6

Managing Information Systems Project Time and Resources

Themes of Chapter 6

- What is project time management?
- What characteristics define an effective project manager?
- What principles are important in project management?
- What tools are useful?
- What skill sets are important?
- What is the life cycle of an information systems development project?
- What are the stages in the information systems development life cycle?
- Why is there a need for good information systems project managers?
- How is the balance between sociocultural and technical factors achieved?

This chapter describes project time management and its importance to the success of information systems projects. A vital characteristic of successful project managers is the way they manage time and the way they help team members manage time.

A critical success factor for effective time management is timely communication of standards and expectations. Setting milestones provides appropriate reference points for the project manager and team members. This chapter describes the ***Program Evaluation Review Technique (PERT)*** and ***Critical Path Method (CPM)***, the most widely used tools for scheduling, monitoring, and communicating time aspects of projects. Using this network approach, this chapter also describes how to analyze project schedules and modify them to meet deadlines. Finally we provide suggestions that will help you keep to deadlines.

This chapter discusses techniques, but it is important to understand that although such techniques can be helpful to the project manager, the use of such techniques does not guarantee success. Indeed, as our discussion with Terry Young, an experienced leader of research projects shows, a combination of experience, a willingness to negotiate, and the commitment of people can be even more important (Exhibit 6.1).

Exhibit 6.1 The Case Against the Use of Techniques (A Discussion With Terry Young)

Although I learned about PERT charts at university, I have never really used them at work, and I have not used many software-based tools either. My first experiences of project management were in a commercial research center. The central drive was to keep to schedule and budget through monthly reviews. The company had a strong financial drive, and I would get the project returns monthly.

The first largish project that I worked on was a European collaboration to develop a combination of circuit elements for optical communication. We built lasers, electronic drivers, waveguides, switches, photo-detectors, and preamplifiers. Planning was done by a group and again was financially constrained. Partners would tend to negotiate a share of the program and then work out what they believed they could do against their own internal strategies within the constraints of the program. The process produced a plan with a granularity of around one to three person-months. Once finalized, this became the project plan against which progress would be reported.

Success or failure depended largely on being able to deliver meaningful outputs from that plan—to satisfy the partners (who might want to reduce your funding at the next round if they were unhappy) and the company (which had to find the matching funds).

One way or another, this was the basic model for all the work I did—plan using experience, cost up, and then monitor monthly against hard financial figures. On the whole this worked well. We were optimistic about how long things would take, but only mildly so, and generally within the safety zones set up through contingency budgets. Project plans would generally consist of a description, followed by milestone achievements and the dates by which each was expected.

As I became more senior in the organization, I took more interest in the bidding and in the monitoring of projects—especially those projects that fell within my own financial codes. Overall my role required skills in recruitment, staff development, contracts, negotiation, bid management, and review. Costing was generally done through discussion and involved an analysis of what our best guesses were and what we thought the constraints were. Risk was explicitly addressed but again was constrained by not wanting to frighten the customer with the level of risk.

Monitoring involved reviewing projects. I was expected to review small projects (less than US $150,000, typically) each month with my staff. Larger projects were reviewed monthly with a team that included my boss, the financial director, and the site director. I was typically responsible for somewhere between $US 5–8 million per annum worth of projects and might have 20 to 30 small projects and 4 to 5 large ones for review. This gave a very clear idea of how much progress could be made in a month and how much it would typically cost.

I also would make up my own consolidated spreadsheet, which reviewed how the division as a whole was doing. Ironically, in view of the amount of data we were given, the process became very internalized and intuitive. We used the project-management terminology and understood what it meant, but we did not often apply it formally.

The other element of the process was the ancillary systems—risk registers, health and safety, export licenses, quality, and so on. People management was also my responsibility—annual reviews, target setting, personal development, and pay reviews. These things tended to go on a biannual cycle.

My take was that experience and consensus were more important than the use of specific techniques, and we tended to apply the latter in only a general way or when the project was big. However, it is true that people working on big projects ($US 20 million to over $100 million) were much more formal and rigorous in their approach.

When I entered the university sector recently, I obtained a grant portfolio of around US $10 million. My research focus lies in the value of healthcare technology and services. However, I discovered it was time to learn a whole new set of skills. I recruited a project manager with commercial experience. But the academic teams hated it. They found it too bureaucratic and, I suspect, too restricting. We had to back off, and what worked best was to set academic targets. Along with my academic colleagues, I reasoned and cajoled the team members through to their deliverables.

The thing I have learned from both experiences is the importance of working with people and getting people on our side. The most optimistic estimate can come in on time and to budget with a really committed team. The most generous contingency (and more) will always be spent by a team conditioned to fail, and the use of techniques will hardly affect the result either way.

6.1. Time as a Resource

Time is a resource if it is managed effectively; otherwise it will be a constraint. Timely delivery of information systems projects has been one of the biggest challenges for information systems project managers. Managing time effectively is therefore a critical component for project success. Time management relates not only to the anticipated planned activities but also to unexpected events—last-minute changes, personnel issues, conflict resolution, and so on. A successful project is the one that is on time, within budget, and delivers what is expected. Project managers should set the standard for a timely outcome by example. If project managers cannot control their time, then they will have difficulties controlling team members, and consequently the entire project is likely to be late. Project managers often work on tight deadlines and feel they have no time to think about time and its effective use. To be effective, a project manager must be organized and ***prioritize*** work. Depending on work habits, this could be done in different ways and may or may not be very formal.

A good way of understanding project time management issues is to consider personal time management. Organizing your own time might seem to be a fairly simple requirement, yet we all know how difficult it is in practice to use our time effectively. *To find out whether you have a time management problem, ask yourself the questions shown in Exhibit 6.2.*

Exhibit 6.2 Questions to Ask When Assessing Your Time Management

- Do you spend a lot of time responding to email messages?
- Do you spend a lot of time returning calls?
- How often do you work overtime?
- How often do you miss social events?
- How often do you reschedule your appointments?
- How often do you feel you need a large block of time to finish a task?
- Do you have a gatekeeper for unexpected visitors who take up your time?
- Do you prioritize your work? Based on what?
- Do you plan your vacation?

You may or may not be able to do something about all of these, but you will get a feel for whether you need to think about your own time management. In any case, whether you are able to address all these questions successfully or not is less important than the realization that time management is important. Information technology is like a double-edged sword, and it can cut both ways. Effective use of information technology can be a significant advantage to time management, but sometimes it can use your time ineffectively.

We will use email as an exemplar of potential time management issues. Email can have a significant positive impact on communications in terms of timeliness, convenience, accuracy, cost, storage, retrieval, and so on. But it can be a problem if not handled efficiently. You may send or receive a message at any time, but it is not a good use of your time if you check whether you have new mail every few minutes. It is not very difficult to surmise a rough distribution pattern for your incoming messages after a while. For example, you may notice that early in the week you get a lot of messages and it slows down toward the end of the week. You also know that when you get into your office on Monday morning there is a long list of email waiting for you, and it is worse when you return from a vacation.

Organize your own time management to accommodate your own email patterns.

With the ease of connectivity at hotels, conventions, airports, and elsewhere, many people tend to check their email messages when they travel out of town. While this may be useful when traveling on business, it does not help your overall productivity if you are on vacation. You must plan your vacation to *disconnect* with daily and routine work. Project managers often work under pressure for time, resource, and high expectation reasons, and that can cause work stress and burnout. Your vacation must provide a relief from all that. You must plan your communications, including email and voice messages, to give yourself flexibility. If you attend to your email continually and voicemail messages throughout the day you are an ineffective time manager. You may want to have a simple routine for checking your messages such as once in the morning and once in the afternoon. If you are preparing to leave for a meeting you should not check your email unless you expect a message about that meeting. A last-minute and unexpected email message can cause you to enter a meeting distracted, disorganized, and sometimes late.

This simple example relating to personal time management can be used to consider the time management of people in the organization generally. Activities need to be monitored, patterns detected, and appropriate plans organized so that time is used both efficiently and effectively.

6.2. Monitoring Time

Project managers who end up with a great deal of overtime or repeated delays should evaluate their time management principles carefully. An effective and experienced project manager should be able to evaluate with reasonable accuracy how long the project will take and how many staff hours are available for the project (leaving some margin of error for unexpected interruptions). Repeated delays and prolonged overtime may be the results of inaccurate evaluation of these two important components of time management.

It is possible to keep track of a small number of activities in your mind. But for multi-activity projects you will need a more systematic approach to control or keep track of time. In picking a method, try to select one that you feel comfortable with and can easily create and revise. For example, a simple status form such as the one shown as Figure 6.1 can help your time management.

A similar form with minor changes, like the one shown as Figure 6.2, can be used for daily activities.

❖ **Figure 6.1** Status Form

Activity tracking for project ....n a m e...........				
Activity	**Date Required**	**Duration**	**Start Date**	**Status**

❖ **Figure 6.2** Activity Form

Activities to be completed today ....d a t e.........				
Activity	**Time Required**	**Duration**	**Start Time**	**Status**

An effective project manager has a priority list. The lack of prioritization has an adverse effect on time management and decision making. People procrastinate either habitually or because they do not know how to finish the job. In either case, indecisiveness impacts negatively on time management. You may have worked with people who take too long to make a decision, not because they are not sure what to decide but because they hesitate to decide, fearing the consequences. Decision making is a part of a project manager's responsibilities, and often project managers must make decisive decisions within a short time. Indecisiveness can affect project organization, progress, personnel, and ultimately the outcome. Decisions have consequences, and that comes with the job. This does not mean that you should not consider all facts or should not solicit input from others or should not think about consequences. All this is essential to good management. However, consider the laws of diminishing returns, where, beyond a certain point, additional time and energy is unnecessary and if continued can be counterproductive.

Managers, including project managers, are said to spend most of their time in meetings. Many managers would argue that they attend too many meetings and most meetings are too time-consuming. What is important is not so much the number of meetings one attends or the amount of time spent in meetings but what is accomplished in relation to time spent. Frequent meetings lose significance and may become an end to themselves rather than a means to achieving goals. Sometimes people "fill in the space" with unnecessary and even irrelevant remarks, leaving everyone else frustrated at this "waste of time." Attending meetings can be tiring and is amongst the least favored activities that managers do, together with report writing and documentation. An effective project manager conducts a meeting with a few principles in mind (see Exhibit 6.3).

Exhibit 6.3 Principles About Meeting Management

- Longer meetings do not necessarily produce better results
- The need for an agenda that is communicated to all
- The need for continued focus and control
- Opportunity for participation by all
- Summation of outcome and closure

6.3. Project Activity Network

A typical information systems project management job involves planning, scheduling, and controlling all activities necessary to design, develop, implement, or maintain a computer application on time and within budget and meet user expectations. Information systems projects involve activities relative to hardware, software, networks, database, procedure, and people. Large and complex projects involve the participation of groups and individuals other than team members. These might include user departments, outside consultants, vendors, and government agencies. Projects will include a variety of interdependent tasks and expertise that require systematic record keeping and good communication channels.

It is very important for the project manager to be able to monitor progress for each activity at all times. To help information systems project managers plan, schedule, and control projects, a variety of methodologies currently exist, many of them in the form of software tools that are easy to use and modify. This section will describe the techniques of ***Program Evaluation Review Technique (PERT)*** and ***Critical Path Method (CPM)*** for planning, scheduling, and controlling information systems project activities. Although PERT and CPM were developed separately and for different reasons, there are similarities between them. In recent years features of both methods have been combined in project management software tools, such as Microsoft Project (see appendix). As shown in Exhibit 6.4, PERT/CPM helps project managers in their role in a number of ways.

Exhibit 6.4 Potential of PERT/CPM

- Estimate minimum time required for completing the entire project.
- Identify critical activities that must be completed in time for the entire project to be completed as scheduled.
- Show progress status for critical activities.
- Show progress status for noncritical activities.
- Estimate the length of time that these noncritical activities can be delayed.
- Estimate the likelihood of completing the entire project on schedule.

PERT/CPM shows the *sequence* and *duration* for each activity and enables the information systems project manager to determine which task may become a bottleneck and thus delay the entire project. It illustrates the interrelationship of events and activities involved in a project. PERT is described in terms of a network that consists of activities connected by arrows. Each activity is labeled by a number or a character and has a beginning, duration, and ending. You should be able to refer to each activity on this network in terms of when it starts, when it ends, and how long it takes to complete. Where each activity is depicted on the network suggests its position relative to other activities; activities that it follows and activities that it precedes.

Consider, for example, activities involved for a Web page development project. We will use a simplified version just to demonstrate the principles of a typical PERT/CPM network. This project involves the nine activities that were identified when producing the work breakdown structure discussed in Chapter 4. We can also estimate the duration for each activity and establish a sequence. The information can be organized as follows in Figure 6.3.

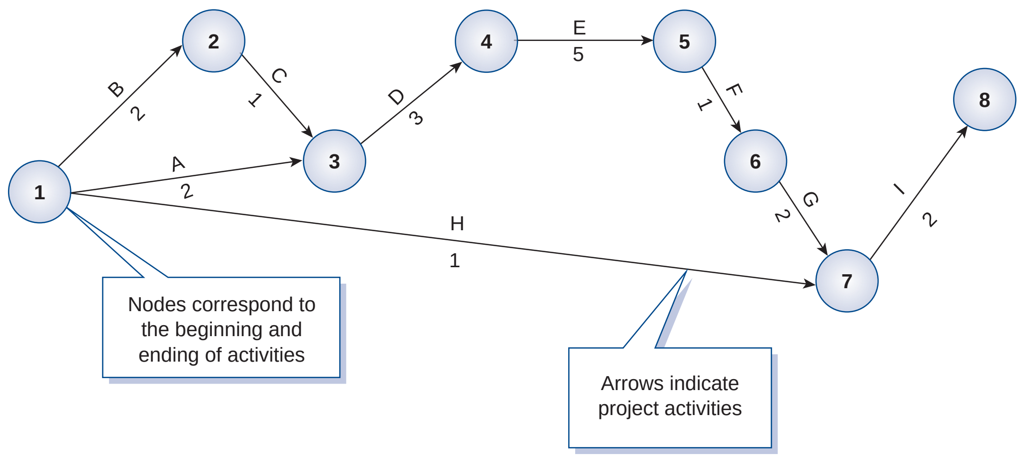
❖ **Figure 6.3** Development of a Personal Web Page

Activity	Activity Description	Duration (Days)	Preceding Activities
A	Determine user needs	2	–
B	Review software and languages	2	–
C	Purchase software	1	B
D	Design format and style	3	A, C
E	Write programs	5	D
F	Review outcome product with user	1	E
G	Make revisions	2	F
H	Select server site	1	–
I	Install on server and test	2	G

Note that the total time required to complete the project is 19 days, but the project can be completed within 16 days because activities A, B, and H can start at the same time and they do not have preceding activities, making them independent of other activities. The PERT/CPM network diagram, shown in Figure 6.4, depicts these nine activities together with the estimated duration for each. An arrow presents each activity. Activity duration is shown below the arrow. The network depicts the interdependence of all activities needed to complete this project. It correctly identifies activity B as the predecessor for activity C, activities A and B as the predecessors for activity D, and activities G and H as the predecessors for activity I, the final activity. An activity can start only after the preceding activity is complete.

Using this network we can determine the total project completion time by identifying what is called the ***critical path***. A ***path*** is a sequence of connected activities that extends from the starting node (1) to the completion node (8). The critical path in a network represents the longest path activities. Analyzing our nine-activity network, we can identify three paths. One path includes activities B, C, D, E, F, G, and I, which are connected by nodes 1–2–3–4–5–6–7–8. Another path includes activities A, D, E, F, G, and I, which are connected by nodes 1–3–4–5–6–7–8. And the third path includes activities H and I, which are connected by nodes 1–7–8. The total path duration for the first path is 16 days (2 + 1 + 3 + 5 + 1 + 2 + 2), for the second path is 15 days (2 + 3

❖ **Figure 6.4** Network of Nine Activities



+ 5 + 1 + 2 + 2), and for the third path is 3 days (1 + 2). Thus the first path with the ***longest*** path activities is the critical path in this network.

To reduce the total duration of the project, we will need to examine activities on the critical path and try to see if we can shorten the duration of any of those activities. However, as we reduce duration for some activities on the critical path another path may become the longest, making it the new critical path. This process can get complicated as the network gets larger and more complex. A more systematic approach is required that helps identify properties of each activity within the network. It starts by determining the earliest start and the earliest finish as well as the latest start and the latest finish times for each activity as part of what is called ***critical path analysis***.

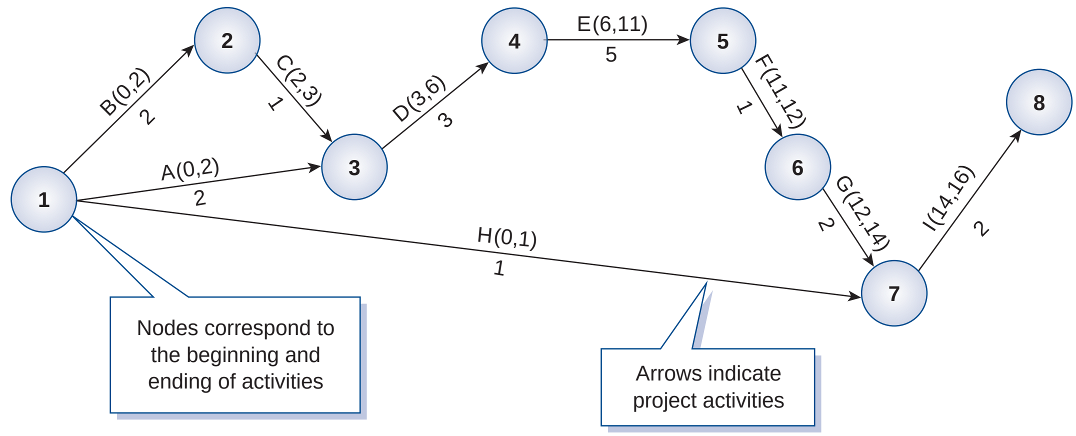
6.4. Critical Path Analysis

To analyze the critical path, we must first compute ***earliest start (ES)*** and ***earliest finish (EF)*** time for each activity in the network. Starting at the origin of the network that is node 1 in our diagram, we assign 0 to the start of all activities that begin at node 1. The earliest finish time for an activity is calculated by adding the duration for that activity to the earliest start time for that activity. For example, activity A starts at time 0 and has a duration of 2 days to complete. Thus the earliest finish time for activity A is 0 + 2 = 2. Using the abbreviations ES and EF to represent earliest start and earliest finish and t to represent time duration, the relationship can be expressed as:

$$EF = ES + t$$

The earliest start time for activities with multiple predecessors is the largest finish time among all preceding activities because all activities leading to any specific activity must be complete before that activity can start. For example, activity D on our network can start only after activities A, B, and C are complete. Even though activity A is estimated to take 2 days, activity D cannot start until activity C is complete—that is, on Day 3 because activity C cannot start until its preceding activity, B, is complete. Thus, *the rule for setting the earliest start time for any activity is to consider the latest of the earliest finish times for all preceding activities.* To make our network more informative, we present ES and EF information above the arrow next to the letter representing each activity as shown in the revised network diagram (Figure 6.5).

❖ **Figure 6.5** Network of Activities With ES and EF



Once the earliest start and earliest finish times are worked out, we need to calculate the ***latest start** (LS)* and ***latest finish** (LF)* times. To do this, we must start from the last node and work backward, calculating LS and LF for each activity. In our network, we start from node 8 and activity I first. For activity I to complete on time, the latest finish time must be 16 (the same as EF time), and since it takes 2 days to complete this activity we can calculate the latest start time by subtracting 2 from 16. Using the abbreviations LS and LF to represent latest start and latest finish and *t* to represent duration, the relationship can be expressed as:

$$LF = LS + t$$

or

$$LS = LF - t$$

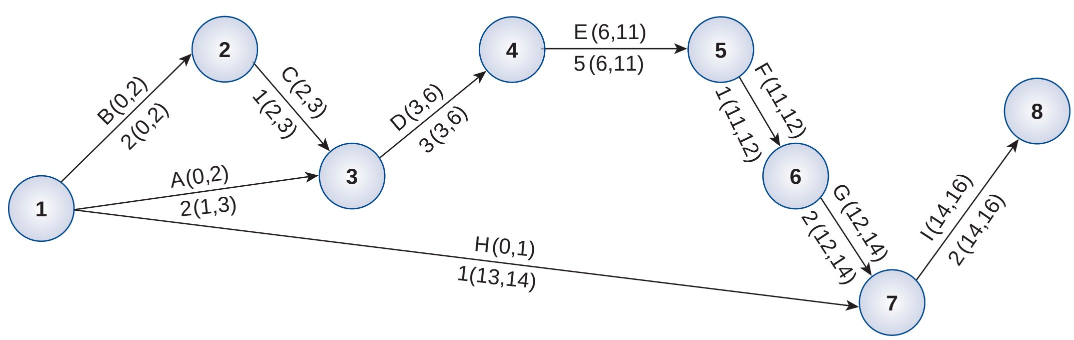
Using this expression we work backward and calculate the latest start time and the latest finish time for each activity on the network. If there is more than one activity leaving a node, *the rule for calculating the latest finish time for that activity is to use the smallest value of the latest start time for all activities leaving that activity.* This simply means that LF for any activity must be the same as the *smallest* LS for all activities following it. Otherwise it will cause delay in one or more of those activities that follow it. Using the relationship expressed as LF = LS + t (or LS = LF – t), we work backward to calculate LS and LF for activity G:

$$\text{LF} = 14$$

$$\text{LS} = 14 - 2 = 12$$

We need to continue this calculation for all activities. To reflect this information on our network diagram, we present LS and LF values below the arrow next to the duration for each activity as shown in Figure 6.6. The start and finish times shown on the diagram give detailed information for all activities. For example, Figure 6.7 depicts the information about activity H as part of the entire project network diagram.

