that are either reached within the plan of a project (such as the completion of a phase of work) or imposed upon the plan(such as a deadline by which to apply for funding). milestones don't involve work, therefore there duration is zero.
4. Identify suitable links among tasks to create task dependencies between them.
5. Identify resources. Some types of resources are:
   - **Work resources** - Include people and equipments needed to complete the tasks in a projects plan.
   - **Cost resources** - Represent a financial associated with a task you need to account for in a plan. E.g expenses like travel, entertainment e.t.c.
   - **Material resources** - Consumables you use up as a project proceeds.
6. Assign resources to tasks.
7. Using Microsoft Project, create Work Break down Structure (WBS) and a Gantt chart for your project. View the activity schedule of your project.

6.1.2 Practice 2

Your company has decided that it needs a new sales recording system and that an off-the-shelf package is the best solution. The main tasks have been identified and durations assessed as shown in Figure 21:

A	Draw up a functional requirements specification	4 weeks
B	Consider various relevant software packages and select one	3 weeks
C	Identify and specify the necessary hardware and communications equipment	2 weeks
D	Order the hardware and equipment	1 week
E	Identify the key package modifications needed to meet the functionality required	2 weeks
F	Modify the software package as necessary	8 weeks
G	Accept delivery and install all hardware and equipment needed for the package	10 weeks
H	Design a training plan	3 weeks
I	Set up a testing plan	3 weeks
J	Unit test all the amended package modules	4 weeks
K	Train the users	3 weeks
L	Full integration and acceptance testing	3 weeks
M	Implement the new system	1 week

Figure 21: Main Tasks

The dependencies between the tasks in Figure 21 are as follows:

- B cannot start until A is completed
- C, E, H and I cannot start until B is completed
- D cannot start until C is completed
- F cannot start until E is completed
- G cannot start until D is completed
- J cannot start until F, G and I are completed
- K cannot start until H is completed
- L cannot start until J and K are completed
- M cannot start until L is completed

Using Microsoft Project software, do the following:

1. Draw a full Gantt chart for the project, to show all dependencies, float and highlighting the critical path.
2. Describe how each of the following changes to task durations (on their own) would affect the critical path and project duration.

(a) Task B - reduced to 1 week

(b) Task F - increased to 11 weeks

(c) Task G - reduced to 7 weeks

7 Project Quality Management

7.1 What is Project Quality Management?

The purpose of project quality management is to ensure that the project will satisfy the needs for which it was undertaken. Recall that project management involves meeting or exceeding stakeholder needs and expectations. The project team must develop good relationships with key stakeholders, especially the main customer for the project, to understand what quality means to them. After all, the customer ultimately decides if quality is acceptable. Many technical projects fail because the project team focuses only on meeting the written requirements for the main products being created and ignores other stakeholder needs and expectations for the project.

Quality: An IT system is considered to be of quality if it meets the customer's needs and some predefined set of standards.

Quality, therefore, must be on an equal level with project scope, time, and cost. If a projects stakeholders are not satisfied with the quality of the project management or the resulting products of the project, the project team will need to adjust scope, time, and cost to satisfy the stakeholder. Meeting only written requirements for scope, time, and cost is not sufficient. To achieve stakeholder satisfaction, the project team must develop a good working relationship with all stakeholders and understand their stated or implied needs.

7.2 The Process of Project Quality Management

Project quality management involves three main processes:

1. *Planning quality management* includes identifying which quality requirements and standards are relevant to the project and how to satisfy them. Incorporating quality standards into project design is a key part of quality planning. For an IT project, quality standards might include allowing for system growth, planning a reasonable response time for a system, or ensuring that the system produces consistent and accurate information. Quality standards can also apply to IT services. For example, you can set standards for how long it should take to get a reply from a help desk or how long it should take to ship a replacement part for a hardware item under warranty. The main outputs of planning quality management are a quality management plan, a process improvement plan, quality metrics, quality checklists, and project documents updates. A metric is a standard of measurement. Examples of common metrics include failure rates of products, availability of goods and services, and customer satisfaction ratings.

2. *Performing quality assurance* involves periodically evaluating overall project performance to ensure that the project will satisfy the relevant quality standards. The quality assurance process involves taking responsibility for quality throughout the projects life cycle. Top management must take the lead in emphasizing the roles all employees play in quality assurance, especially senior managers roles. The main outputs of this process are change requests, project management plan updates, project documents updates, and organizational process asset updates.

3. *Controlling quality* involves monitoring specific project results to ensure that they comply with the relevant quality standards while identifying ways to improve overall quality. This

process is often associated with the technical tools and techniques of quality management, such as Pareto charts, quality control charts, and statistical sampling. You will learn more about these tools and techniques later in this chapter. The main outputs of quality control include quality control measurements, validated changes, validated deliverables, work performance information, change requests, project management plan updates, project documents updates, and organizational process asset updates.

7.3 Methods for monitoring quality

Various methods exist for conducting quality control reviews, some rather informal and others highly structured. In choosing one, the guiding idea should be the usual touchstone of appropriateness. Whatever approach is taken, the review process must be planned. The reviewers must be clear about:

- The criteria to be applied.
- The definitions of pass or fail for the items reviewed.

Among the approaches you might consider are the following.

Self-checking: This really supports the total quality management (TQM) theme and relies on the author of the work having a good understanding of the requirement and also of the skills and techniques needed to meet it. The approach is best suited to more experienced team members who should, as with any other check, formally record their reviews. The big disadvantage with self-checking is that, if someone has misunderstood something in, say, a design document, they will continue to labour under the same misapprehension during the checking process and the defect will not be discovered. For this reason, one of the other forms of check should be used in areas of known criticality and occasionally elsewhere to verify the self-checking procedure.

Team leader reviews: Here, a team members supervisor is responsible for checking that work meets its specification and conforms to any requisite standards. If defects are identified, corrective work is undertaken and the work is then reinspected. This method is useful when reviews of work are to be linked to coaching as will often be the case for junior staff. The problem is that it is only as effective as the supervisors ability to spot problems and, of course, the team leader may not in fact be as skilled as the author in the particular discipline or technique involved. In addition, bottlenecks can occur with this method, as all checking has to be undertaken by one person; this is particularly the case with projects that are using fast programming methods where programmer productivity can outstrip the ability of the team leader to review the work.

Peer reviews: This is similar in principle to a team leader review in that one person is checking the work of another. Team leader review and peer review can be used in tandem, with the team leader in effect sharing the review work with one of the more experienced team members. Peer review does, of course, rely on the ability of the reviewer to spot defects, and some people are better at this than others. There is a special danger for the project manager to watch for with peer reviews: that of rivalry or one-upmanship between the author and reviewer. They may need reminding that the objective is not to score points off each other but to produce a high-quality product. In a multidisciplinary team, where the team leader does not have expertise in the area to be reviewed, peer review may be the only practical way of conducting quality control.

Walkthroughs: Conducting a walkthrough, which involves a review by a group of people, can prove very effective, as the skills, knowledge and eyesight (for spotting errors) of a number

of people are brought to bear. Walkthroughs do, however, require good organization so that everyone concerned is clear about their objectives and has the necessary documentation available early enough for proper study. In addition, to keep review meetings moving forward and to stop them straying from the point, good chairmanship is essential. It is particularly important in walkthroughs to stick to the identification of problems and to avoid trying to find solutions. Obviously, if a solution does emerge immediately it would be silly to discard it; but since, in meetings, the length of time spent in discussion tends to rise exponentially with the number present, too many ideas for solutions will soon get the meeting completely bogged down. Finally, since reviewing is an intensive activity, meetings should be time-limited say to a maximum of one or two hours. If the review cannot be completed in that time, it will be much more productive to adjourn and reconvene than to continue with the current meeting.

Fagan inspections: Fagan inspections are a formalized form of walkthrough, named after Michael Fagan who devised the technique for IBM. With this method, the author of a piece of work reports to the project manager that it is complete and ready for checking. This triggers a six-stage review process:

1. *Planning.* A trained Fagan moderator organizes the inspection, nominating people for the roles of inspector, reader and scribe and defining the date, duration and purpose of the meeting.
2. *Overview.* This optional meeting can be used to provide background information on the work or on the Fagan process or to assign particular inspection tasks to individuals.
3. *Preparation.* Individuals prepare for the inspection by examining the material and developing their understanding prior to the review.
4. *Meeting.* This is very structured and chaired by the moderator. The reader paraphrases the item; each inspector, including the author and moderator, reports defects in the item and these are recorded by the scribe.
5. *Rework.* The author takes the list of defects and, having corrected them, categorizes them by severity and type.
6. *Follow-up.* A reviewer, nominated by the moderator, checks that the rework is complete and that the defects have been categorized correctly. The data resulting from the inspection is recorded on a database and the moderator signs off the inspection. The compilation of statistics is an important part of the Fagan process, since they can be used to:
   - Measure the cost of the inspection.
   - Produce defect rates for the project.
   - Identify hot spots in a project for more intensive management.
   - Predict the effort required for quality management.

Disadvantages cited of the Fagan technique are that training is required in the various roles especially those of moderator and inspector and that inspections are time-consuming and expensive. Whilst there is some truth in both of these claims, it must be remembered that the costs of not discovering problems early enough usually outweigh the costs of thorough checking.

External review: It may sometimes be a good idea to request a review of work from a body or individual outside the project team. This could be by a quality assurance department or simply from an expert in the work being undertaken. External reviews may be a

requirement of the contract or they may be imposed as part of an ISO 11001 conformance procedure. The principal disadvantage of an external review is probably cost, but, on a large project at least, the plans should allow some margin for it. There is an additional problem in that the reviewer will not have the same familiarity with the material as will members of the project team, so an external review is likely to take longer. The obverse of this is that the external person approaches the review without any preconceptions and the resultant objectivity should improve the effectiveness of the review.

8 Project Human Resource Management

8.1 Importance of Human Resource Management

People are our most important asset. People determine the success and failure of organizations and projects. Most project managers agree that managing human resources effectively is one of the toughest challenges they face. Project human resource management is a vital component of project management, especially in the IT fieldin which qualified people are often hard to find and keep. It is important to understand global IT workforce issues and their implications for the future.