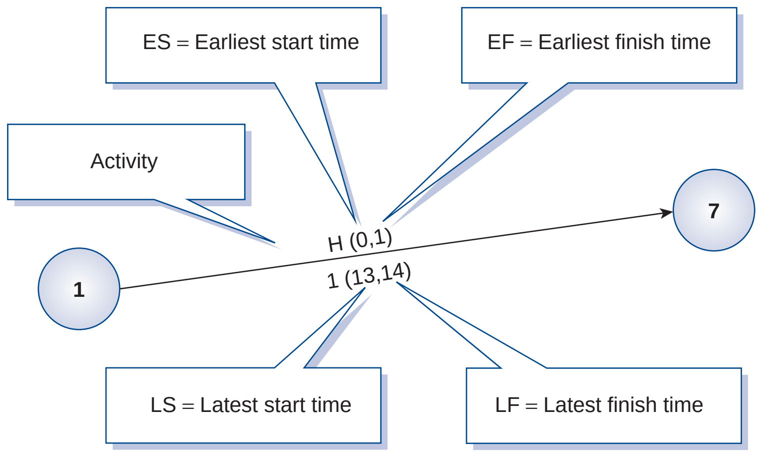
❖ **Figure 6.6** Network of Activities With ES, EF, LS, and LF



Note that activities with values of ES = LS and EF = LF form the critical path (Figure 6.6). Thus values in brackets above the arrow are identical to values in brackets below the arrow. Other activities are said to have *slack*, or free time. For example, activity A has 1-day slack time, calculated by LF – EF (3 – 2 = 1) or LS – ES (1 – 0 = 1). Similarly, activity H has 13 days slack time, calculated by LF – EF (14 – 1 = 13) or LS – ES (13 – 0 = 13). This means that activity A can start 1 day late and activity H can be delayed 13 days without any effect on the completion time for the entire project. Thus, ***activities with zero slack time form the critical path.*** This information can be presented in a tabular form in Table 6.1. Activities B, C, D, E, F, G, and I have zero slack and thus form the critical path.

To summarize, PERT/CPM provides answers to the important questions listed in Exhibit 6.5.

❖ **Figure 6.7** ES, EF, LS, and LF for Activity H



❖ **Table 6.1** Activity Schedule for Web Page Development

Activity	Duration	ES	LS	EF	LF	Slack
A	2	0	1	2	3	1
B	2	0	0	2	2	0
C	1	2	2	3	3	0
D	3	3	3	6	6	0
E	5	6	6	11	11	0
F	1	11	11	12	12	0
G	2	12	12	14	14	0
H	1	0	13	1	14	13
I	2	14	14	16	16	0

The outcome of any PERT/CPM application depends on:

- A complete list of activities necessary to complete the project
- A proper sequence of activities and identification of preceding activities
- Reliable activity estimates

Once this information is established, a few steps are required to complete the procedure as shown in Exhibit 6.6.

Exhibit 6.5 Potential of PERT/CPM

- What is the total time to complete the project?
- What are the scheduled start and completion times for each activity?
- What activities are critical and must be completed as scheduled in order to complete the entire project on time?
- What are noncritical activities, and how long can they be delayed before affecting the completion time for the entire project?

Exhibit 6.6 PERT/CPM—The Final Steps

- Draw the network diagram showing all activities and their preceding activities.
- Calculate the completion time for the entire project, determining the earliest start time and the earliest finish time for each activity on the network. The earliest finish time for the last activity gives the project completion time.
- Calculate slack times by determining the latest start time and the latest finish time for each activity, working backward through the network. For each activity, the difference between the latest start time and the earliest start time or the difference between the latest finish time and the earliest finish time is the slack time.
- Determine the critical path by identifying activities with zero slack time.

6.5. Estimating Activity Duration

It is important to estimate activity duration as accurately as possible. To do this, information systems project managers rely on experience, documentation, and input from experts. Experienced information systems project managers tend to use past projects as a basis for estimating activities. They may modify such estimates upward or downward depending on changes in technology, the skill level of team members, vendor reliability, resource availability, and so on. For example, a new technology may speed up certain activities but at the same time may call for a higher skill set that requires training of project team members. Often a new technology is learned through self-training, and that too requires additional resources. Documentation such as reports, time sheets, and work plans also provide project managers with details about previous projects. In many cases reference to historical data is a better option than relying on memory. Experience and historical data are useful for repeat projects. Estimating activity time for unique projects is likely to prove more difficult.

In estimating activity duration for unique projects or when experience is lacking or historical data do not exist, information systems project managers can get input from experts to estimate activity duration. In fact, when uncertain, information systems project managers may obtain multiple estimates for each activity and take the weighted average rather than relying on a single estimate. A popular approach for estimating activity duration involves obtaining three estimates. One estimate is referred to as ***optimistic***, and it is based on the assumption that everything is under control and the activity will progress according to an "ideal" plan. Another estimate is referred to as ***pessimistic***, and it is based on the assumption that whatever can go wrong will go wrong. The third estimate is referred to as the ***most likely***, and it is based on a reasonable assumption of normality, somewhere between the other two.

These three estimates provide a range of values from the best possible situation to the worst possible one. To avoid putting undue emphasis on the extreme estimates, the most likely value is counted four times compared with optimistic and pessimistic values. For example, if we have optimistic, most likely, and pessimistic estimates of 3.5 weeks, 5.5 weeks, and 9 weeks for a given activity, we can calculate the t value for that activity using the following formula:

$$t = (o + 4m + p)/6$$

where o is for the optimistic estimate, m is for the most likely estimate, and p is for the pessimistic estimate. Thus, the expected duration for the activity in our example is:

$$t = (3.5 + 4(5.5) + 9)/6 = 5.75 \text{ weeks}$$

Given the distribution among the range of values for this activity, we can calculate the variance in these values using commonly used standard deviation formula. The variance is the square of the standard deviation and is calculated using the following formula.

$$\sigma^2 = ((p - o)/6)^2$$

This formula assumes that standard deviation is approximately 1/6 of the difference between the extreme values of the distribution. Using this formula, the variance for our example will be:

$$\sigma^2 = ((9 - 3.5)/6)^2 = 0.84$$

The variance reflects the degree of uncertainty in the estimated value for any activity duration. The greater the range between the optimistic estimates (o) and the pessimistic estimates (p) the greater the variance and uncertainty.

We will review what we have covered for PERT/CPM through an example. Consider an information system project with seven activities listed in Table 6.2. The systems analyst has obtained three estimates that represent *optimistic*, the *most likely*, and *pessimistic* times (in days) for each activity. The activity sequence is also determined, and preceding events for each activity are shown. Given this information we want to:

1. Draw the network diagram.
2. Determine duration for each activity.

❖ **Table 6.2** Uncertain Duration Estimates for Seven Activities

Activity	Preceding Activities	Optimistic (*o*)	Most Likely (*m*)	Pessimistic (*p*)
A	-	6	7	8
B	-	6	9	14
C	A	7	9	11
D	A	5	10	12
E	C,B	7	10	12
F	D	8	8	11
G	E,F	5	8	10

3. Determine the critical path.
4. Compute slack times for noncritical activities.
5. Compute the expected project completion time and the variance.
6. Use the variance information and compute the probability that the entire project will be complete in 35 days.

The PERT/CPM network for the information system project is shown in Figure 6.8. The network depicts the preceding activities as described in Table 6.2.

Next, we need to compute the duration for each activity using optimistic, the most likely, and pessimistic estimates given in Table 6.2. For example using the formula provided above, the expected duration t for activity A will be:

$$t = (o + 4m + p)/6$$

$$t_A = (6 + 4(7) + 8)/6 = 42/6 = 7 \text{ days}$$

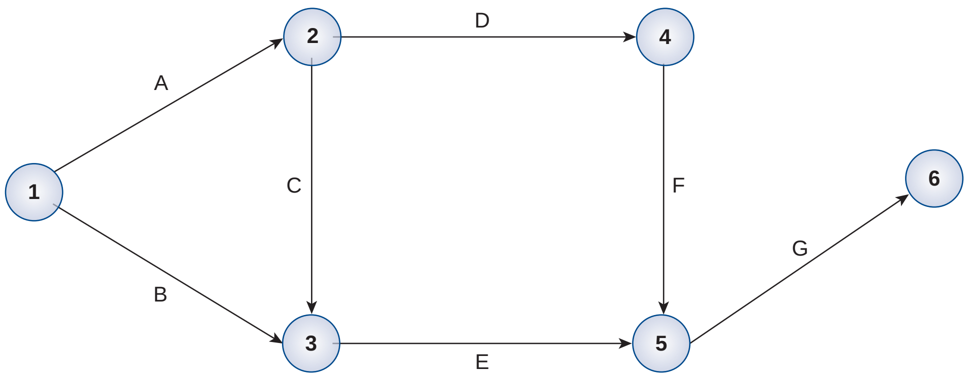
Using the above formula for variance and the distribution between values of 6 (optimistic), 7 (most likely), and 8 (pessimistic), the variance for activity A will be:

$$\sigma^2 = ((p - o)/6)^2$$

$$\sigma^2_A = [8 - 6)/6]^2 = 0.11$$

Note that for the variance formula we only use extreme values of optimistic and pessimistic. Using the data in Table 6.2 and the above formulas, we continue and calculate expected duration and variance for all activities. Table 6.3 provides the expected

❖ **Figure 6.8** Network of Seven Activities



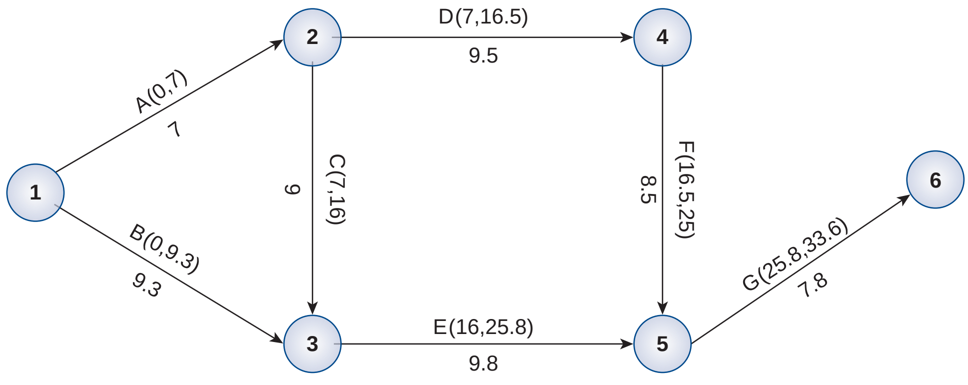
❖ **Table 6.3** Expected Duration and Variance for Seven Activities

Activity	Optimistic (*o*)	Most Likely (*m*)	Pessimistic (*p*)	Expected *t* (days)	Variance σ^2
A	6	7	8	7.0	0.11
B	6	9	14	9.3	1.78
C	7	9	11	9.0	0.44
D	5	10	12	9.5	1.36
E	7	10	12	9.8	0.69
F	8	8	11	8.5	0.25
G	5	8	10	7.8	0.69

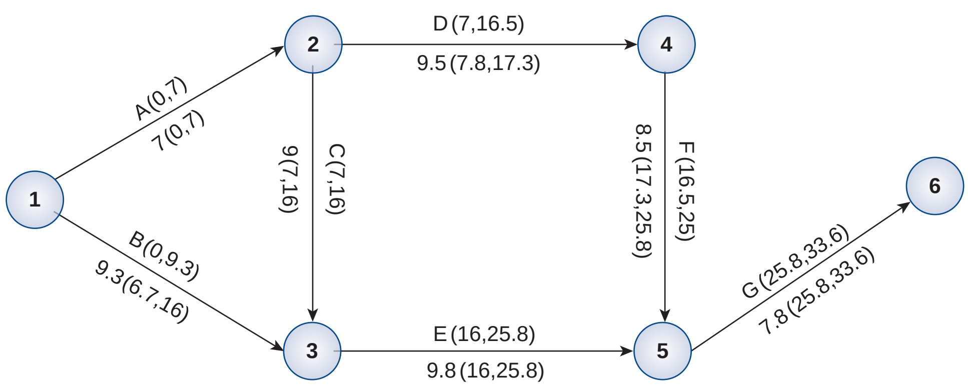
duration and variance for each of the seven activities. In this example, activity duration is estimated in terms of days. For larger projects, weeks and months may be used to estimate activity duration. Whatever is the unit of estimates, it should be used consistently throughout the estimating process, in progress reports, and other documents.

Based on the information given in Table 6.3 for activity duration, we now proceed to establish the earliest start (ES) and the earliest finish (EF) times for each activity going forward through the network. Figure 6.9 shows the network of seven activities together with activity duration as well as ES and EF information. On this network, the earliest finish time for the last activity, G, is 33.6 days. That means the expected duration for the entire project is 33.6 days.

❖ **Figure 6.9** Network of Seven Activities With ES and EF



❖ **Figure 6.10** Network of Seven Activities With ES, EF, LS, and LF



Next, to find the critical path we need to calculate the latest start (LS) and the latest finish (LF) times by working backward through the network. The information computed through this procedure is given in Figure 6.10, showing the network schedule. The information about the earliest start (ES) and the earliest finish (EF) times as well as the latest start (LS) and the latest finish (LF) times are summarized in Table 6.4. This information suggests that activities A, C, E, and G form the critical path for this project. These are the activities with zero slack time. The slack times for noncritical activities are shown in the last column of Table 6.4. Note that activity B can start anytime between zero and 9.3 days without affecting the overall project duration.

❖ **Table 6.4** Activity Schedule for the Project With Seven Activities

Activity	Earliest Start ES	Earliest Finish EF	Latest Start LS	Latest Finish LF	Slack (LS – ES)
A	0	7	0	7	0
B	0	9.3	6.7	16	9.3
C	7	16	7	16	0
D	7	16.5	7.8	17.3	.8
E	16	25.8	16	25.8	0
F	16.5	25	17.3	25.8	.8
G	25.8	33.6	25.8	33.6	0

Information system project managers are often asked whether a project will be complete by a certain date and the probability of that happening, similar to the last question on the list of questions we posed for the seven-activity project. To compute a response to our final question, we need to use the calculated variance for activities on the critical path and a commonly used table of standard normal distribution. This table gives the information for any value between the mean and a given value of standard deviation from the mean. This value is expressed by the letter *z* and is calculated by dividing the difference between the mean and the desired completion time (35 days in our example) by standard deviation(σ). As you will recall, the standard deviation is the variance squared. To calculate the variance for the entire project we simply add variance for activities on the critical path. If we represent the duration for the entire project by the letter *T*, we will have:

$$\text{Variance (T)} = \sigma^2_A + \sigma^2_C + \sigma^2_E + \sigma^2_G$$
$$= .11 + .44 + .69 + .69 = 1.93$$

We then compute the standard deviation for the project's completion time as:

$$\sigma = \sqrt{\sigma^2} = \sqrt{1.93} = 1.39$$

The *z* value for the normal distribution at day 35 is computed as:

$$z = (35 - 33.6)/1.39 = 1$$

For $z = 1$, the normal distribution table suggests the probability value of 0.3413. The chapter on quality includes a normal distribution table (Figure 12.3). This value is a portion in one-half of the area under the normal distribution curve. Thus the probability of completing the project in 35 days is 0.3413 + 0.5000 = 0.8413. Thus there is an 84% chance that the project will be completed in 35 days. We summarize responses to our six questions in Exhibit 6.7.

Exhibit 6.7 Responses to Our Six Questions

1. The network diagram is shown in Figure 6.8.
2. The durations are shown in Figure 6.9.
3. The critical path includes A - C - E - G (see Table 6.4).
4. Slack times for noncritical activities are shown in the last column of Table 6.4. Three activities have slack time.
5. The expected project duration is 33.6 days (see Figure 6.9) and the project variance is 1.93.
6. There is an 84% chance that the entire project will be completed in 35 days.

6.6. Resource Implications

The allocation of resources to a project is a task that can make or break a project, and we look in Chapter 9 at the process of forming a project team. However, in this section we consider the more mechanistic aspects. In Table 6.5 we show a simple form using Microsoft Project to support the resource allocation task. Here we are allocating time of people (Joe, Bill, and Ted) to activities (Tasks 1, 2, and 3).

By including the hourly rates of people in the resource details we can calculate the costs of our resource usage for each task as shown in Table 6.6.

This information can be used to generate a resource allocation graph using a computer software package such as Microsoft Project (see the appendix to this chapter). As you will see when using this software or another planning tool, although it may take

❖ **Table 6.5** Allocating People Hours to Activities

Resource Name	Work	Details	T	W	T	F	S	S	M (14 May '07)	T	W	T	F
Joe	36.8 hrs	Work		6.4h	6.4h	6.4h			6.4h	6.4h			1.6h
Task 3	*4.8 hrs*	Work											1.6h
Task 1	*32 hrs*	Work		6.4h	6.4h	6.4h			6.4h	6.4h			
⊟ Bill	28.8 hrs	Work		4.8h	4.8h	4.8h			4.8h	4.8h			1.6h
Task 3	*4.8 hrs*	Work											1.6h
Task 1	*24 hrs*	Work		4.8h	4.8h	4.8h			4.8h	4.8h			
⊟ Ted	46.4 hrs	Work		5.6h	5.6h	5.6h			5.6h	5.6h	5.6h	5.6h	2.4h
Task 3	*7.2 hrs*	Work											2.4h
Task 2	*39.2 hrs*	Work		5.6h	5.6h	5.6h			5.6h	5.6h	5.6h	5.6h	
⊟ Bill (half time)	11.2 hrs	Work		1.6h	1.6h	1.6h			1.6h	1.6h	1.6h	1.6h	
Task 2	*11.2 hrs*	Work		1.6h	1.6h	1.6h			1.6h	1.6h	1.6h	1.6h	
Ted (half time)	0 hrs	Work											
David	0 hrs	Work											
Printing	0	Work											

❖ **Table 6.6** Costs of Tasks

	Task Name	Total Cost	Baseline	Variance	Actual	Remaining
1	Task 3	£348.00	£348.00	£0.00	£0.00	£348.00
2	Task 1	£1,400.00	£1,400.00	£0.00	£0.00	£1,400.00
3	Task 2	£756.00	£756.00	£0.00	£0.00	£756.00

time to learn, it does support much of the work of the project manager and eases progress tracking, re-planning, and what-if analysis. Further, the quality of presentation is much better than attempting the same by hand.

Software packages can also aggregate the various resources, such as the number of people working on the activity, and attempt to smooth their use throughout the project. This ***resource smoothing*** process can be particularly useful as management reviews and approves of plans. It is usually better to use resources as smoothly as possible in the lifetime of the project, otherwise staff will be used efficiently for only part of the project. Although the examples presented here and in the appendix would not be too difficult to replicate by hand, software is required for a project that has hundreds of activities and tens of people working on it. Such numbers are by no means unrealistic. Resource smoothing in such circumstances can have a dramatic effect in reducing overall costs.

Normally, although not necessarily, as Fred Brooks has observed (see Section 3.3), there is a tradeoff between time and cost (assuming the same quality); in other words, the more resources allocated (and the more costly the project), the quicker it can be finished. Conversely, resource smoothing may well delay the project as fewer resources may lead to critical activities being delayed. However, by taking resources out of noncritical activities, the reduction in cost may not be associated with an equivalent increase in project time. It might also be possible to exchange certain resources if talents are duplicated. The project manager may also like to input various estimates of resource availability, basing them on past experience in terms of minimum, most likely, and maximum figures. This will give three different results for time/cost comparisons.

Many project control packages will report on inconsistencies within the network, such as the same resource being used at the same time on more than one activity. Although the plan should allow for minor deviations, the package may permit the project manager to ask "what if?" questions so that the consequences of more major deviations can be seen—for example, the implications of reallocating staff, unexpected staff leave, or machine breakdown. Useful reports from a package might also include a list of activities presented in order of latest starting date and earliest starting date and information by department or by resource or by responsibility.

Packages can simulate the effects of prolonging an activity—reducing resources applied to it or adding new activities. Similarly, they can be used to show the effects of changing these parameters on project costs. The project manager may be faced with two alternatives: a resource-limited schedule, where the project end date is put back to reflect resource constraints, or a time-limited schedule, where a fixed project end date leads to an increase in other resources used, such as people and equipment. As Exhibit 6.8 shows, a package can also monitor progress to reveal the present situation and look at alternative plans to get a failing project back on track.

Exhibit 6.8 Progress Monitoring

- Compare the time schedule with the actual progress made.
- Compare the cost schedule with the actual costs.
- Maintain the involvement of users and clients.
- Detect problem areas and re-plan and reschedule as a result.
- Inform management of the new plan and get their agreement.
- Provide a historical record, both for projects meeting goals and those that do not, as they can both be useful for future project planning.

6.7. Avoiding Project Delay

Information systems projects are often not completed on time. Timely delivery remains a difficult task for information systems project managers. Every project manager has reasons for justifying delays. Here are a few suggestions to help more timely delivery.

Communications. Time estimates for each activity as well as progress toward completing each activity must be clearly communicated to team members and be readily available to them at all times. Project managers need to decide what method of communication will best serve their situation. Information systems technology and project management tools such as MS Project and spreadsheets are readily available and easily applicable for preparing timetables and controlling schedules. Yet, many projects are late even when a software tool is used to keep track of time. Many project managers use software to keep themselves informed of project activity time and progress. However, they often keep that information to themselves. It needs to be communicated to team members.

Methods. Activity times are as good as the methods used to estimate them. Complex and sophisticated methods do not automatically produce reliable estimates. It takes time and needs careful preparation. Rushing through that task will result in project delay later on. Estimates are as good as their source. Experience is, by and large, the best source of estimating time requirements, and that requires good documentation and archiving. For new activities for which we have no records, the judgments of many experts provide a useful source. Team members must understand those methods and believe that estimates are realistic; people will more readily accept and comply if they understand how estimates are prepared.

Separation. Team members are responsible for work units that they are specifically assigned to and they are accountable for. Project managers are responsible for separating team members' work and responsibilities from those of stakeholders such as users and functional managers who may want to influence the project timetable or process. Team members might be bogged down by stakeholder interference or unexpected demands. Project managers should prepare and communicate clear policies in order to help team members with their time management.

Support. Team members must feel confident of project manager support in order to stick to their schedule. Often when functional managers get involved with the project planning they tend to continue that involvement into the development phase, and that could create confusion for team members and their responsibilities. Project managers must act as a buffer between team members and the management in order to provide necessary breathing space to the project team for timely completion of their tasks. Project managers must use their political influence to support and protect their team members.

Analysis. Often project delay is due to poor up-front needs analysis. By and large the temptation by system developers is to get to the development phase of a system too quickly and as a result they rush through the analysis phase. To avoid delay later on, project managers must provide leadership to ensure careful needs analysis is carried out before allowing the project to go on. Poor up-front needs analysis may ultimately cause significant project delay, especially in terms of project rework.

Closure. Many people do good work but they just don't know when to stop, and that is not unique to information systems professionals. The laws of diminishing returns suggest that marginal benefit relative to time and effort spent on a task will eventually reach a point where benefits turn into costs. Team members need to be reminded that similar to the project itself, each task requires closure and members need to move on to the next tasks. A similar problem exists when people kill a lot of time searching for some information on the Web that may not exist or may be easier to get elsewhere, such as by asking colleagues. Project managers are responsible to move resources, including human resources, on to the next phase and next project.

6.8. Interview With a Project Manager

This interview took place with a project manager at one of the largest contractors in the United States.

What would you consider to be the most challenging aspect to being a project manager?

> "My company currently has many projects. In fact, they have more projects than project managers. This requires that all of us manage multiple projects concurrently. I am managing three of the top ten projects currently assigned to the IT department. I would say that both proper prioritization and time management are the most challenging. You must ensure you spend the right amount of time on the right project to ensure all your goals are met."

What project management tools and computer software do you find the most useful?

> "We are using Project 2002 and Project 2002 Server as our project management software tools. These allow us to track all of our projects and provide pretty accurate time estimates. It's best to estimate the project up front and then provide a work breakdown structure once the estimate is provided. This is a pretty accurate method, provided you have the expertise at your disposal to input accurate time estimates on the project."

What skills are essential to becoming a "successful" project manager? How many projects have you been involved in, and how many have actually been a "success"?

> "People skill has to be the most important for both internal and external communications. Many times you run into people who are very contentious, and keeping the peace can be both extremely important and paramount to the continued success of your project. Next to that would be organization, especially when you're controlling multiple projects such as we do. Without the ability to stay organized and on track, your project will most assuredly fail! For instance, as a project manager, recording information is everything. Maintaining your paperwork and relaying information to people helps keep your infrastructure [resources] on time, on schedule, and under budget. Most projects fail because everything wasn't recorded and something was omitted during the processing of requirements. Without defining the proper user requirements up front, you can bet your bottom dollar that the project has a good chance of failing.
>
> A good case in point would be a colleague of mine who was in charge of a file expense recording system. He failed to ensure the data he was given was both accurate and complete. The project began suffering immensely from scope creep, and the project ended up over time, and over budget, as well as incomplete."

How do you forecast the necessary time to complete a step in the work breakdown structure?

> "We use two methods for forecasting time. Both are software driven and were good when we first purchased them. The way they work is that you plug in input transactions, output transactions, and other deliverables and then the program will provide you an estimated time. We are currently preparing to evaluate some different software, as it is more exact than what we currently employ."

(Continued)

(Continued)

When calculating project costs, do you budget in slack time or do you provide a full assessment and a separate contingency assessment? If you do use the contingency assessment, how do you determine what constitutes an appropriate amount?

> "Estimates are sometimes, if not most often, overstated by experts. One project we had, not too long ago, estimated a particular timeframe for completion. We provided this estimate to our experts who had actually been involved with a project very similar to this one. They gave us an estimate that cut the original one in half, and we still ended up under time. Estimating is a science that is very difficult to master. One of the estimate tools we own is called QFM. It utilizes historic industry data as a factor where it takes knowledge obtained across the industry and factors that into the calculations for budgeting time. It always seems to provide us a poor time estimate, as they always seem out of whack by our experts.
>
> Contingency time isn't something that is well accepted by our upper management. They feel that putting down something called 'contingency' on paper leaves open too many questions. They feel it makes us look unprepared and that we are looking for a way to factor in extra costs. We're always expected to factor the contingency time across the entire project."

How do you successfully manage customer expectations without overwhelming them with too much information about the project?

> "People skills! Know your customer! By knowing the technical expertise of your customer, you have a pretty good idea of what or how much information to provide. Remember that scope creep is always a huge danger, so you should know how much to tell your customer, but you should always know where the 'borders' of the project are. Failure to clarify requirements can cause major problems as the project progresses. We call this the 'Bring Me a Rock' syndrome. Basically, the customer asks you to bring them a rock. When you provide it, they say it's too big. The next rock you bring is too small. The next one is too round. This goes on and on and on! You should always negotiate with the user up front for the scope of the project. If something is brought to you later, you must draw the line or negotiate different project phases. You close out the requirements list and then start a second one for the 'second generation' of the project."

How do you ensure project team members are spending adequate time on their project-specific tasks when these people are not under your direct supervision?

> "I use time sheets and weekly reports and weekly meetings to keep track of specific project tasks. Project Server is great for this, as everyone must put in their own time into the program. I can download this weekly to obtain a results synopsis and know where to direct more of my attention."

What was the last project under your management? Was the project a success? What hurdles prevented you from successfully completing the project, or what main factors contributed to the successful completion?

"The last project I managed was an Automated Customer Price List Tracking program. The project was originally built by the customer in Microsoft Access, which sat on one person's desktop and allowed no one else to access. We changed this into an enterprise application and brought it to a successful completion. The problems we encountered were the fact that the person who had built and maintained it no longer worked at the company. We had to figure out what the logic behind the application was before we could prepare any type of estimation of the project, and this was extremely difficult.

I haven't had a project that failed, but another colleague of mine did. This was a tracking application that just finished 3 weeks ago. It finished 3 weeks late in fact! This was due to scope creep caused by the customer, and we had already received, in writing, the customer confirmation that they knew this would happen due to the additional functionality requested."

Have you had to cancel a project after significant resources (time, money, and personnel) were already spent? If so, were there repercussions that affected your management of future projects?

"Yes!! In fact, I had just finished the project the day before and it was being deployed as I was on my way to work. I received a call from our management screaming at me to stop its deployment immediately! We stopped it right away and later found out that this project was pretty much dead. I had inherited this project from the desk of someone who had been laid off months prior to its scheduled completion. It had been overlooked until the customer had called on a status update. The original estimate provided by the, now departed, project manager had been way off. Additionally, he had not recorded the entire project scope, and much of what the project was expected to do was not available. We lost a lot of money on that project."

Of the projects you have managed, which one was the most challenging? Please explain.

"The Oracle 11-5-8 update has to be the most challenging yet. This project started back in the summer of 2000 and went into production in 2002. It was a huge effort that cost $3 million in the first year, had three project managers, and consisted of implementing both new hardware and software. The software being used was Oracle, and we had to have it upgraded twice before we could get it to work. This required a huge collaborative effort with the people at Oracle (the customer had a contact there and insisted on us utilizing it as the back end). Budgeting the resources was most challenging, as there was a lot of overtime involved and it was costing a lot to keep the project going. We managed to pull it off, though!"

How were you able to control a project effectively if there were three project managers?

"The size of the project pretty much required that many. One project manager was a functional manager, another was in charge of documentation, and I was in charge of coordinating the efforts. This is where documentation and devotion to constant communication becomes necessary. What helped out a lot was co-locating the functional managers for both us and the customer. By working together [side by side], they were able to get instant answers and feedback when it was required."

(Continued)

(Continued)

Tell me about the most difficult client contact you have made in the last 6 months. What obstacles did you face? How did you overcome them?

> "I was put in charge of the Work Smart Standards project, which was managed by the Department of Energy (DOE). The DOE asked me to take over for them, and that's when I found out about the problems! No formal requirements had been developed. This caused me to stop the entire project and develop those requirements and time estimates before going anywhere. Several hands have a stake in this, including the DOE, my company, and the federal government. The bureaucracy is unbelievable! I finished the estimates several months ago, and I'm still waiting for an okay to proceed."

As a project manager, what are some tips you would give to aspiring project managers?

> "Stock up on aspirin and antacids! Seriously, I would say that a project manager should always stay upbeat and take things with a grain of salt. What I mean is that if you get too caught up in the pressures of the job, you're just waiting for something to happen, and it probably will. Always learn from your mistakes and take it all in stride. Most of all have fun doing it!"

Do you feel organizations consider formal project management processes and training a waste of resources?

> "My company most definitely does not! We are always getting the training we need, and there is an open-door policy anytime something doesn't seem to be going right.
>
> Of course, we're not without problems. A good case in point is the title of project manager. Since my company is a project management company, we actually have a department of people who have the title of project manager. Since we are a small part of the overall company, politics decided we shouldn't be called project managers."

Do you think employees are adequately evaluated/compensated for their participation in projects, especially when this participation is above and beyond their day-to-day responsibilities?

> "I'm not sure how others do this, but when I feel someone has really worked hard, I write letters to their immediate supervisors and department managers recognizing them for their efforts. I have no more control after that point, and so I can't tell you if they receive anything more than a pat on the back."

How many of your projects have involved the participation of a third-party company? What unique challenges did you encounter with this type of project team configuration?

> "Most of our projects involve a third party. We are a contractor, and therefore we contract to different companies all the time. Oracle and Northrop-Grumman are a couple of examples. It's really hard to narrow down what unique challenges there are because they vary from company to company. Coordination is probably one of the factors I would say is challenging. Another is aligning our ideas and strategies with theirs."

6.9. Chapter Summary

Timely delivery of any information systems project is a critical success factor. Together with cost and project scope, time is considered a constraint in the triple-constraints concept. A large project with many activities requires careful scheduling that allocates time for each individual activity. Communicating and monitoring these activity times is an important task for the information systems project manager. One of the most widely used tools for managing time and schedule is PERT-CPM. This helps the management of the overall project duration as well as the individual activities. This time management tool *helps to set time, identify activity sequence, communicate time constraints, and monitor progress.*

A critical part of developing a PERT-CPM network is obtaining reliable estimates. Sources for estimating activity time include the experience of project managers themselves, input by others involved in similar project activities, and documentation. This chapter highlights the importance of time management and suggests ways to schedule activities better and monitor their progress. It also suggests ways of estimating the likelihood of project completion within a specified time and how time improvement can be made through the critical path analysis. Finally, it discusses resource implications and discusses ways in which resource use can affect project time.

DISCUSSION QUESTIONS

1. Discuss the idea that time is a resource but also a constraint. Is this a contradiction?

2. Describe signs that tell you if an information system project manager is managing time effectively or not. What specific suggestions do you have for a project manager who is deficient in time management skills?

3. Discuss ways of obtaining good estimates for a project activity. What are good sources of getting estimates? What is prudent to do when you need to estimate an activity for the first time? Is it prudent to overestimate time for new activities or underestimate them?

4. How does information on variance help you assess uncertainty? What would you do when you have higher confidence in one of the estimators?

5. In Exhibit 6.1 we had the views of Terry Young, who argued that experience, the willingness to negotiate, and the commitment of people were far more important than the use of techniques such as PERT to achieve a successful project. Yet others argue that the correct use of techniques will more likely lead to a positive result. Argue each case and also suggest a "middle ground."

EXERCISES

1. Consider the IS project with seven activities (Table 6.2) described in this chapter. Use the variance given in Table 6.3 and compute the number of days that gives the project manager a 95% chance of completing the entire project.

2. Again, consider the IS project with seven activities (Table 6.2) described in this chapter. What will happen if activity F took 1 day longer than it is estimated to complete?

3. It is often suggested that project managers obtain three time estimates for work units that have significant uncertainty associated with their time estimates. Assume you have collected three time estimates for each activity for a performance monitoring system at an international airport baggage handling systems. Your "cost estimate worksheet" suggests the following:

Project estimate:	250 hours
Project standard deviation:	18 hours

   Based on this information and assuming three standard deviations from the mean to include approximately 99.75% of the area under the normal distribution curve, calculate:

   - Project highest credible hours
   - Project lowest credible hours
   - Upper confidence limit
   - Lower confidence limit

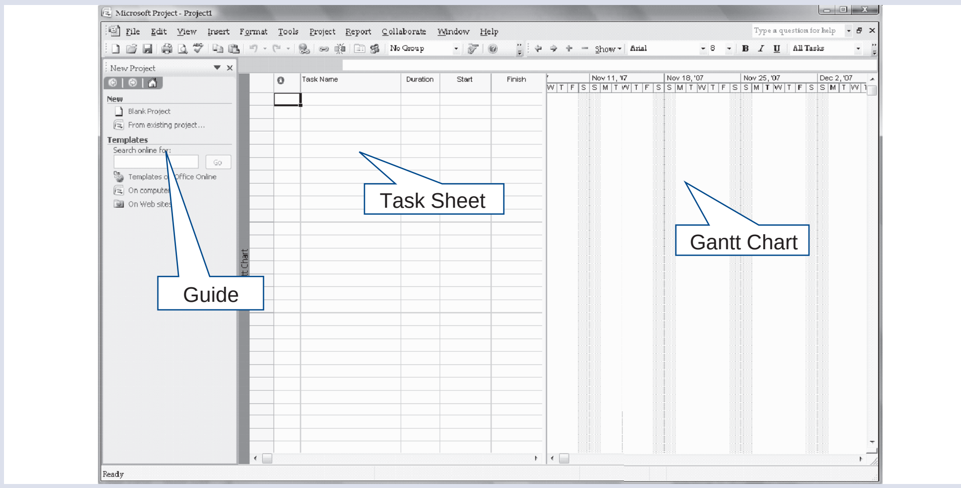
   Explain to the airport executives, your project sponsors, what these numbers mean.

APPENDIX TO CHAPTER 6: AN INTRODUCTION TO MICROSOFT PROJECT

MS Project is a project management tool that allows the tasks involved in a project to be structured in an informative way. We provide two tutorial exercises to using MS Project in this appendix. With software, the best way of getting to know it is through practice. We have used the 2007 version of Microsoft Project.

PART 1. ENTERING TASK DETAILS AND START DATE

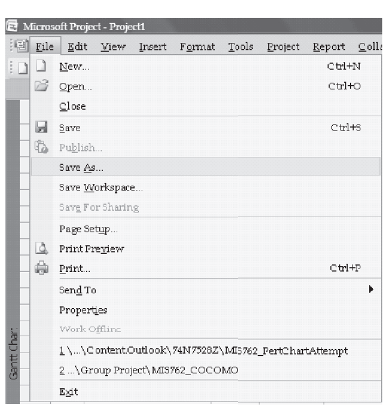
1. Start MS Project. **Project1** will appear on the screen, as shown below:

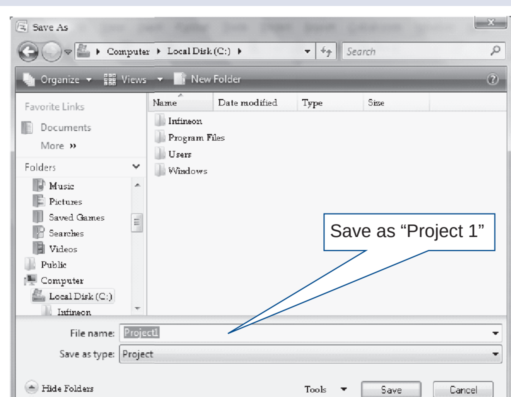


Common to all of Microsoft's 2002, XP, and Vista applications, there is a guide displayed along with the main task sheet and Gantt chart. The guide is shown on the left. The task sheet is a spreadsheet-like table on the middle of the screen, while the (currently empty) Gantt chart is on the right-hand side. You will see the Gantt chart being created as you enter information into the task sheet.

2. To give us more room to see what we are doing, close the guide by clicking on the × to the right of **New Project** (New Project ▾ ×).

3. Save the project with the file name Project1. Now we will create the project plan.





(Continued)

(Continued)

4. Using the WBS contained at the end of this first tutorial example, type in the task names in the column that says **Task Name**.