8.2 What is Project Human Resource Management

Project human resource management includes the processes required to make the most effective use of the people involved with a project. Human resource management includes all project stakeholders: sponsors, customers, project team members, support staff, suppliers supporting the project, and so on. Human resource management includes the following four processes:

1. *Planning human resource management* involves identifying and documenting project roles, responsibilities, and reporting relationships. The main output of this process is a human resource plan.

2. *Acquiring the project team* involves assigning the needed personnel to work on the project. Key outputs of this process are project staff assignments, resource calendars, and project management plan updates.

3. *Developing the project team* involves building individual and group skills to enhance project performance. Team-building skills are often a challenge for many project managers. The main outputs of this process are team performance assessments and enterprize environmental factors updates.

4. *Managing the project team* involves tracking team member performance, motivating team members, providing timely feedback, resolving issues and conflicts, and coordinating changes to help enhance project performance. Outputs of this process include change requests, project management plan updates, project documents updates, enterprize environmental factors updates, and organizational process assets updates.

8.3 Developing a Human Resource Management Plan

To develop a human resource plan for a project, you must identify and document:

- project roles and responsibilities.
- skills and reporting relationships.

The human resource plan often includes:

- an organizational chart for the project,
- detailed information on roles and responsibilities,
- a staffing management plan

Before creating an organizational chart or any part of the human resource plan for a project, top management and the project manager must identify what types of people the project needs to ensure success.

8.3.1 Project Organizational Charts

The nature of IT projects often means that project team members come from different backgrounds and possess a wide variety of skills. It can be very difficult to manage such a diverse group of people, so it is important to provide a clear organizational structure for a project. After identifying important skills and the types of people needed to staff a project, the project manager should work with top management and project team members to create an organizational chart for the project. Figure 22 provides part of an organizational chart for a large project that involves hardware and software development.

8.3.2 Staff Management Plan

A staffing management plan describes when and how people will be added to the project team and taken off it. The level of detail may vary based on the type of project. For example, if an IT project is expected to need 100 people on average over a year, the staffing management plan would describe the types of people needed to work on the project, such as Java programmers, business analysts, and technical writers, and the number of each type of person needed each month. The plan would also describe how these resources would be acquired, trained, rewarded, and reassigned after the project. All of these issues are important to meeting the needs of the project, the employees, and the organization.

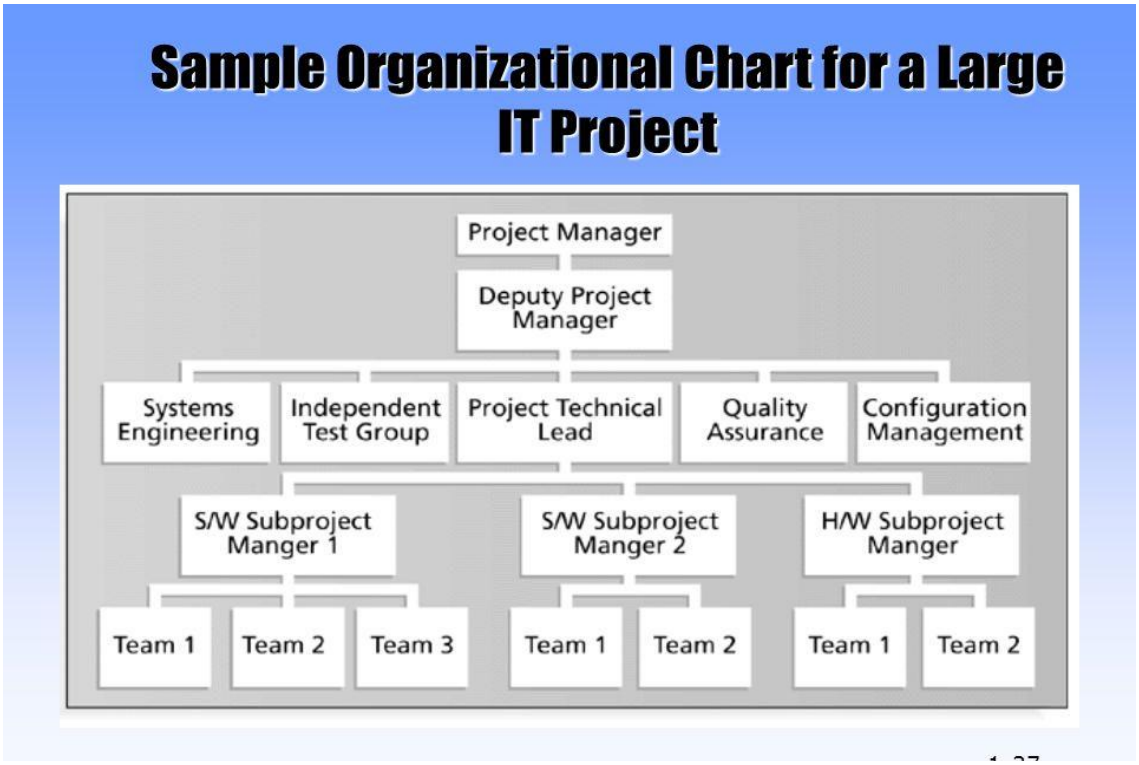


Figure 22: Sample organizational chart for a large IT project

8.4 Acquiring the Project Team

In addition to recruiting team members, it is also important to assign the appropriate type and number of people to work on projects at the appropriate times. The process of acquiring project team is an activity that allows selecting and approving human resource availability according to the list of required skills and criteria for choosing human resource for the purpose of obtaining the team necessary to accomplish project work.