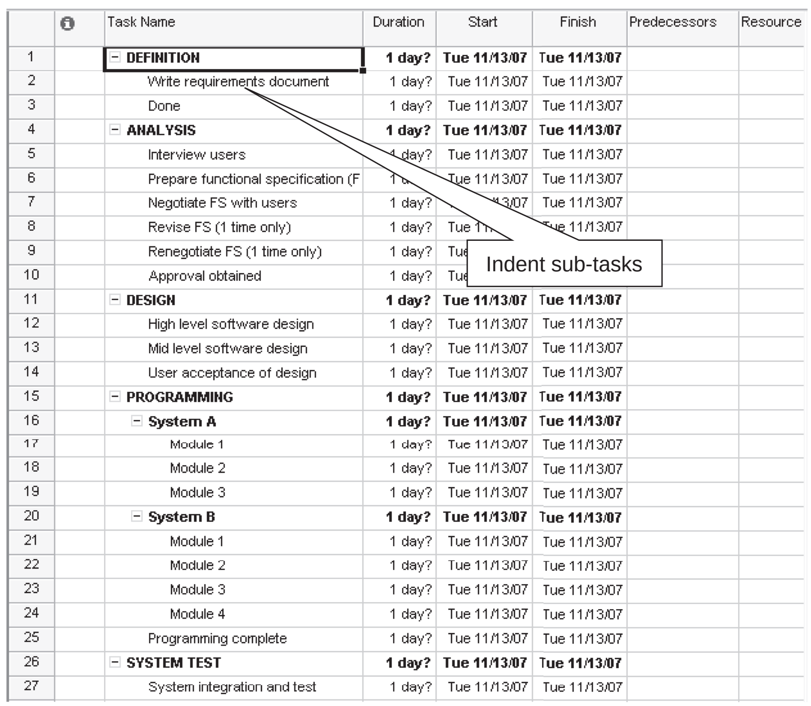
	ℹ	Task Name	Duration	Start	Finish	Predecessors	Resource
1		DEFINITION	1 day?	Tue 11/13/07	Tue 11/13/07		
2		Write requirements document	1 day?	Tue 11/13/07	Tue 11/13/07		
3		Done	[illegible]	Tue 11/13/07	Tue 11/13/07		
4		ANALYSIS	[illegible]	[illegible]	[illegible]		
5		Interview users	[illegible]	[illegible]	[illegible]		
6		Prepare functional specification (FS)	1 day?	Tue 11/13/07	Tue 11/13/07		
7		Negotiate FS with users	1 day?	Tue 11/13/07	Tue 11/13/07		
8		Revise FS (1 time only)	1 day?	Tue 11/13/07	Tue 11/13/07		
9		Renegotiate FS (1 time only)	1 day?	Tue 11/13/07	Tue 11/13/07		
10		Approval obtained	1 day?	Tue 11/13/07	Tue 11/13/07		
11		DESIGN	1 day?	Tue 11/13/07	Tue 11/13/07		
12		High level software design	1 day?	Tue 11/13/07	Tue 11/13/07		
13		Mid level software design	1 day?	Tue 11/13/07	Tue 11/13/07		
14		User acceptance of design	1 day?	Tue 11/13/07	Tue 11/13/07		
15		PROGRAMMING	1 day?	Tue 11/13/07	Tue 11/13/07		
16		System A	1 day?	Tue 11/13/07	Tue 11/13/07		
17		Module 1	1 day?	Tue 11/13/07	Tue 11/13/07		
18		Module 2	1 day?	Tue 11/13/07	Tue 11/13/07		
19		Module 3	1 day?	Tue 11/13/07	Tue 11/13/07		
20		System B	1 day?	Tue 11/13/07	Tue 11/13/07		
21		Module 1	1 day?	Tue 11/13/07	Tue 11/13/07		
22		Module 2	1 day?	Tue 11/13/07	Tue 11/13/07		
23		Module 3	1 day?	Tue 11/13/07	Tue 11/13/07		
24		Module 4	1 day?	Tue 11/13/07	Tue 11/13/07		
25		Programming complete	1 day?	Tue 11/13/07	Tue 11/13/07		
26		SYSTEM TEST	1 day?	Tue 11/13/07	Tue 11/13/07		
27		System integration and test	1 day?	Tue 11/13/07	Tue 11/13/07		

Enter tasks in this column

As you type, MS Project will query the length of each task. Don't worry about that for the moment. We will put in names first, then indent, then type in durations, and then define predecessors.

5. Once you have typed in all the names, indent the sub-tasks as shown in the WBS. Note, for instance, that **DEFINITION** is a top-level task name, while **Write requirements document** is a sub-level task and must be indented in MS Project using the indent () button located middle-right of the toolbar (

). All indentations must be as they appear in the work breakdown structure. You will notice that all major task names are now shown in bold. **NOTE:** A number of tasks can be indented at the same time by selecting the rows and clicking on the indent button.



		Task Name	Duration	Start	Finish	Predecessors	Resource
1		**DEFINITION**	**1 day?**	**Tue 11/13/07**	**Tue 11/13/07**		
2		Write requirements document	1 day?	Tue 11/13/07	Tue 11/13/07		
3		Done	1 day?	Tue 11/13/07	Tue 11/13/07		
4		**ANALYSIS**	**1 day?**	**Tue 11/13/07**	**Tue 11/13/07**		
5		Interview users	1 day?	Tue 11/13/07	Tue 11/13/07		
6		Prepare functional specification (F	[illegible]	Tue 11/13/07	Tue 11/13/07		
7		Negotiate FS with users	1 day?	[illegible]	Tue 11/13/07		
8		Revise FS (1 time only)	1 day?	[illegible]	[illegible]		
9		Renegotiate FS (1 time only)	1 day?	[illegible]	[illegible]		
10		Approval obtained	1 day?	[illegible]	[illegible]		
11		**DESIGN**	**1 day?**	**Tue 11/13/07**	**Tue 11/13/07**		
12		High level software design	1 day?	Tue 11/13/07	Tue 11/13/07		
13		Mid level software design	1 day?	Tue 11/13/07	Tue 11/13/07		
14		User acceptance of design	1 day?	Tue 11/13/07	Tue 11/13/07		
15		**PROGRAMMING**	**1 day?**	**Tue 11/13/07**	**Tue 11/13/07**		
16		**System A**	**1 day?**	**Tue 11/13/07**	**Tue 11/13/07**		
17		Module 1	1 day?	Tue 11/13/07	Tue 11/13/07		
18		Module 2	1 day?	Tue 11/13/07	Tue 11/13/07		
19		Module 3	1 day?	Tue 11/13/07	Tue 11/13/07		
20		**System B**	**1 day?**	**Tue 11/13/07**	**Tue 11/13/07**		
21		Module 1	1 day?	Tue 11/13/07	Tue 11/13/07		
22		Module 2	1 day?	Tue 11/13/07	Tue 11/13/07		
23		Module 3	1 day?	Tue 11/13/07	Tue 11/13/07		
24		Module 4	1 day?	Tue 11/13/07	Tue 11/13/07		
25		Programming complete	1 day?	Tue 11/13/07	Tue 11/13/07		
26		**SYSTEM TEST**	**1 day?**	**Tue 11/13/07**	**Tue 11/13/07**		
27		System integration and test	1 day?	Tue 11/13/07	Tue 11/13/07		

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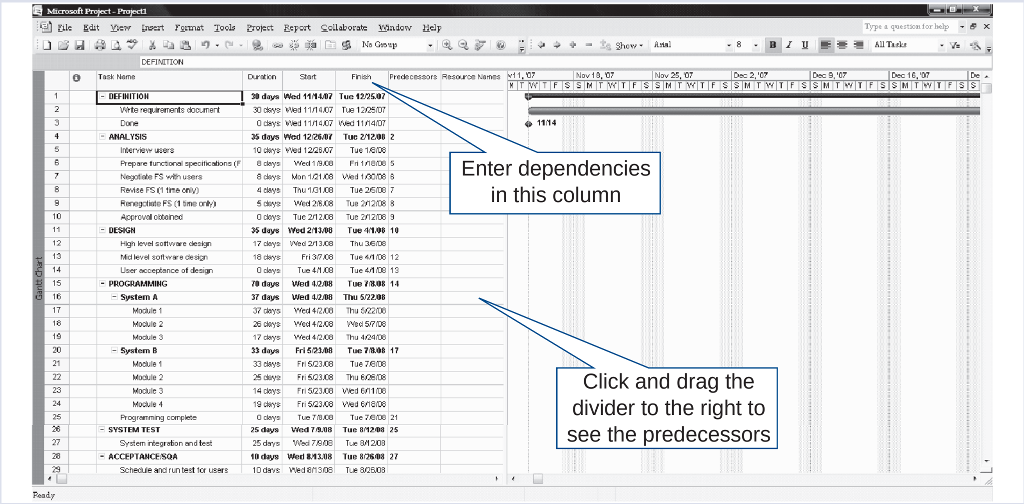
6. Starting from the top again, type in the durations in the **Duration** column. For instance, the 30-day duration for **Write requirements document** is entered by typing **30** in the **Duration** column. Make sure that all **0** durations are also entered, otherwise the default 1 day is left (and that's wrong). **BEWARE:** You only enter durations for sub-tasks, not for main tasks (the names in bold). It's Project's job to work out the duration of main tasks based on the information you enter for the sub-tasks. Probably now is a good time to save the project file ( ). So do it!

		Task Name	Duration	Start	Finish	Predecessors	Resource Names
1		**DEFINITION**	**30 days**	**Tue 11/13/07**	**Mon 12/24/07**		
2		Write requirements document	30 days	Tue 11/13/07	Mon 12/24/07		
3		Done	0 days	Tue 11/13/07	Tue 11/13/07		
4		**ANALYSIS**	**10 days**	**Tue 11/13/07**	**Mon 11/26/07**		
5		Interview users	10 days	Tue 11/13/07	Mon 11/26/07		
6		Prepare functional specification (F	8 days	Tue 11/13/07	Thu 11/22/07		
7		Negotiate FS with users	8 days	Tue 11/13/07	Thu 11/22/07		
8		Revise FS (1 time only)	4 days	Tue 11/13/07	Fri 11/16/07		
9		Renegotiate FS (1 time only)	5 days	Tue 11/13/07	Mon 11/19/07		
10		Approval obtained	0 days	Tue 11/13/07	Tue 11/13/07		
11		**DESIGN**	**18 days**	**Tue 11/13/07**	**Thu 12/6/07**		
12		High level software design	17 days	Tue 11/13/07	Wed 12/5/07		
13		Mid level software design	18 days	Tue 11/13/07	Thu 12/6/07		
14		User acceptance of design	0 days	Tue 11/13/07	Tue 11/13/07		
15		**PROGRAMMING**	**37 days**	**Tue 11/13/07**	**Wed 1/2/08**		
16		**System A**	**37 days**	**Tue 11/13/07**	**Wed 1/2/08**		
17		Module 1	37 days	Tue 11/13/07	Wed 1/2/08		
18		Module 2	26 days	Tue 11/13/07	Tue 12/18/07		
19		Module 3	17 days	Tue 11/13/07	Wed 12/5/07		
20		**System B**	**33 days**	**Tue 11/13/07**	**Thu 12/27/07**		
21		Module 1	33 days	Tue 11/13/07	Thu 12/27/07		
22		Module 2	25 days	Tue 11/13/07	Mon 12/17/07		
23		Module 3	14 days	Tue 11/13/07	Fri 11/30/07		
24		Module 4	19 days	Tue 11/13/07	Fri 12/7/07		
25		Programming complete	0 days	Tue 11/13/07	Tue 11/13/07		
26		**SYSTEM TEST**	**25 days**	**Tue 11/13/07**	**Mon 12/17/07**		
27		System integration and test	25 days	Tue 11/13/07	Mon 12/17/07		

Enter durations in this column

7. Next, we need to tell MS Project how one task is related to another. If Task 2 depends on the completion of Task 1, we say 1 is the predecessor of 2 (it has to be done first). The WBS gives us that information. So, let's define the predecessors.

8. To make the predecessor column easier to see, use your mouse to drag the right-hand frame bar of the task sheet out, making the Gantt chart smaller as a result. Then find the predecessor column and enter a 2 for Task 4, ANALYSIS, as shown below:



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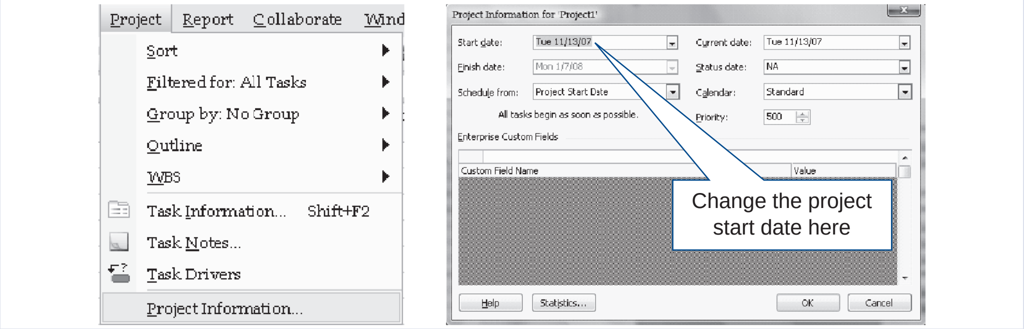
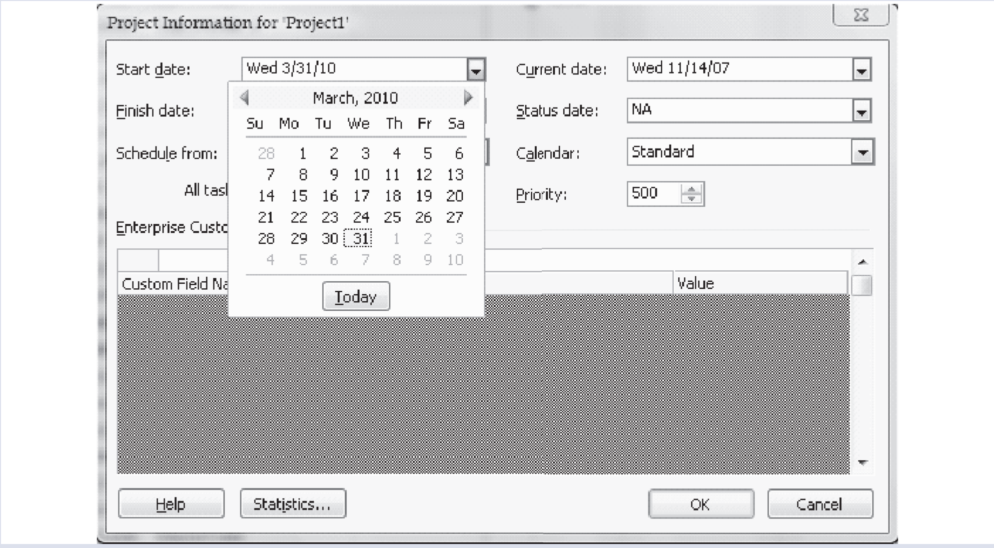
9. Double-check that you have entered the right predecessors; if it looks OK, save the file ( ).

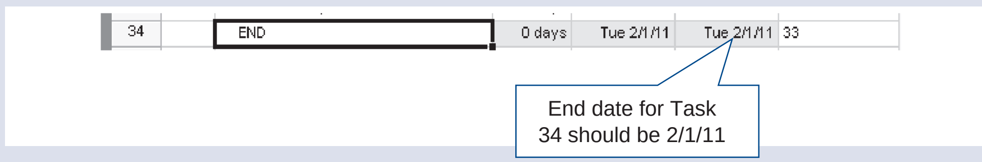
10. So far, so good. One problem, though: The project doesn't begin today; it starts on March 31, 2010! We had better change the start date. To change the scheduled start, click on **Project>Project Information**. The **Project Information** dialog box will appear.



11. Pull down the **Start Date** field and advance the calendar to 2010 and then March, then click on the 31st, as shown:

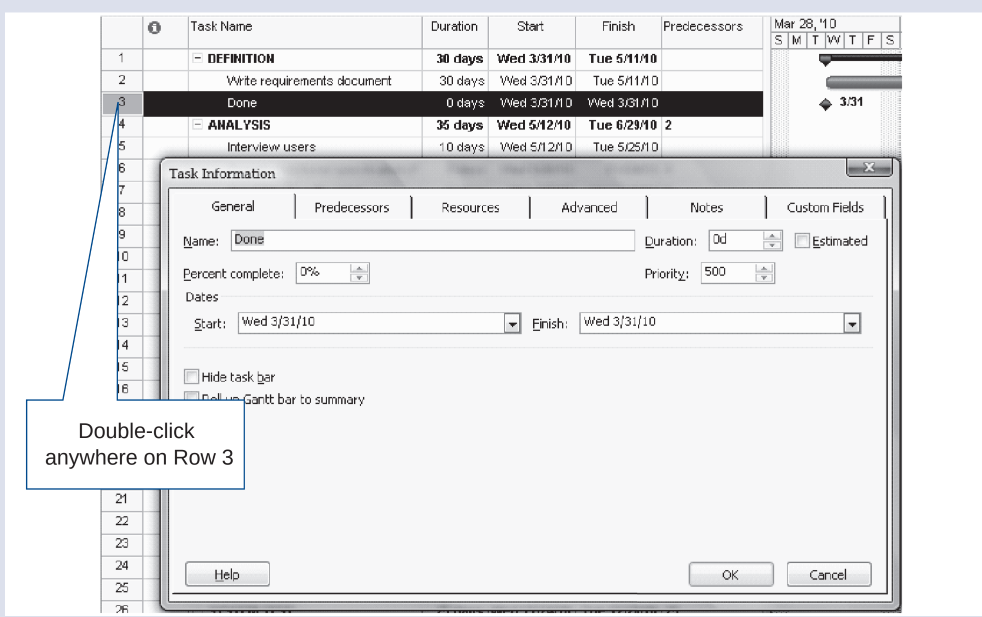


12. Click on **OK**. MS Project will now recalculate calendar start and end dates for all the project activities based on this start date. Scroll down to Task 34 (Project end), if you have done everything right, the end date for the project should read 2/1/11.



PART 2. DEFINING TASKS AS MILESTONES, AND VIEWING THE PROJECT

1. Tasks 3, 10, 14, 25, and 34 are milestones in the project—that is, points at which significant progress in the project should have been made and is open to review. To identify Task 3 as a milestone, double-click on Row 3. The **Task Information** dialog box will appear.



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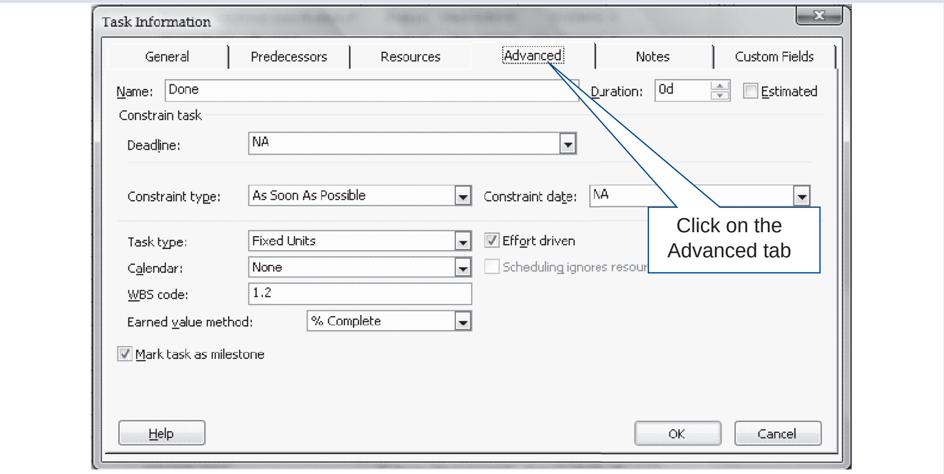
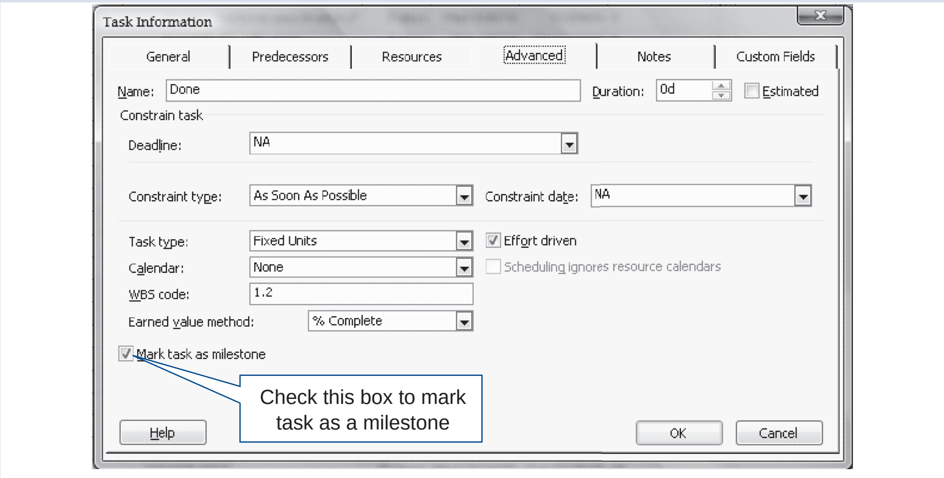
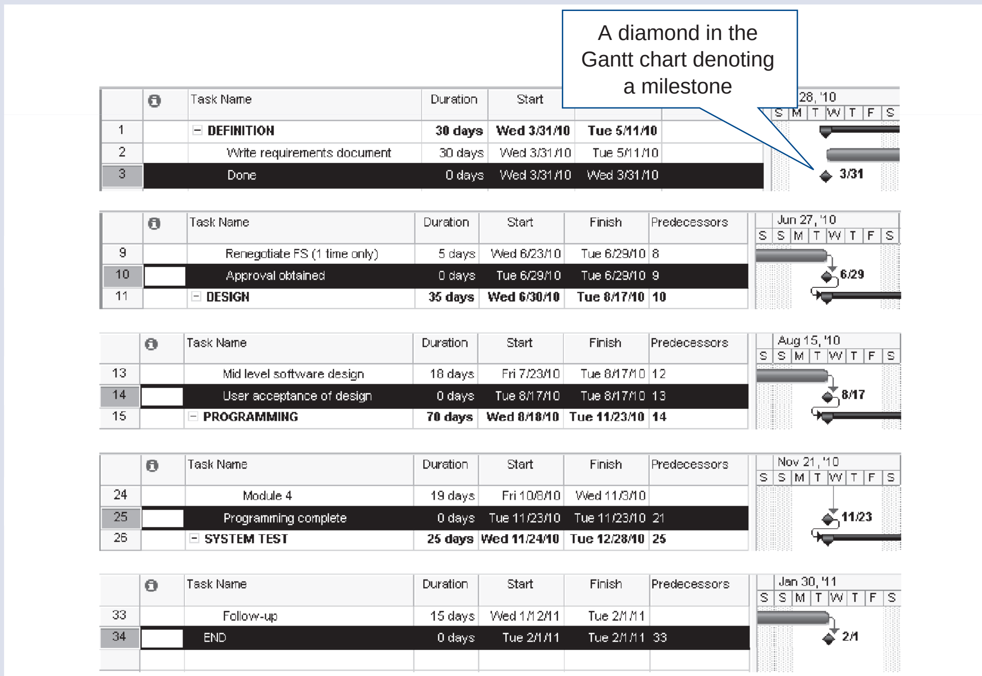
2. Click on the **Advanced** tab. This dialog box allows us to more precisely define the task, including name, duration, start times, and constraint types. If you have important constraints to apply to a task, this is the box to use.



3. For our milestone, since we have already assigned a **0** duration to the task, MS Project automatically identifies task 3 as a milestone. Otherwise, it would be necessary to click on the Mark Task as Milestone box.



In the Gantt chart, a diamond will denote the milestone. Check that Tasks 10, 14, 25, and 34 are all defined as milestones.



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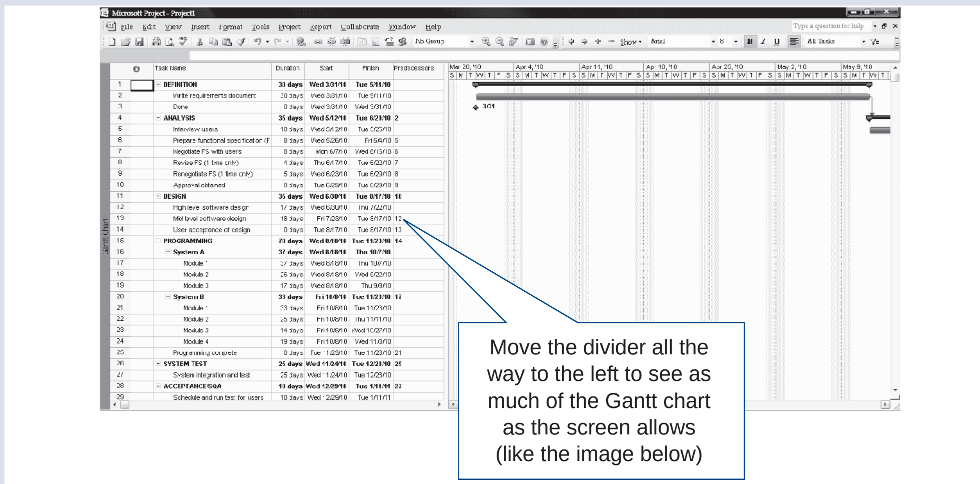
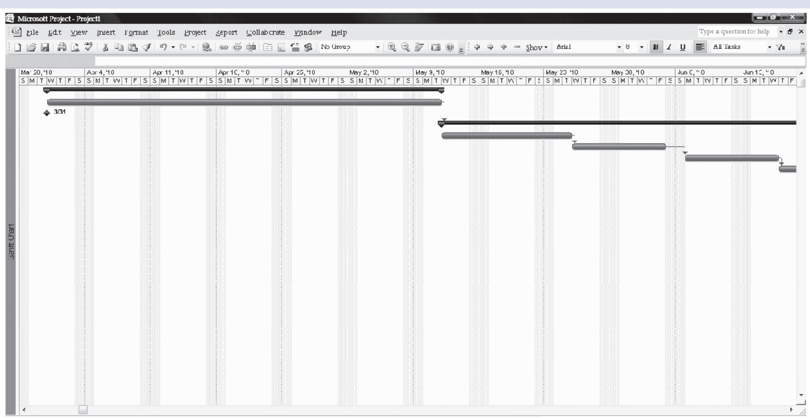
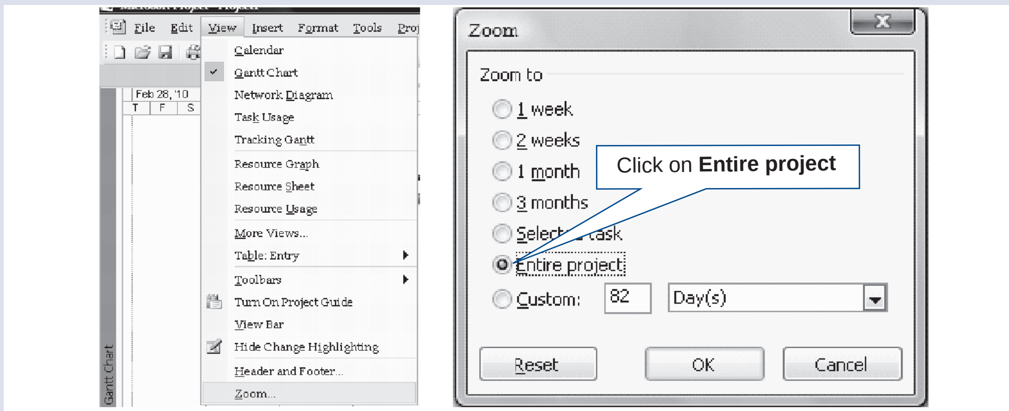
4. I know you're dying to see the complete Gantt chart, so we'll do that one last task. First, reduce the size of the task sheet so as much of the Gantt chart can be seen.

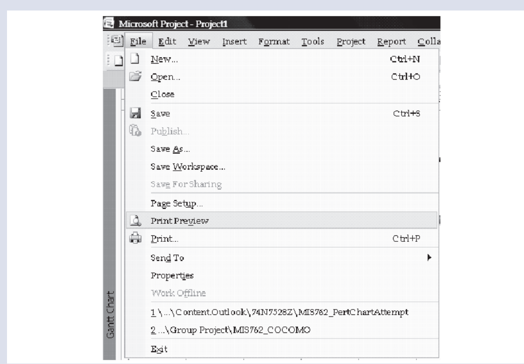


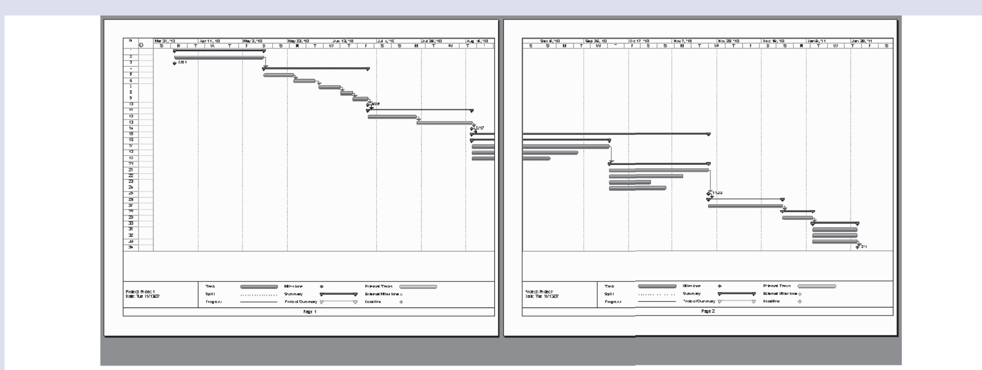


5. Now click on **View>Zoom . . .** and when the **Zoom** dialog box appears, click on **Entire project**.



6. Click on **OK**. Now click on **File>Print Preview** and a condensed version of the Gantt will be shown, ready for printing.





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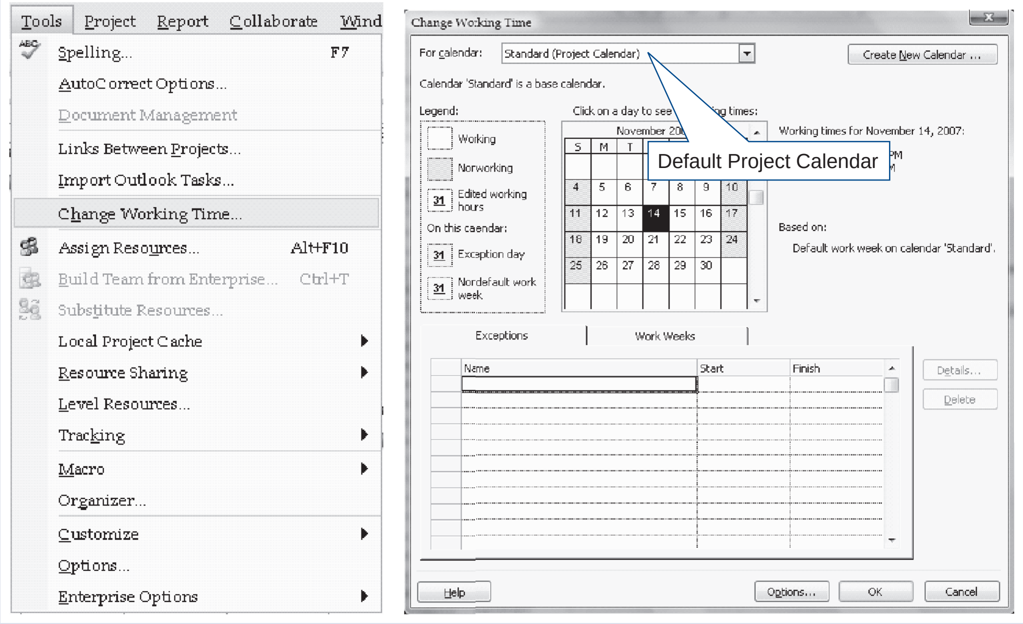
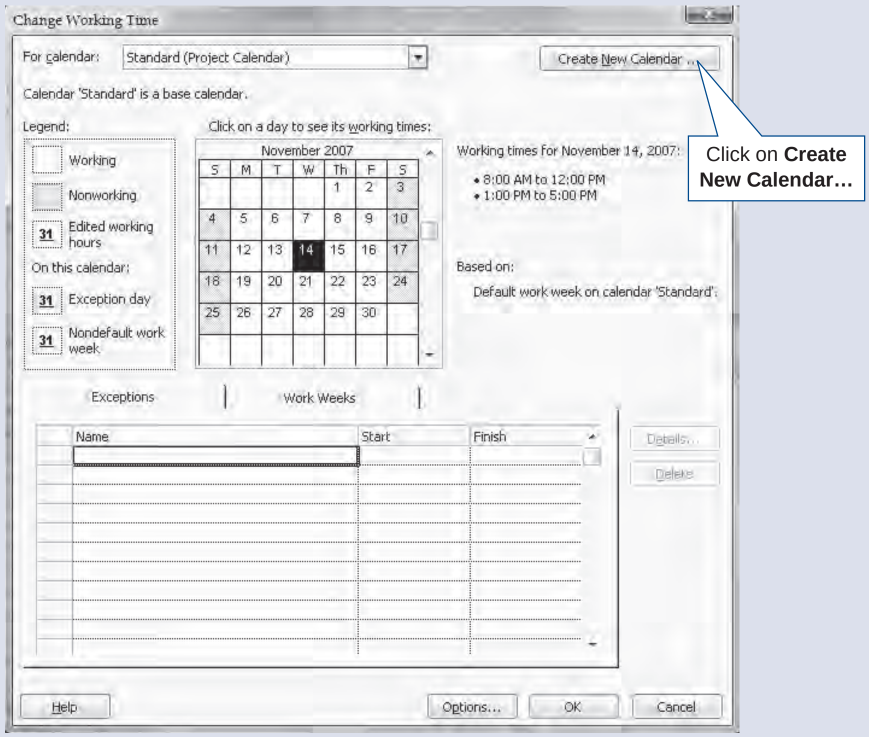
PART 3. CREATING AND ASSIGNING A CUSTOM CALENDAR

1. The calendar that MS Project uses to calculate dates does make allowances for lunch breaks, weekends, etc, but the defaults do not necessarily fit those we would like to use. To make a more realistic calendar, we must create, save, and then assign a custom calendar to the project. A custom calendar allows certain hours and/or days to be defined as nonworking. When assigned to a project, the Gantt chart is adjusted automatically and a new end date is likely to appear. To create a custom calendar, click on the Tools>Change Working Time . . . The calendar currently shown is MS Project's Standard (default) project calendar, as shown below:



2. To create a customized version, click on the **Create New Calendar . . .** button.



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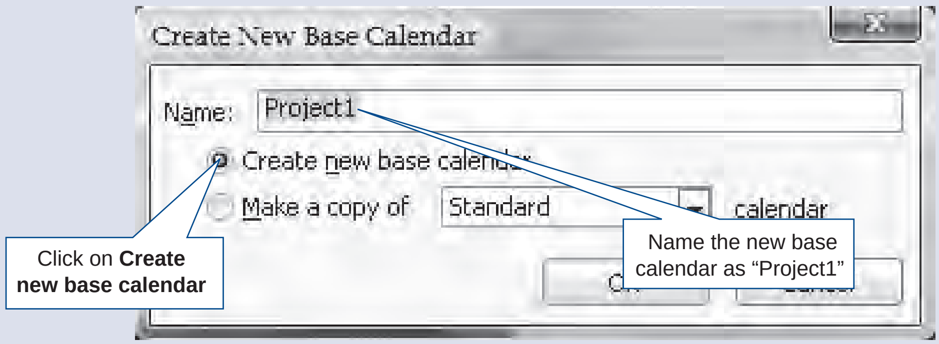
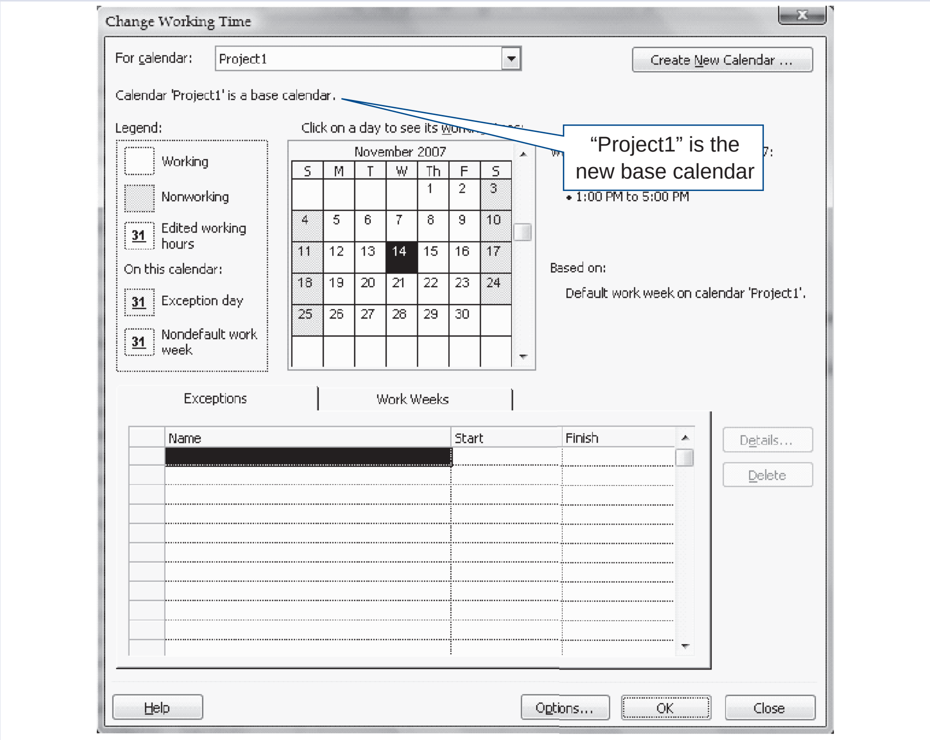
The **Create New Base Calendar** dialog box will appear. Click on **Create New Base Calendar**, and then in the **Name** field, type:

Project1.



3. Click **OK**. The **Change Working Time** dialog box will reappear, with Project1 shown in the **For** field.



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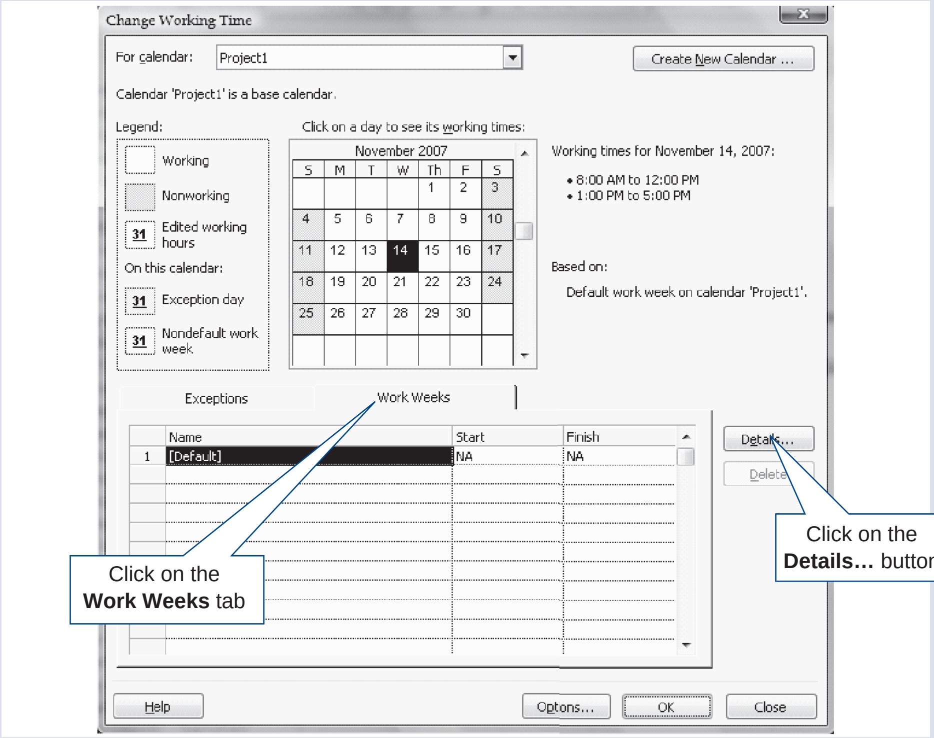
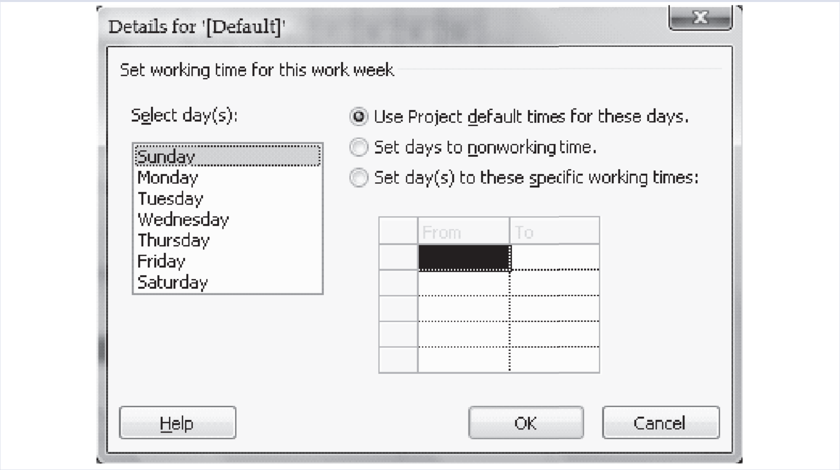
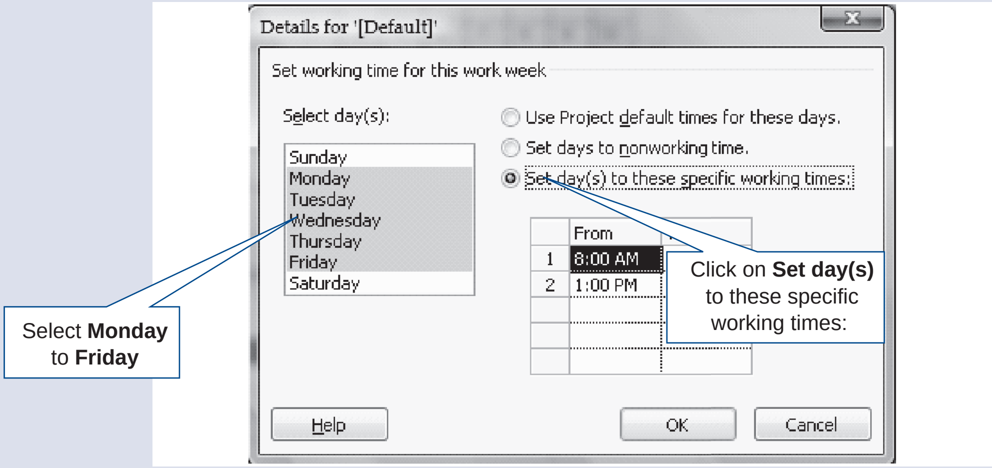
4. Click on the **Work Weeks** tab on the bottom half of the **Change Working Time** dialog box. Then, click on the **Details . . .** button on the right.