8.4.1 Criteria For Acquiring Project Team

The process is managed by the project management team. The project manager is a person who has an authority to manage the recruiting process and decide on team members. While selecting and deciding on team members, the following acquiring project team criteria should be considered:

- *Required level of experience at appropriate projects and activities.* The project manager gathers all information about current experience level of team member to compare it with the required experience level.
- *Interest level.* The project manager defines whether team member is interested in participating in project and why.
- *Personal qualifications.* By means of interviews and questionnaires, the project manager look at personal skills and talents of team member and measure how this individual team member will work with other project team members.
- *Availability.* The project manager identifies whether project team member desired for the project is available. The project manager should decide with functional managers on the availability of potential team members.
- *Knowledge.* The project manager identifies the competency and proficiency of available project team members.

8.5 Project Team Developing

Even if a project manager has successfully recruited enough skilled people to work on a project, the project manager must ensure that people can work together as a team to achieve project goals. Many IT projects have talented people working on them, but it takes teamwork to complete most projects successfully. The main goal of team development is to help people work together more effectively to improve project performance.

The process of developing project team is an activity that allows improving internal and external interactions of team members, developing their competencies and skills, and optimizing the overall team environment for the purpose of enhancing project performance. The process pursues the following major project team development objectives:

- Improve skills and technical competencies of team members to increase the probability of achieving project deliverables in the context of decreasing costs, improving quality and reducing schedules.
- Improve internal agreement and personal recognition among team members to enhance morale, reduce number of conflicts, and improve productivity.
- Establish a dynamic team culture to improve team spirit and cooperation between team members to contribute to better knowledge and expertise sharing.

To achieve these team development objectives, the outputs obtained during the acquiring project team process are used. Project staff assignment documentation, resource schedules and human resource plan allow achieving the following:

- Creating a list of team members who will participate in project team development activities.
- Defining times when team members can participate in project team development activities.
- Identifying training and development strategies to improve performance of team members.

8.5.1 Assessment Of Team Performance

Development of project team should be assessed in order to identify success of team development activities and team building strategies. Assessment of team development efforts can be achieved by using the following team performance assessment indicators:

- Improvements in skills and competencies of team members to allow a team member to perform assignments more efficiently.
- Reduced rate of staff turnover.
- Improved team cohesiveness (united and working together effectively) which contributes to an increase of the overall project performance.

8.6 Managing Project Team

In addition to developing the project team, the project manager must lead it in performing various project activities. After assessing team performance and related information, the project manager must decide if changes should be requested to the project, or if updates are needed to enterprise environmental factors, organizational process assets, or the project management plan. Project managers must use their soft skills to find the best way to motivate and manage each team member.

8.6.1 Tools and Techniques for Managing Project Teams

Several tools and techniques are available to assist in managing project teams:

Observation and conversation: Project managers need to observe team members at work to assess how they are performing and ask team members how they feel about their work. Many project managers like to practice management by walking around to physically see and hear their team members at work. Informal or formal conversations about how a project is going can provide crucial information. For virtual workers, project managers can still observe and discuss work and personal issues via e-mail, telephone, or other media.

Project performance appraisals: allows measuring performance of project team members to clarify project team roles and responsibilities, review constructive feedback, discover unresolved issues, develop individual training programs, and outline specific goals for future project activities.

Conflict management: Few projects are completed without conflicts. Some types of conflict are actually desirable on projects, but many are not. Its important for project managers to understand strategies for handling conflicts and to proactively manage conflict.

The implementation of the tools and techniques for managing teams results in fostering teamwork, integrating collaborative efforts of team members, and achieving high performance. In particular, the following outputs can be obtained from the successful project team management process implementation:

- Change requests are generated during the course of the process and submitted to the project management team. Change requests allow reducing the probability or issue occurrence and mitigate a negative impact on project activities. The major purpose of change requests is to ensure development of preventive actions to reduce team member absence, achieve appropriate role clarification, and avoid gaps in project schedules and timelines.
- Project management plan updates generally include changes to team member roles, responsibilities and authorities which all together are parts of the staff management plan.
- Project management organization assets include lessons learned documentations, historical records, various templates, and standards. All this information can be collected and then used later in future projects.

8.7 General Advice on Managing Teams

Teamwork is almost always lacking within organizations that fail, and often present within those that succeed.36 The five dysfunctions of teams are:

- Absence of trust
- Fear of conflict
- Lack of commitment
- Avoidance of accountability
- Inattention to results

Some suggestions for ensuring that teams are productive include the following:

- Be patient and kind with your team. Assume the best about people; do not assume that your team members are lazy and careless.
- Fix the problem instead of blaming people. Help people work out problems by focusing on behaviors.
- Establish regular, effective meetings. Focus on meeting project objectives and producing positive results.
- Limit the size of work teams to three to seven members.
- Plan some social activities to help project team members and other stakeholders get to know each other better. Make the social events fun and not mandatory.
- Stress team identity. Create traditions that team members enjoy.
- Nurture team members and encourage them to help each other. Identify and provide training that will help individuals and the team as a whole become more effective.

9 Project Risk Management

Risk: An uncertain event or condition that, if it occurs, has a positive or negative effect on the project objectives. **Project risk management** is the art and science of identifying, analyzing, and responding to risk throughout the life of a project and in the best interests of meeting project objectives. Six major processes are involved in risk management:

1. *Planning risk management* involves deciding how to approach and plan risk management activities for the project. By reviewing the project management plan, project charter, stakeholder register, enterprise environmental factors, and organizational process assets, project teams can discuss and analyze risk management activities for their particular projects. The main output of this process is a risk management plan.

2. *Identifying risks* involves determining which risks are likely to affect a project and documenting the characteristics of each. The main output of this process is the start of a risk register.

3. *Performing qualitative risk analysis* involves prioritizing risks based on their probability and impact of occurrence. After identifying risks, project teams can use various tools and techniques to rank risks and update information in the risk register. The main outputs are project documents updates.

4. *Performing quantitative risk analysis* involves numerically estimating the effects of risks on project objectives. The main outputs of this process are project documents updates.

5. *Planning risk responses* involves taking steps to enhance opportunities and reduce threats to meeting project objectives. Using outputs from the preceding risk management processes, project teams can develop risk response strategies that often result in updates to the project management plan and other project documents.

6. *Controlling risk* involves monitoring identified and residual risks, identifying new risks, carrying out risk response plans, and evaluating the effectiveness of risk strategies throughout the life of the project. The main outputs of this process include work performance information, change requests, and updates to the project management plan, other project documents, and organizational process assets.

9.1 Planning Risk Management

Planning risk management is the process of deciding how to approach risk management activities and plan for them in a project; the main output of this process is a risk management plan. A risk management plan documents the procedures for managing risk throughout the project. Project teams should hold several planning meetings early in the projects life cycle to help develop the risk management plan. The project team should review project documents as well as corporate risk management policies, risk categories, lessons-learned reports from past projects, and templates for creating a risk management plan.

A risk management plan summarizes how risk management will be performed on a particular project. Like plans for other knowledge areas, it becomes a subset of the project management plan. Figure 23 lists the general topics that a risk management plan should address. It is important to clarify roles and responsibilities, prepare budget and schedule estimates for risk-related work, and identify risk categories for consideration. It is also important to describe how risk management will be done, including assessment of risk

probabilities and impacts as well as the creation of risk-related documentation. The level of detail included in the risk management plan can vary with the needs of the project.

In addition to a risk management plan, many projects also include contingency plans, fallback plans, and contingency reserves.

- Contingency plans are predefined actions that the project team will take if an identified risk event occurs. For example, if the project team knows that a new release of a software package may not be available in time to use for the project, the team might have a contingency plan to use the existing, older version of the software.
- Fallback plans are developed for risks that have a high impact on meeting project objectives, and are put into effect if attempts to reduce the risk do not work. For example, a new college graduate might have a main plan and several contingency plans for where to live after graduation, but if these plans do not work out, a fallback plan might be to live at home for a while. Sometimes the terms contingency plan and fallback plan are used interchangeably.
- Contingency reserves or contingency allowances are provisions held by the project sponsor or organization to reduce the risk of cost or schedule overruns to an acceptable level. Contingency reserves are for known risks, while management reserves are funds held for unknown risks. For example, if a project appears to be off course because the staff is inexperienced with some new technology and the team had not identified the problem as a risk, the project sponsor may provide additional funds from contingency reserves to hire an outside consultant to train and advise the project staff in using the new technology.

Before you can really understand and use project risk management processes on IT projects, it is necessary to recognize and understand the common sources of risk.

Topic	Questions to Answer
Methodology	How will risk management be performed on this project? What tools and data sources are available and applicable?
Roles and responsibilities	Which people are responsible for implementing specific tasks and providing deliverables related to risk management?
Budget and schedule	What are the estimated costs and schedules for performing risk-related activities?
Risk categories	What are the main categories of risks that should be addressed on this project? Is there a risk breakdown structure for the project? (See the information on risk breakdown structures later in this chapter.)
Risk probability and impact	How will the probabilities and impacts of risk items be assessed? What scoring and interpretation methods will be used for the qualitative and quantitative analysis of risks? How will the probability and impact matrix be developed?
Revised stakeholders' tolerances	Have stakeholders' tolerances for risk changed? How will those changes affect the project?
Tracking	How will the team track risk management activities? How will lessons learned be documented and shared? How will risk management processes be audited?
Risk documentation	What reporting formats and processes will be used for risk management activities?