A **Details for "[Default]"** dialog box will appear.



Select the days Monday, Tuesday, Wednesday, Thursday, and Friday by clicking on Monday and dragging down to Friday or by holding down **Ctrl** or **Shift** to select all five days. Also click on **Set day(s)** to these specific working times.



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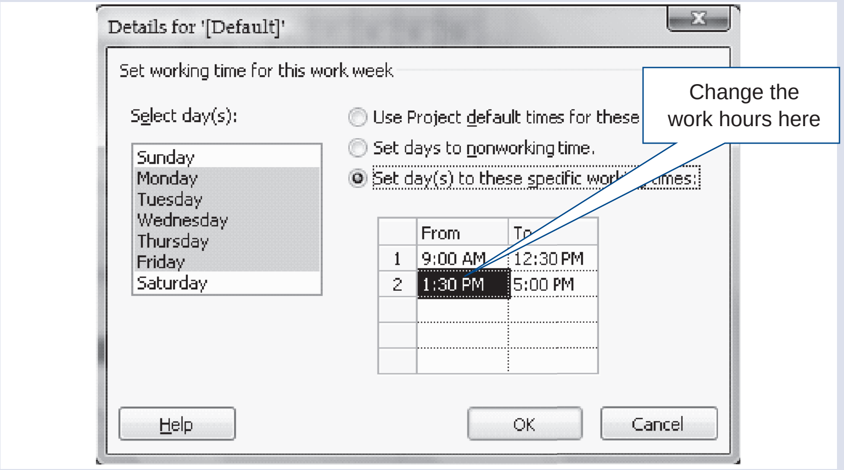
5. In the **From:** time field, change the 8 to a 9 (to read 9:00 am).
6. In the **To** field, type:

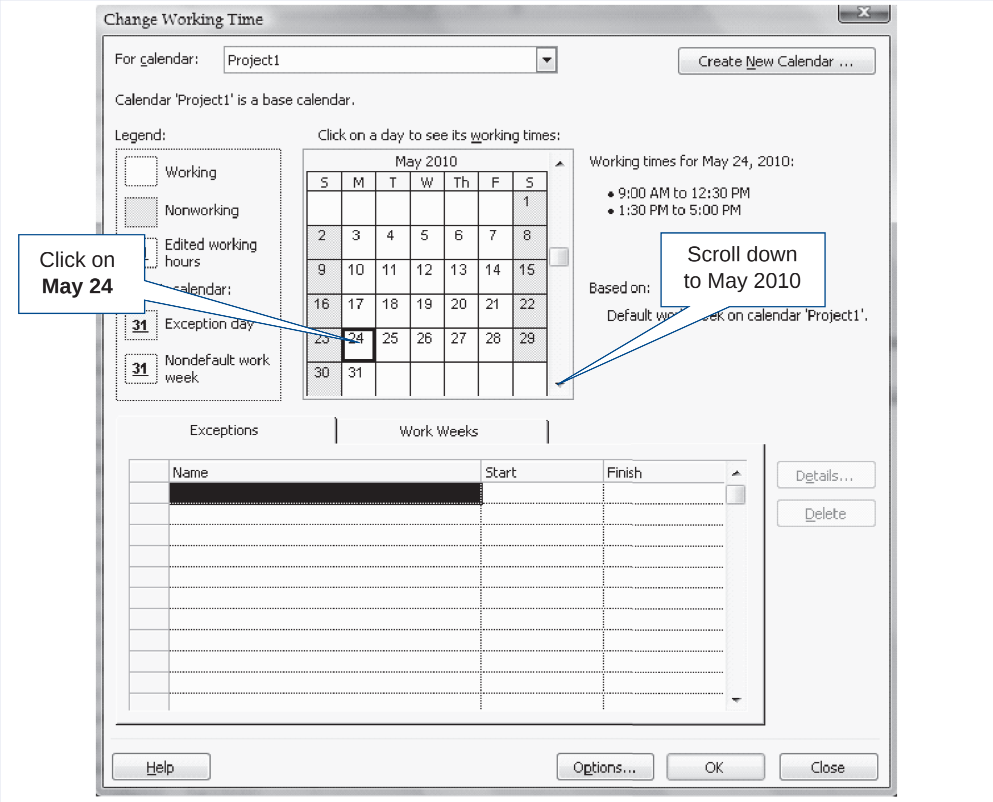
   12:30
7. In the second row **From** field, type:

   1:30 pm

We will leave the end-of-the-day time at 5:00 pm. So, click **OK**.



8. Now scroll down the calendar to May 2010 (using the scroll bars to the right of the calendar), and click on the 24th (Memorial Day).



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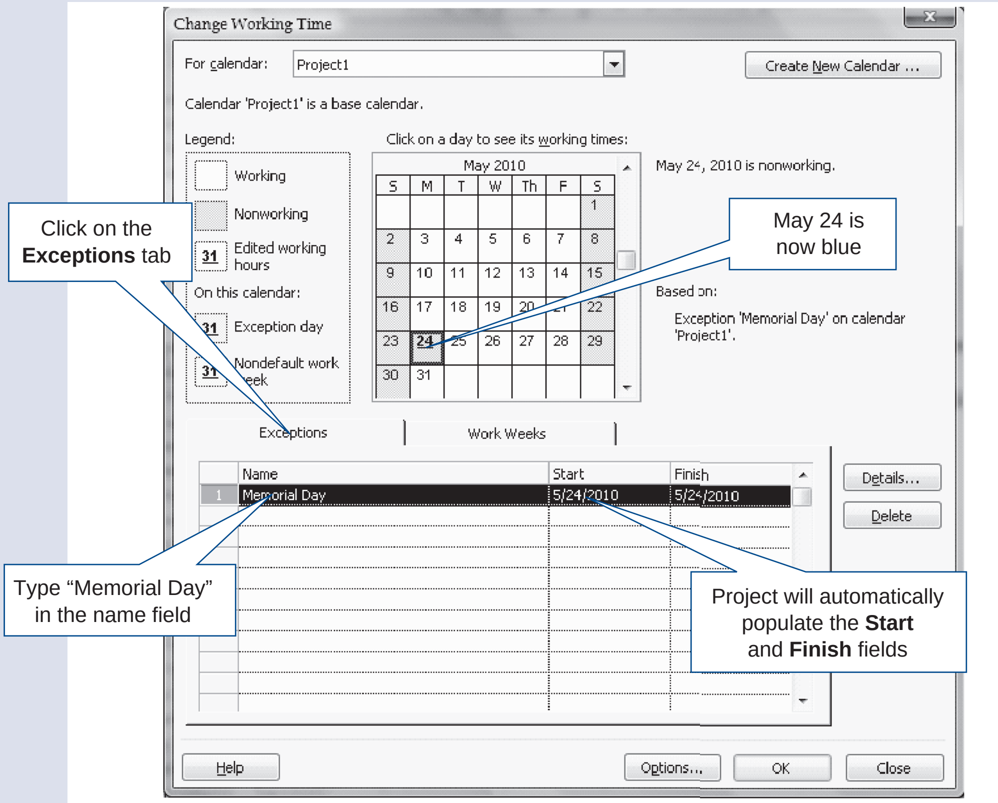
9. To make this day a holiday, click on the **Exceptions** tab. In the **Name** field, type Memorial Day to name the holiday, and press **Tab**. Project will automatically populate both **Start** and **Finish** fields with 05/24/2010 (the date highlighted in the calendar). This day is now highlighted in blue (exception day) and will not be counted by MS Project in calculating start and end dates for tasks.



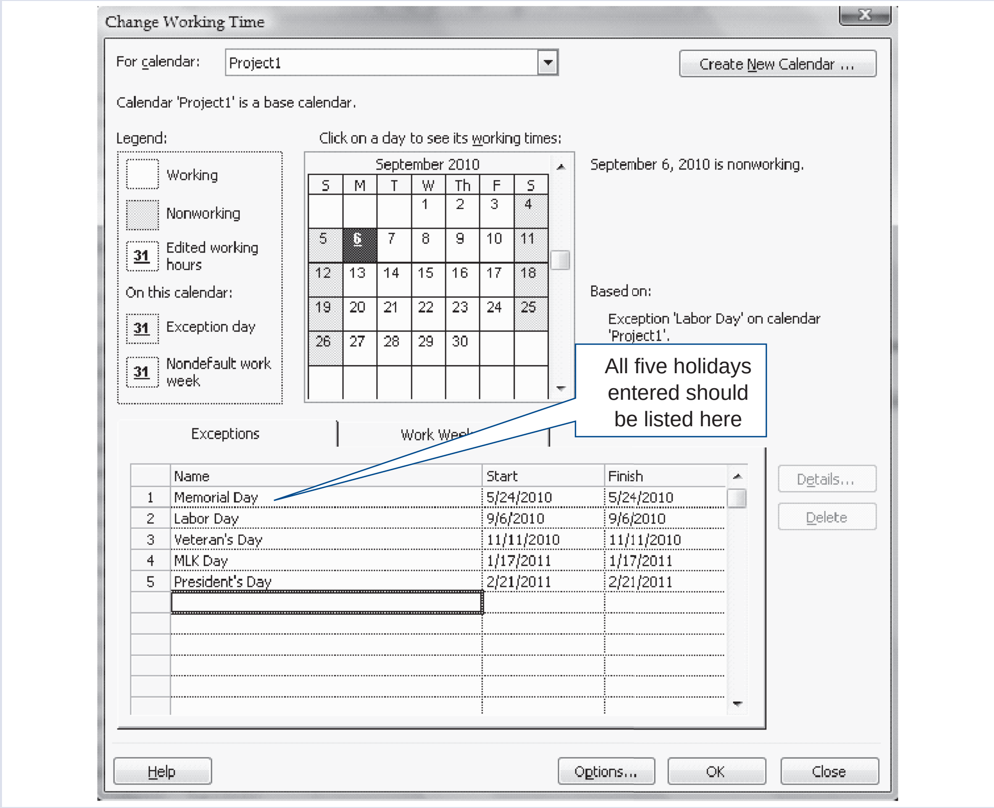
10. Using the same method, define the following days as holidays:

    September 6, 2010 (Labor Day)

    November 11, 2010 (Veterans Day)

    January 17, 2011 (Martin Luther King Jr. Day)

    February 21, 2011 (Presidents Day)



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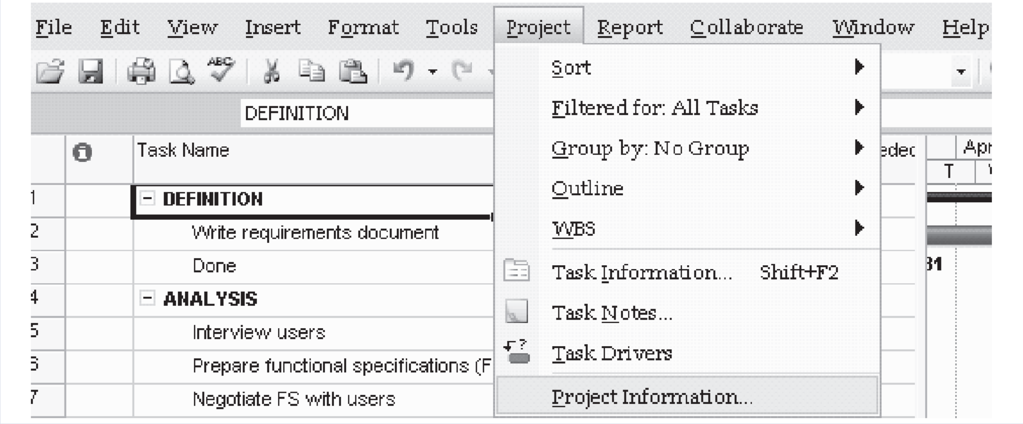
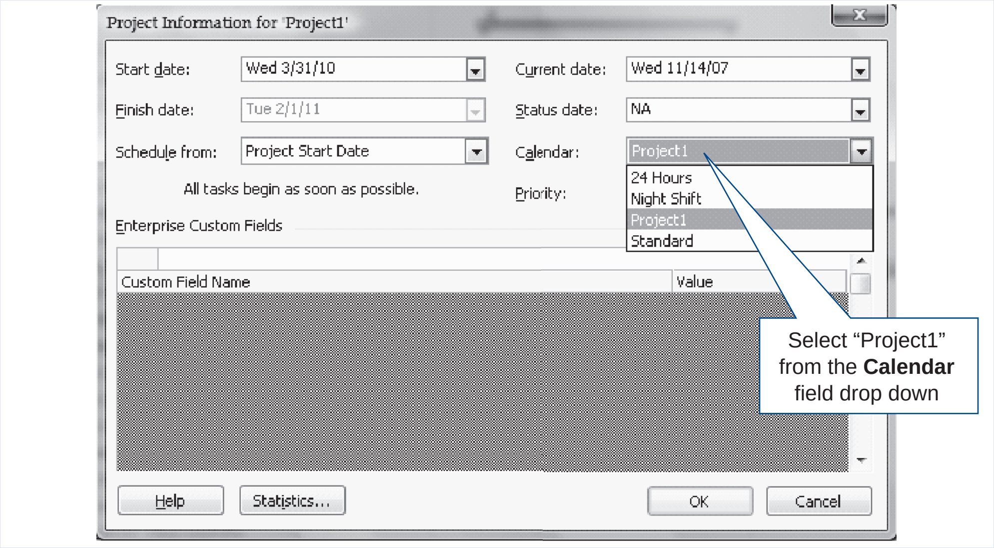
11. After entering the last holiday, save the calendar by clicking on the **OK** button.

12. To assign this customized calendar to Project1, click on **Project>Project Information**.



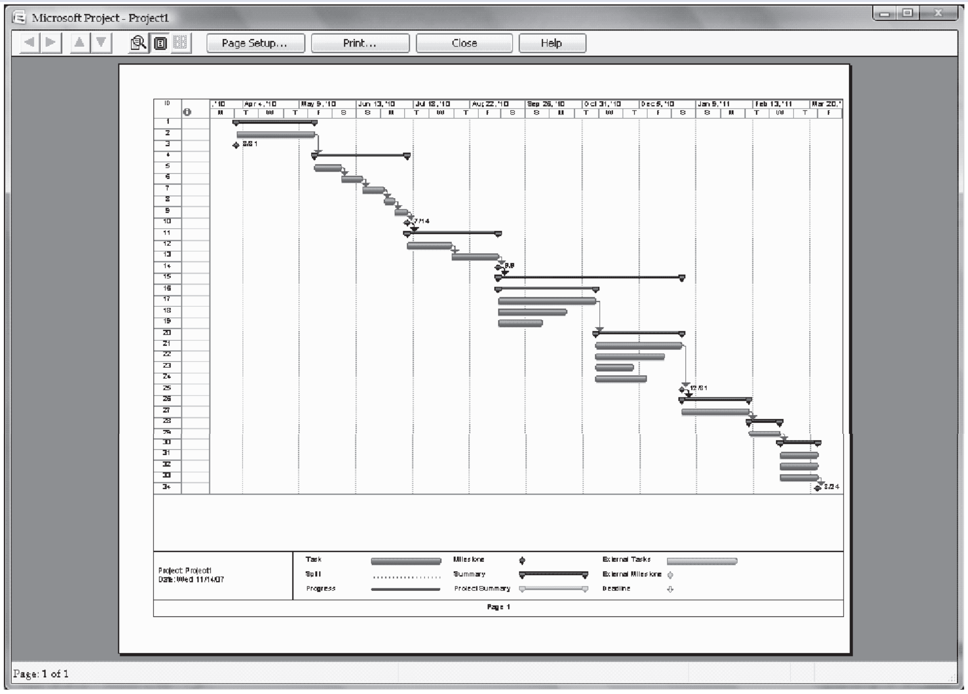
13. Using the combo box in the **Calendar** field, select Project1.



14. Click on the **OK** button. The Gantt chart will have the customized calendar assigned. By looking at the finish date, you will notice that the completion date for the project has moved forward from February 1 to March 24. It's a good thing we remembered all those nonworking days!

	ℹ	Task Name	Duration	Start	Finish	Predec
33		Follow-up	15 days	Tue 3/1/11	Thu 3/24/11	
34		END	0 days	Thu 3/24/11	Thu 3/24/11	33

The final Gantt chart will look something like that shown below:



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Work Breakdown Structure (WBS)

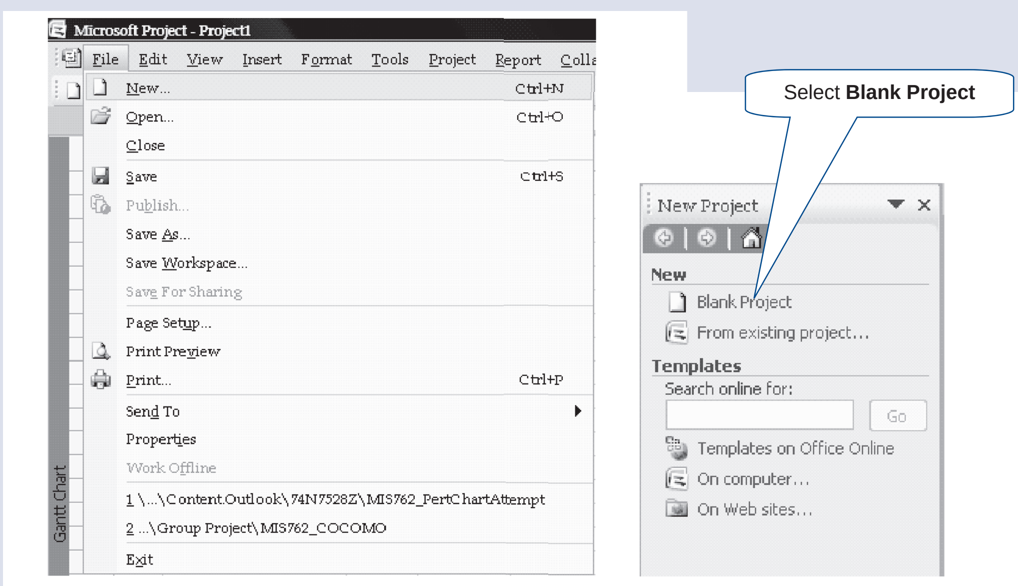
Status Form

	Task Name	Duration	Predecessor
1	DEFINITION		
2	Write requirements document	30	
3	Done	0	
4	ANALYSIS		2
5	Interview users	10	
6	Prepare functional specification (FS)	8	5
7	Negotiate FS with users	8	6
8	Revise FS (1 time only)	4	7
9	Renegotiate FS (1 time only)	5	8
10	Approval obtained	0	9
11	DESIGN		10
12	High-level software design	17	
13	Mid-level software design	18	12
14	User acceptance of design	0	13
15	PROGRAMMING		14
16	System A		
17	Module 1	37	
18	Module 2	26	
19	Module 3	17	
20	System B		17
21	Module 1	33	
22	Module 2	25	
23	Module 3	14	
24	Module 4	19	
25	Programming complete	0	21
26	SYSTEM TEST		25

	Task Name	Duration	Predecessor
27	System integration and test	25	
28	ACCEPTANCE/SQA		27
29	Schedule and run test for users	10	
30	OPERATION		29
31	Training	15	
32	Technical support	15	
33	Follow-up	15	
34	END	0	33

Second Example: Creating a New Project

1. Select **File** > **New** and click on **Blank Project** in the **New Project** task pane that appears:



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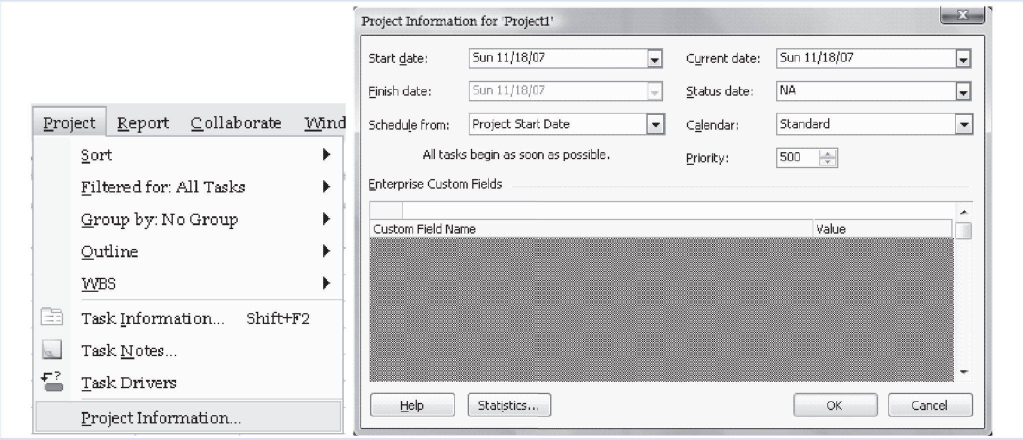
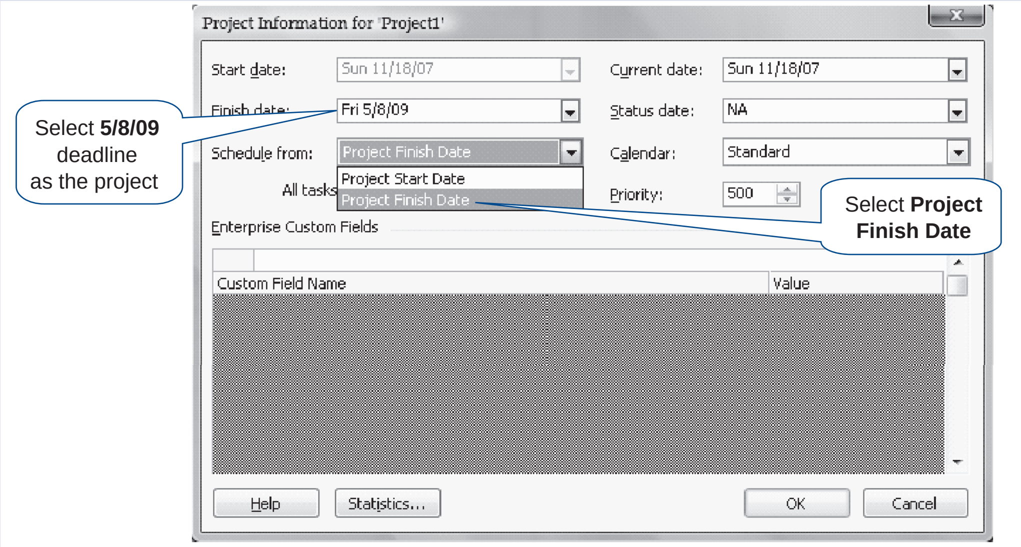
2. We will begin the new project by determining the basic project information. Since the start ***or*** finish date is usually the anchor of a project—the steps of a project are built around either the start date or the finish date—we will enter this information first in the **Project Information** dialog box.

   Select **Project** > **Project Information**. The **Project Information** dialog box will appear:



3. Select **Project Finish Date** from the **Schedule from:** drop down menu and select **Fri 5/8/09** in the **Finish date:** field and click **OK**. These entries indicate that the project deadline is Friday, May 8, 2009, and MS Project will automatically schedule tasks backwards from the deadline.



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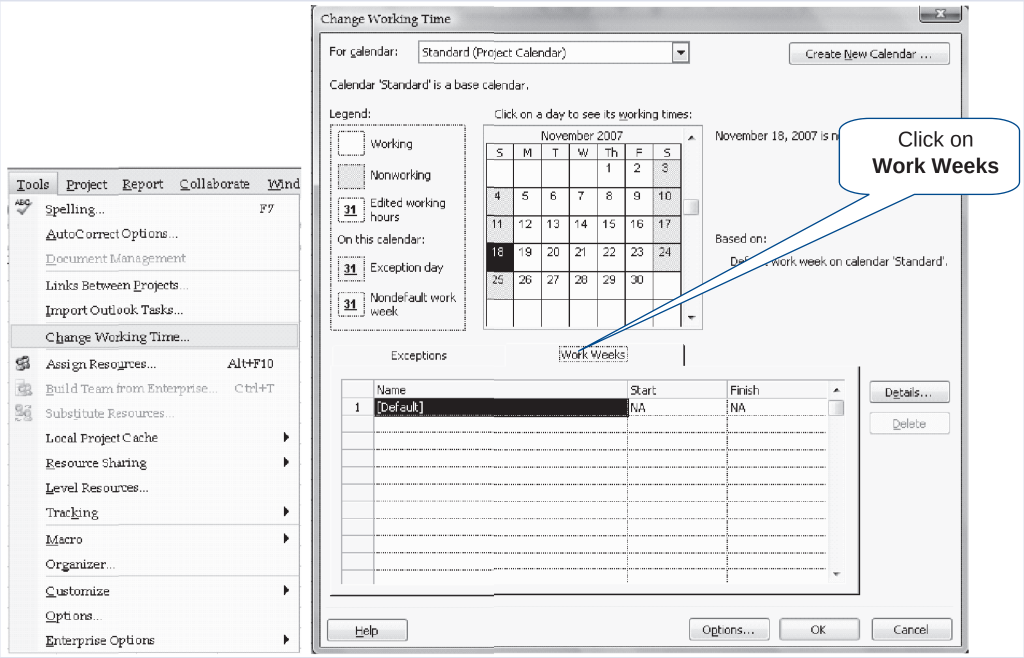
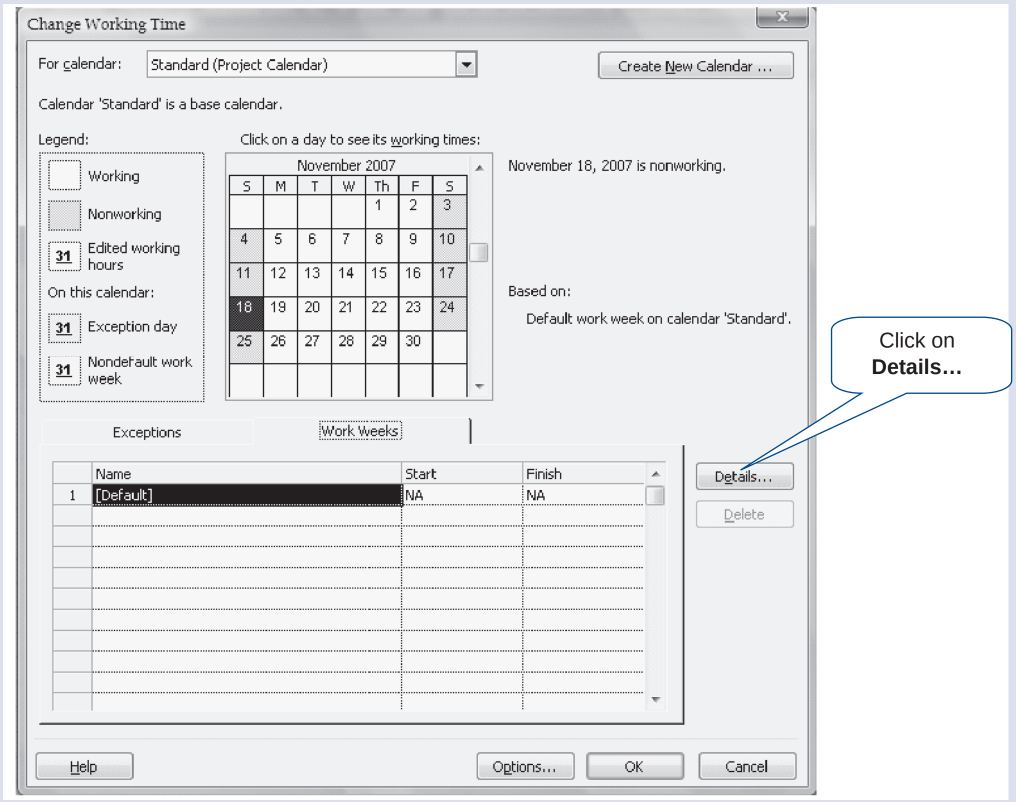
4. Next, we will define the work week. Select **Tools > Change Working Time . . .** and the **Project Information for 'Project1'** dialog box will appear. Click on the **Work Weeks** tab:



Then, click on the **Details . . .** button:



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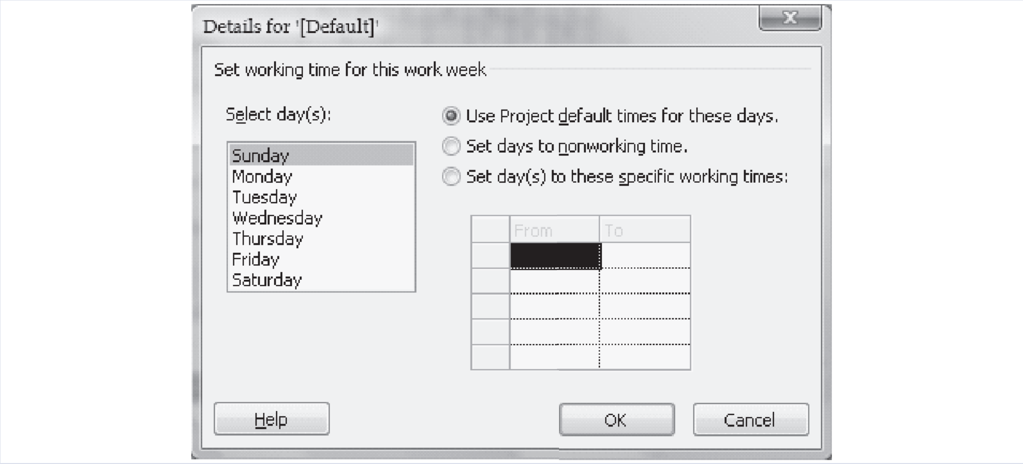
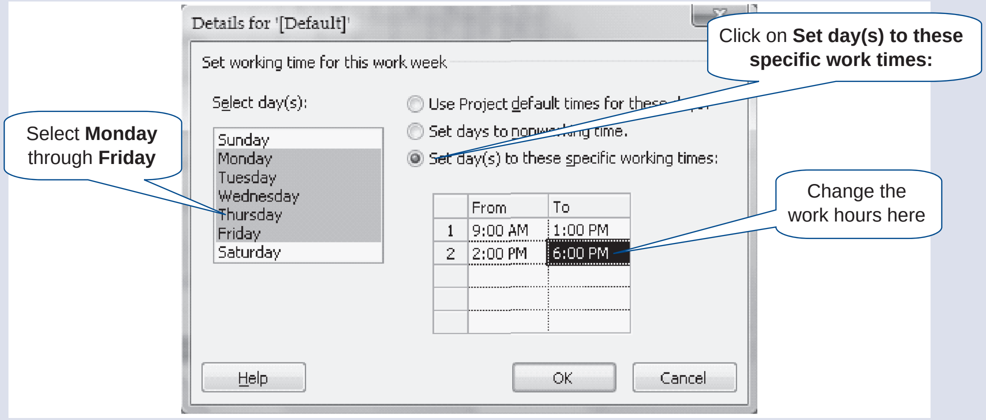
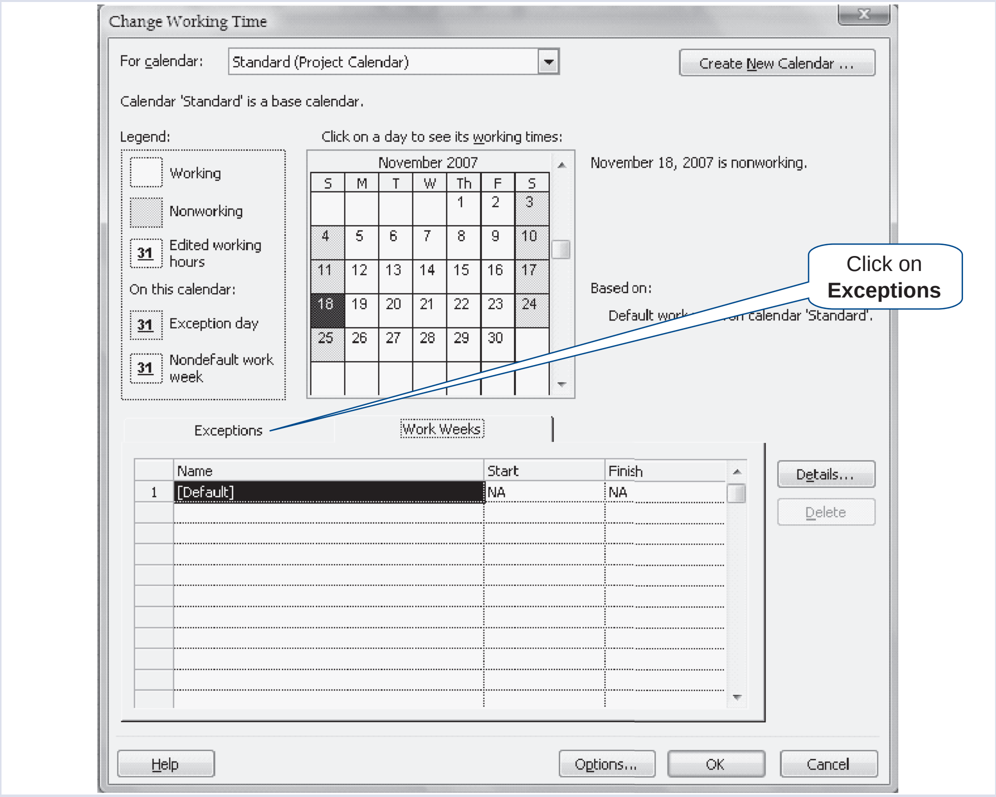
The **Details for '[Default]'** dialog box will appear:



5. We will now define the work week and the work hours. Select **Monday, Tuesday, Wednesday, Thursday**, and **Friday**. Click on **Set day(s) to these specific working times:**. In Row 1, change the **From** time to **9:00AM** and the **To** time to **1:00PM**. In Row 2, change the **From** time to **2:00PM** and the **To** time to **6:00PM** and click **OK**. These entries let MS Project know that the project team only works from 9 am to 6 pm on Mondays to Fridays, with a 1-hour lunch break from 1 pm to 2 pm.



6. Back at the **Project Information for 'Project1'** dialog box, click on the **Exceptions** tab. We will now enter exceptions to the work week we just defined—we will enter holidays as nonworking days.



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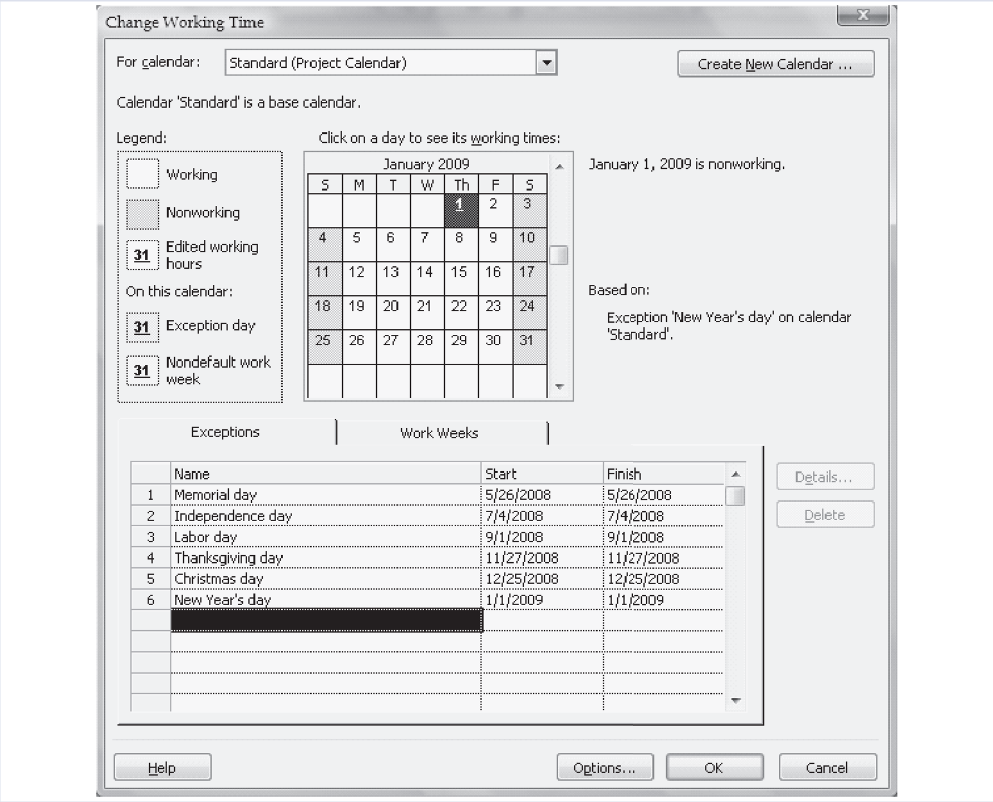
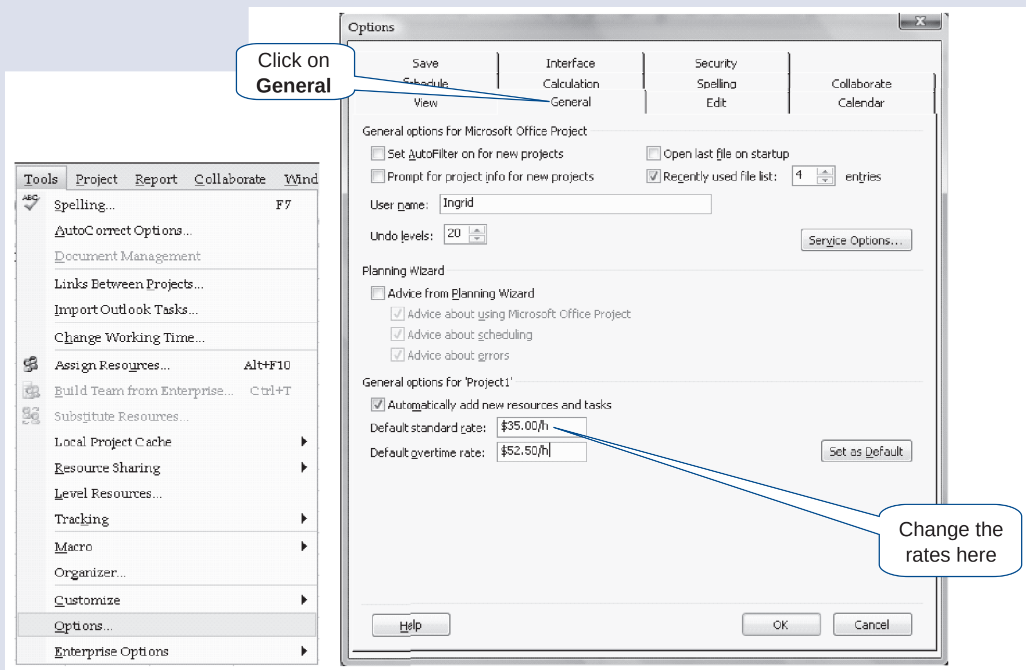
We will enter the holiday name in the **Name** column and the date in both the **Start** and **Finish** column. Click **OK** when you are done.