Figure 23: Topics addressed in a risk management plan

9.2 Common Sources of Risk on IT Projects

Many organizations develop their own risk questionnaires. Broad categories of risks described on these questionnaires might include:

- *Market risk*: If the IT project will create a new product or service, will it be useful to the organization or marketable to others? Will users accept and use the product or service? Will someone else create a better product or service faster, making the project a waste of time and money?
- *Financial risk*: Can the organization afford to undertake the project? How confident are stakeholders in the financial projections? Will the project meet NPV, ROI, and payback estimates? If not, can the organization afford to continue the project? Is this project the best way to use the organizations financial resources?
- *Technology risk*: Is the project technically feasible? Will it use mature, leading-edge, or bleeding-edge technologies? When will decisions be made on which technology to use? Will hardware, software, and networks function properly? Will the technology be available in time to meet project objectives? Could the technology be obsolete before a useful product can be created? You can also break down the technology risk category into hardware, software, and network technology, if desired.
- *People risk:* Does the organization have people with appropriate skills to complete the project successfully? If not, can the organization find such people? Do people have the proper managerial and technical skills? Do they have enough experience? Does senior management support the project? Is there a project champion? Is the organization familiar with the sponsor or customer for the project? How good is the relationship with the sponsor or customer?
- *Structure/process risk*: What degree of change will the new project introduce into user areas and business procedures? How many distinct user groups does the project need to satisfy? With how many other systems does the new project or system need to interact? Does the organization have processes in place to complete the project successfully?

A risk breakdown structure is a useful tool to help project managers consider potential risks in different categories. Similar in form to a work breakdown structure, a risk breakdown structure is a hierarchy of potential risk categories for a project. Figure 24 shows a sample risk breakdown structure that might apply to many IT projects. The highest-level categories are business, technical, organizational, and project management. Competitors, suppliers, and cash flow are categories that fall under business risks. Under technical risks are the categories of hardware, software, and network. Hardware could be broken down further to include malfunctions, availability, and cost.

In addition to identifying risk based on the nature of the project or products created, it is also important to identify potential risks according to project management knowledge areas, such as scope, time, cost, and quality. Notice that a major category in the risk breakdown structure in Figure 24 is project management. The table in Figure 25 lists potential negative risk conditions that can exist within each knowledge area. Understanding common sources of risk is very helpful in risk identification, which is the next step in project risk management.

9.3 Identifying Risks

Identifying risks is the process of understanding what potential events might hurt or enhance a particular project. It is important to identify potential risks early, but you

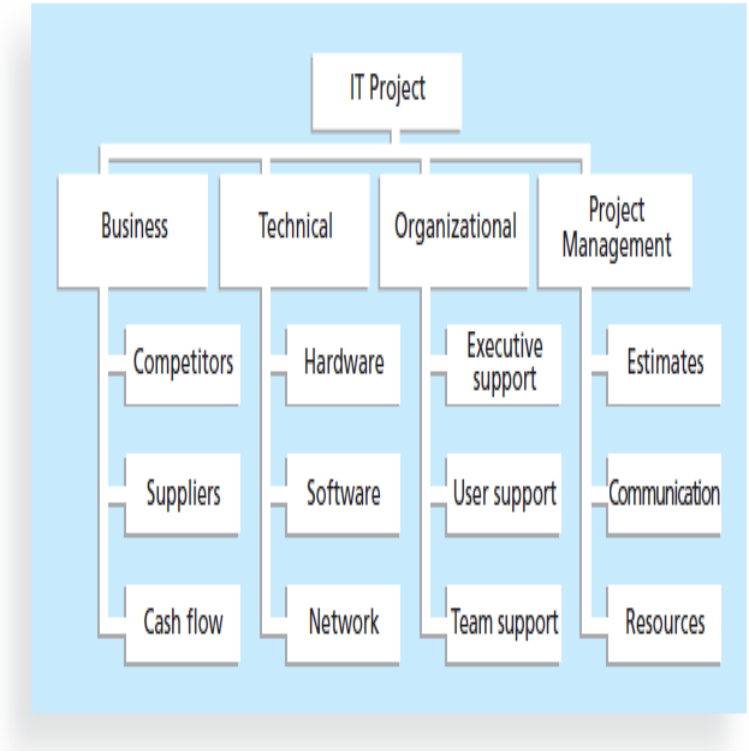


Figure 24: Sample risk breakdown structure

Knowledge Area	Risk Conditions
Integration	Inadequate planning; poor resource allocation; poor integration management; lack of post-project review
Scope	Poor definition of scope or work packages; incomplete definition
Time	Errors in estimating time or resource availability; errors in determining the critical path; poor allocation and management of float; early release of competitive products
Cost	Estimating errors; inadequate productivity, cost, change, or contingency
Quality	Poor attitude toward quality; substandard design, materials, and workmanship; inadequate quality assurance program
Human resource	Poor conflict management; poor project organization and definition of responsibilities; absence of leadership
Communications	Carelessness in planning or communicating
Risk	Ignoring risk; unclear analysis of risk; poor insurance management
Procurement	Unenforceable conditions or contract clauses; adversarial relations
Stakeholders	Lack of consultation with key stakeholder

Figure 25: Potential negative risk conditions associated with each knowledge area

must also continue to identify risks based on the changing project environment. Also remember that you cannot manage risks if you do not identify them first. By understanding common sources of risks and reviewing a projects planning documents (for risk, cost, schedule, quality, and human resource management), activity cost and duration estimates, the scope baseline, stakeholder register, project documents, procurement documents, enterprise environmental factors, and organizational process assets, project managers and

their teams can identify many potential risks.

There are several tools and techniques for identifying risks. Project teams often begin this process by reviewing project documentation, recent and historical information related to the organization, and assumptions that might affect the project. Project team members and outside experts often hold meetings to discuss this information and ask important questions about it as they relate to risk. After identifying potential risks at the initial meeting, the project team might then use different information-gathering techniques to further identify risks. Some common techniques include brainstorming, the Delphi technique, and interviewing.

Brainstorming is a technique by which a group attempts to generate ideas or find a solution for a specific problem by amassing ideas spontaneously and without judgment. This approach can help the group create a comprehensive list of risks to address later during qualitative and quantitative risk analysis. An experienced facilitator should run the brainstorming session and introduce new categories of potential risks to keep the ideas flowing. After the ideas are collected, the facilitator can group and categorize the ideas to make them more manageable. Care must be taken, however, not to overuse or misuse brainstorming. Although businesses use brainstorming widely to generate new ideas, the psychology literature shows that individual people working alone produce a greater number of ideas than they produce through brainstorming in small, face-to-face groups. Group effects, such as fear of social disapproval, the effects of authority hierarchy, and domination of the session by one or two vocal people often inhibit idea generation for many participants.

Delphi technique The Delphi technique is an approach to gathering information that helps prevent some of the negative group effects found in brainstorming. The basic concept of the Delphi technique is to derive a consensus among a panel of experts who make predictions about future developments.

Interviewing is a fact-finding technique for collecting information in face-to-face, phone, e-mail, or instant-messaging discussions. Interviewing people with similar project experience is an important tool for identifying potential risks. For example, if a new project involves using a particular type of hardware or software, people who had recent experience with that hardware or software could describe their problems on a past project. If people have worked with a particular customer, they might provide insight into the potential risks of working for that customer again. It is important to be well prepared for leading interviews; it often helps to create a list of questions to use as a guide during the interview.

9.4 The Risk Register

The main output of risk identification is a list of identified risks and other information needed to begin creating a risk register. A risk register is a document that contains results of various risk management processes; it is often displayed in a table or spreadsheet format. A risk register is a tool for documenting potential risk events and related information. Risk events refer to specific, uncertain events that may occur to the detriment or enhancement of the project. For example, negative risk events might include the performance failure of a product created as part of a project, delays in completing work as scheduled, increases in estimated costs, supply shortages, litigation against the company, and strikes. Examples of positive risk events include completing work sooner or cheaper than planned, collaborating with suppliers to produce better products, and good publicity resulting from the project.

The table in Figure 26 provides a sample of the format for a risk register that might be used on a new project. Actual data that might be entered for one of the risks is included below the table. Notice the main headings often included in the register.

- *An identification number for each risk event*: The project team may want to sort by risk events or quickly search for specific risk events, so they need to identify each risk with a unique descriptor, such as an identification number.
- *A rank for each risk event:* The rank is usually a number, with 1 representing the highest risk.
- *The name of the risk event*: Example names include defective server, late completion of testing, reduced consulting costs, and good publicity.
- *A description of the risk event:* Because the name of a risk event is often abbreviated, it helps to provide a more detailed description. For example, reduced consulting costs might be expanded in the description to explain that the organization might be able to negotiate a lower cost for a particular consultant because she enjoys working with your company.
- *The category under which the risk event falls*: For example, defective server might fall under the broader category of technology or hardware technology.
- *The root cause of the risk*: The root cause of the defective server might be a defective power supply.
- *Triggers for each risk:* Triggers are indicators or symptoms of actual risk events. For example, cost overruns on early activities may be symptoms of poor cost estimates. Defective products may be symptoms of a low-quality supplier. Documenting potential risk symptoms for projects also helps the project team identify more potential risk events.
- *Potential responses to each risk*: A potential response to the defective server might be to include a clause in the suppliers contract to replace the server within a certain time period at a negotiated cost.
- *The risk owner or person who will take responsibility for the risk:* For example, a certain person might be in charge of any server-related risk events and managing response strategies.
- *The probability of the risk occurring:* There might be a high, medium, or low probability of a certain risk event. For example, the risk might be low that the server would actually be defective.
- *The impact to the project if the risk occurs:* There might be a high, medium, or low impact to project success if the risk event actually occurs. A defective server might have a high impact on successfully completing a project on time.
- *The status of the risk*: Did the risk event occur? Was the response strategy completed? Is the risk no longer relevant to the project? For example, a contract clause may have been completed to address the risk of a defective server.

For example, the following data might be entered for the first risk in the register.

- No.: R44
- Rank: 1
- Risk: New customer

No.	Rank	Risk Description	Category	Root Cause	Triggers	Potential Responses	Risk Owner	Probability	Impact	Status
R44	1									
R21	2									
R7	3									

Figure 26: Sample risk register

- Description: We have never done a project for this organization before and dont know too much about them. One of our companys strengths is building good customer relationships, which often leads to further projects with that customer. We might have trouble working with this customer because they are new to us.
- Category: People risk
- Root cause: We won a contract to work on a project without really getting to know the customer.
- Triggers: The project manager and other senior managers realize that we dont know much about this customer and could easily misunderstand their needs or expectations.
- Potential responses: Make sure the project manager is sensitive to the fact that this is a new customer and takes the time to understand them. Have the PM set up a meeting to get to know the customer and clarify their expectations.
- Risk owner: Our project manager
- Probability: Medium
- Impact: High
- Status: PM will set up the meeting within the week.

9.5 Planning Risk Responses

After an organization identifies and quantifies risks, it must develop an appropriate response to them. Developing a response to risks involves developing options and defining strategies for reducing negative risks and enhancing positive risks. The four basic response strategies for negative risks are:

Risk avoidance or eliminating a specific threat, usually by eliminating its causes. Of course, not all risks can be eliminated, but specific risk events can be. For example, a project team may decide to continue using a specific piece of hardware or software on a project because the team knows it works. Other products that could be used on the project may be available, but if the project team is unfamiliar with them, they could cause significant risk. Using familiar hardware or software eliminates this risk.

Risk acceptance or accepting the consequences if a risk occurs. For example, a project team planning a big project review meeting could take an active approach to risk by having a contingency or backup plan and contingency reserves if the team cannot get approval for a specific meeting site. On the other hand, the team could take a passive approach and accept whatever facility the organization provides.

Risk transference or shifting the consequence of a risk and responsibility for its management to a third party. For example, risk transference is often used in dealing

with financial risk exposure. A project team may purchase special insurance or warranty protection for specific hardware needed for a project. If the hardware fails, the insurer must replace it within a specified period of time.

Risk mitigation or reducing the impact of a risk event by reducing the probability of its occurrence. Suggestions for reducing common sources of risk on IT projects were provided at the beginning of this chapter. Other examples of risk mitigation include using proven technology, having competent project personnel, using various analysis and validation techniques, and buying maintenance or service agreements from subcontractors.

The four basic response strategies for positive risks are:

Risk exploitation or doing whatever you can to make sure the positive risk happens. For example, suppose that a company funded a project to provide new computer classrooms for a nearby school in need. They might select one of their top project managers to organize news coverage of the project, write a press release, or hold some other public event to ensure that the project produces good public relations for the company, which could lead to more business.

Risk sharing or allocating ownership of the risk to another party. Using the same example of implementing new computer classrooms, the project manager could form a partnership with the schools principal, school board, or parent-teacher organization to share responsibility for achieving good public relations for the project. On the other hand, the company might partner with a local training firm that agrees to provide free training for all of the teachers on how to use the new computer classrooms.

Risk enhancement or changing the size of the opportunity by identifying and maximizing key drivers of the positive risk. For example, an important driver of getting good public relations for the computer classrooms project might be to generate awareness and excitement about it among students, parents, and teachers. These groups might then do their own formal or informal advertising of the project and the company, which in turn might interest other groups and generate more business.

Risk acceptance also applies to positive risks when the project team does not take any actions toward a risk. For example, the computer classrooms project manager might assume that the project will result in good public relations for the company and not feel compelled to do anything extra.

The main outputs of risk response planning include risk-related contractual agreements, updates to the project management plan and other project documents, and updates to the risk register.

Pine Valley Furniture
System Service Request

REQUESTED BY Juanita Lopez DATE October 1, 2007

DEPARTMENT Purchasing, Manufacturing Support

LOCATION Headquarters, 1-322

CONTACT Tel: 4-3267 FAX: 4-3270 e-mail: jlopez

TYPE OF REQUEST

[X] New System
[ ] System Enhancement
[ ] System Error Correction

URGENCY

[ ] Immediate – Operations are impaired or opportunity lost
[ ] Problems exist, but can be worked around
[X] Business losses can be tolerated until new system installed

PROBLEM STATEMENT

Sales growth at PVF has caused greater volume of work for the manufacturing support unit within Purchasing. Further, more concentration on customer service has reduced manufacturing lead times, which puts more pressure on purchasing activities. In addition, cost-cutting measures force Purchasing to be more aggressive in negotiating terms with vendors, improving delivery times, and lowering our investments in inventory. The current modest systems support for Manufacturing/Purchasing is not responsive to these new business conditions. Data are not available, information cannot be summarized, supplier orders cannot be adequately tracked, and commodity buying is not well supported. PVF is spending too much on raw materials and not being responsive to manufacturing needs.

SERVICE REQUEST

I request a thorough analysis of our current operations with the intent to design and build a completely new information system. This system should handle all purchasing transactions, support display and reporting of critical purchasing data, and assist purchasing agents in commodity buying.

IS LIAISON Chris Martin (Tel: 4-6204 FAX: 4-6200 e-mail: cmartin)

SPONSOR Sal Divario, Director, Purchasing

TO BE COMPLETED BY SYSTEMS PRIORITY BOARD

[ ] Request approved Assigned to
Start date
[ ] Recommend revision
[ ] Suggest user development
[ ] Reject for reason

Figure 27: System Service Request Form