Name	Start	Finish
Memorial day	Monday, May 26, 2008	Monday, May 26, 2008
Independence day	Friday, July 4, 2008	Friday, July 4, 2008
Labor day	Monday, September 1, 2008	Monday, September 1, 2008
Thanksgiving day	Thursday, November 27, 2008	Thursday, November 27, 2008
Christmas day	Thursday, December 25, 2008	Thursday, December 25, 2008
New Year's day	Thursday, January 1, 2009	Thursday, January 1, 2009



7. Next, let's enter the financial estimates to time usage. Click on **Tools > Options** and the **Options** dialog box will appear. Click on the **General** tab. Under **General Options for 'Project1,'** set the **Default standard rate** to **$35.00/h** and the **Default overtime rate** to **$52.50/h** and click **OK.**



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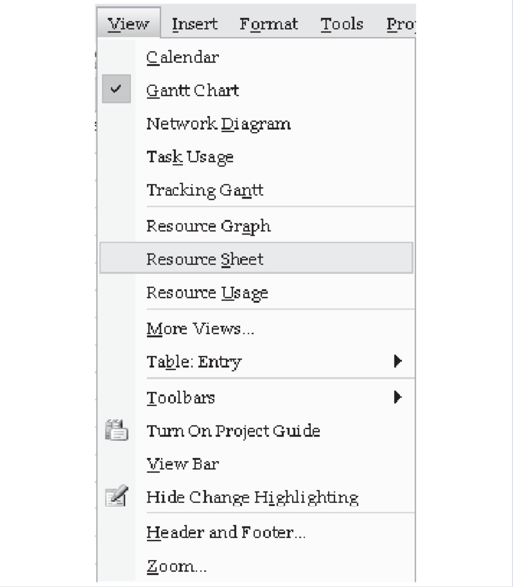
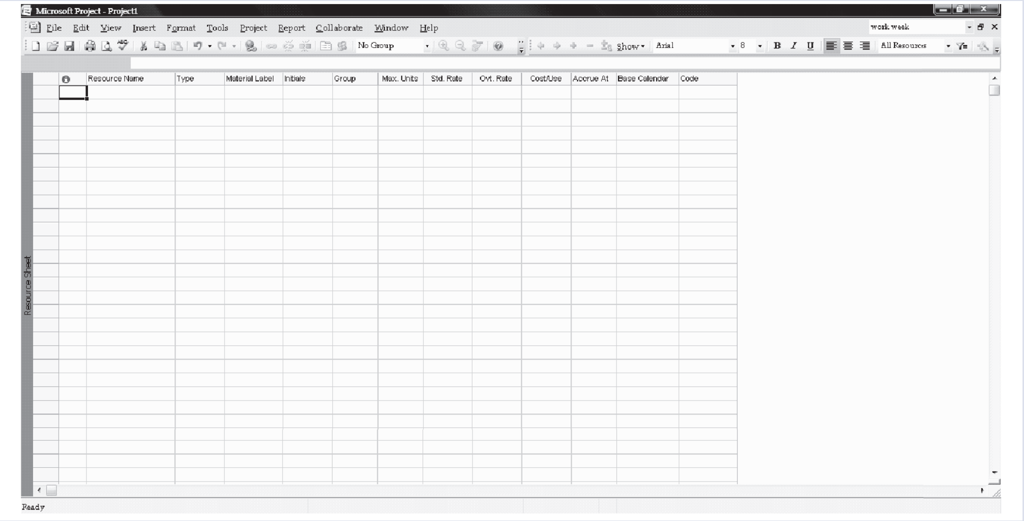
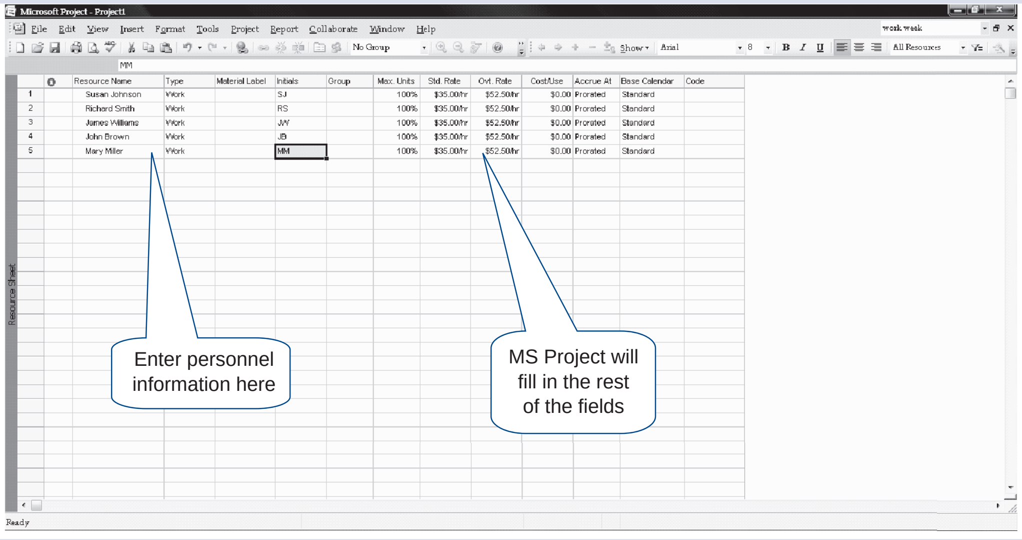
8. Now that we've set the basic project parameters, we will enter personnel resource information. Select **View > Resource Sheet**. The main project screen will change from the Gantt chart view to the resource sheet view.





In the first row of the **Resource Name** column, type *Susan Johnson.* Under **Type**, select **Work** from the combo box list. Under **Initials** enter *SJ.* MS Project will automatically fill in the remaining fields using the rates we entered previously. In the following rows, enter the information for the rest of the project team.

Resource Name	Type	Initials
Richard Smith	Work	RS
James Williams	Work	JW
John Brown	Work	JB
Mary Miller	Work	MM



Now, return to the Gantt chart view by selecting **View** > **Gantt Chart.**

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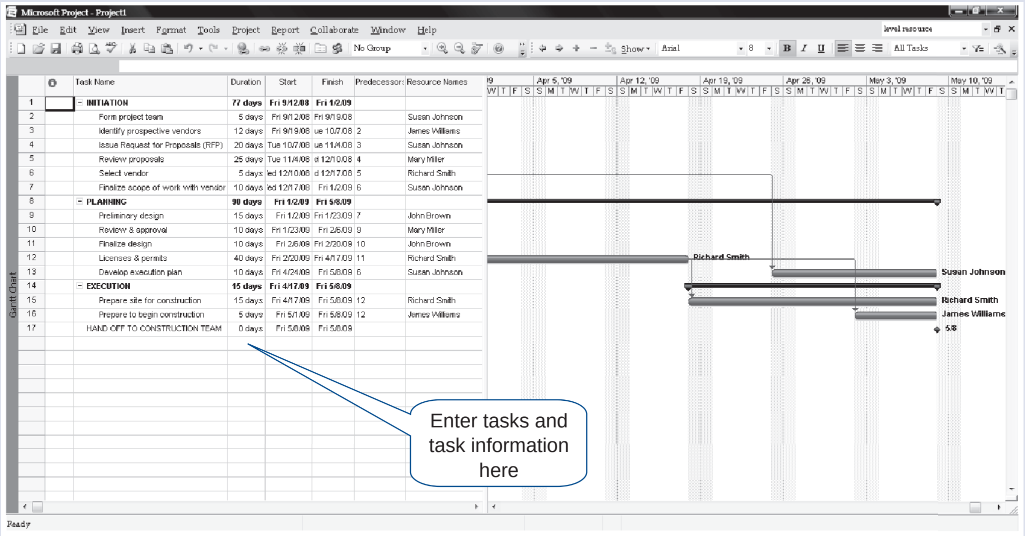
Entering Project Tasks

Once the basic project information has been entered in MS Project, we are ready to add the project tasks. Enter the tasks and task information below. Type in the **Task Name, Duration**, and **Predecessors**. Select the **Resource Name** from the drop-down list.

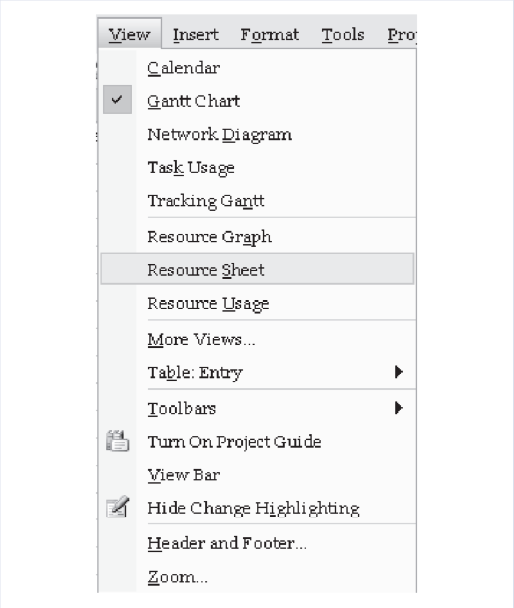
The Gantt chart will be created as you enter the tasks. Notice that MS Project creates the Gantt chart ***backwards*** from the May 8, 2009, deadline we defined earlier.

Task #	Task Name	Duration (Days)	Predecessors	Resource
1	INITIATION			
2	Form project team	5		SJ
3	Identify prospective vendors	12	2	JW
4	Issue Request for Proposals (RFP)	20	3	SJ
5	Review proposals	25	4	MM
6	Select vendor	5	5	RS
7	Finalize scope of work with vendor	10	6	SJ
8	PLANNING			
9	Preliminary design	15	7	JB
10	Review & approval	10	9	MM
11	Finalize design	10	10	JB
12	Licenses & permits	40	11	RS
13	Develop execution plan	10	6	SJ
14	EXECUTION			
15	Prepare site for construction	15	12	RS
16	Prepare to begin construction	5	12	JW
17	HAND OFF TO CONSTRUCTION TEAM	0		



Entering Material Resource Information

1. Select View > Resource Sheet.



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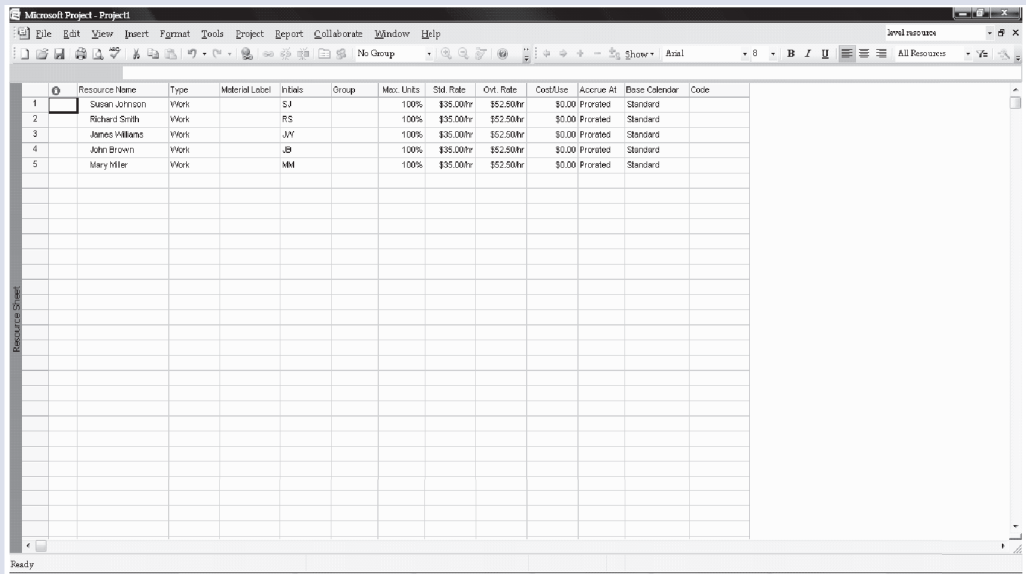
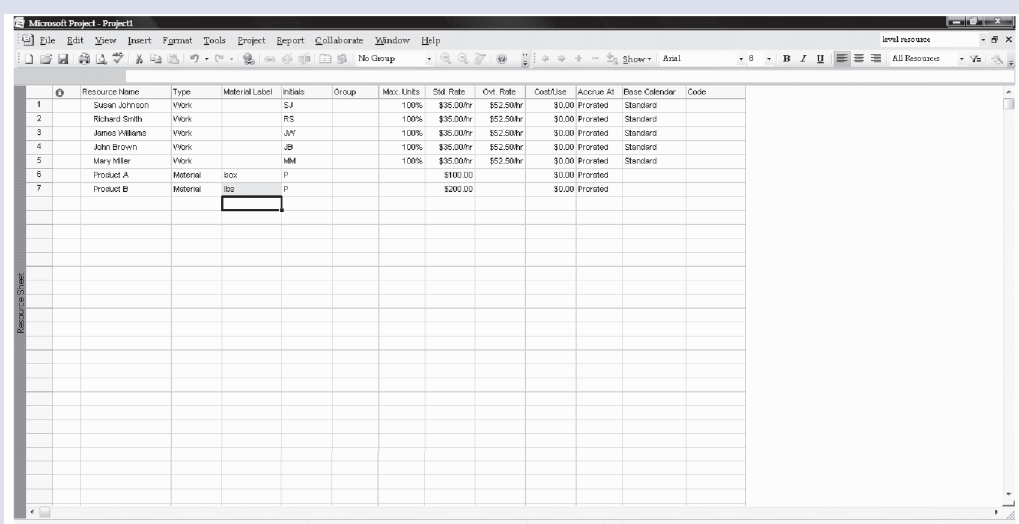


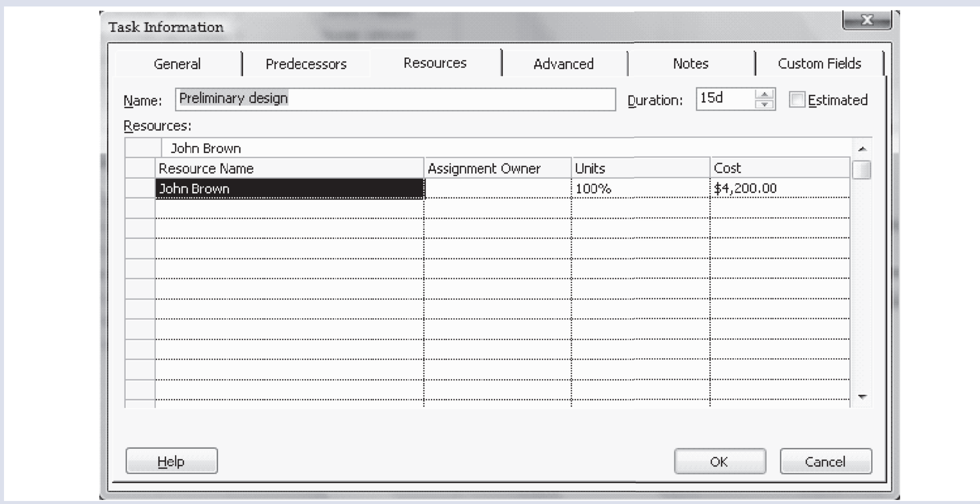
2. In the empty cell below row 5, type *Product A* for **Resource Name**. Select *Material* for **Type** and type *box* for **Material Label**. Enter *$100* for **Std Rate**.

3. In the next empty row, type *Product B* for **Resource Name**. Select *Material* for **Type** and type *lbs* for **Material Label**. Enter *$200* for **Std Rate**.

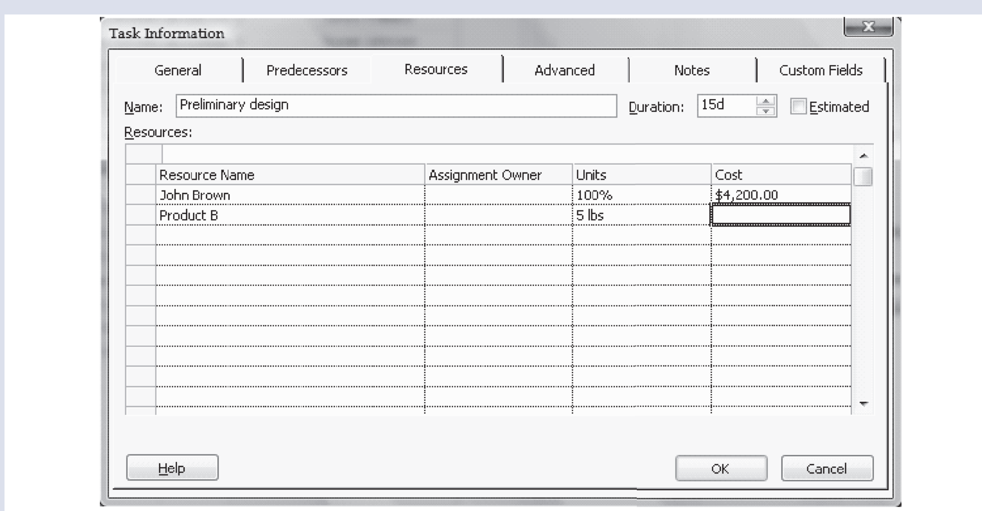


4. Return to the Gantt chart view by selecting **View > Gantt Chart**.

5. Double-click anywhere on Row 9 (Preliminary design). The **Task Information** dialog box will appear.



Click on the **Resources** tab. In the empty field below John Brown in the **Resource Name** column, select *Product B* from the drop-down list. Type in *5* (5 lbs) in the **Units** column and click **OK.**



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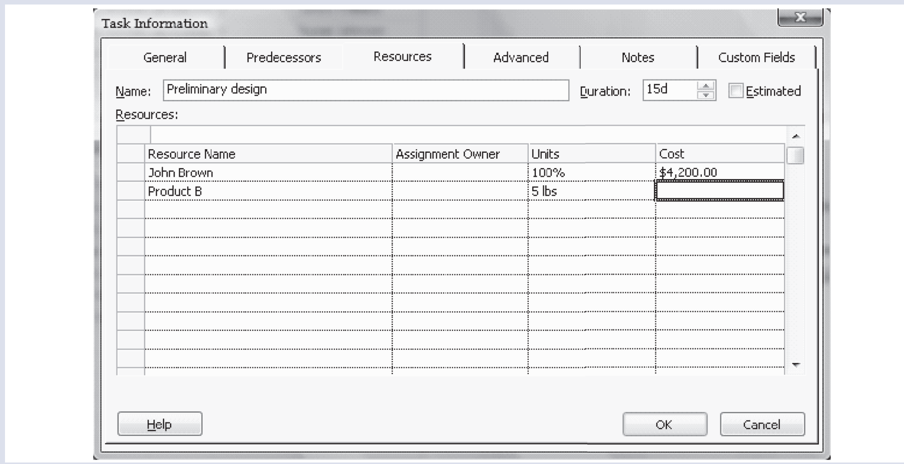
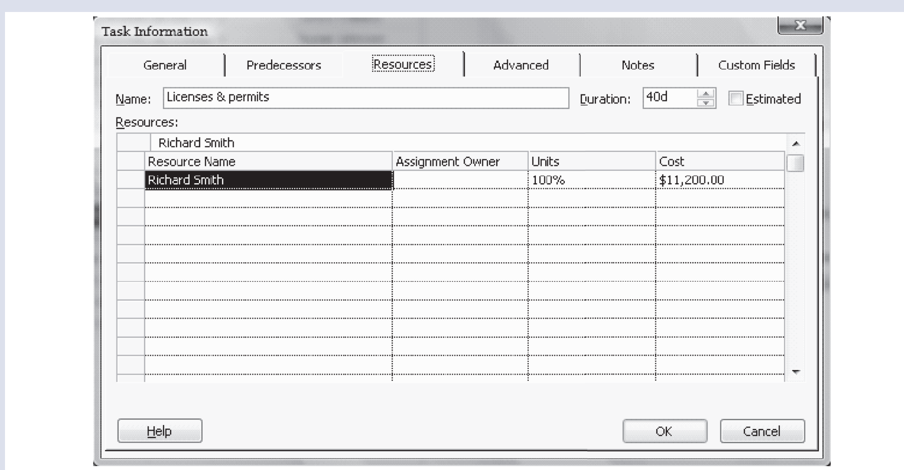
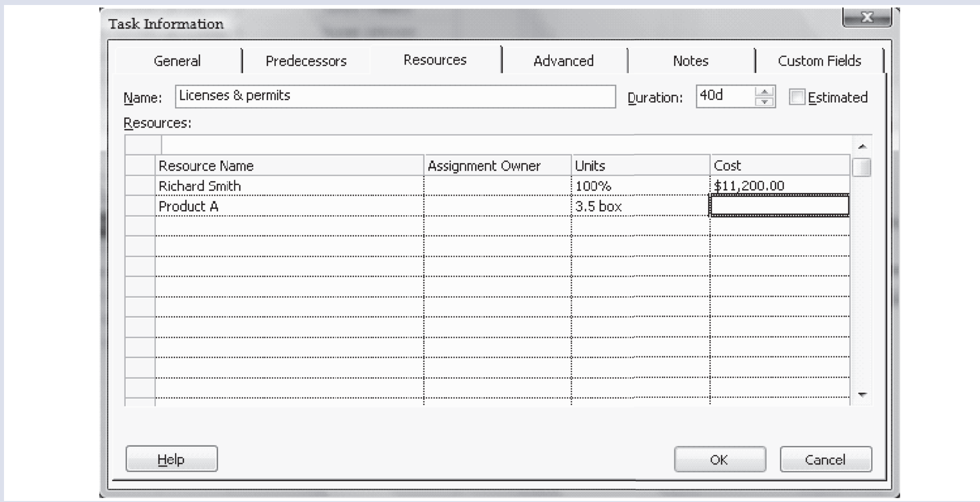


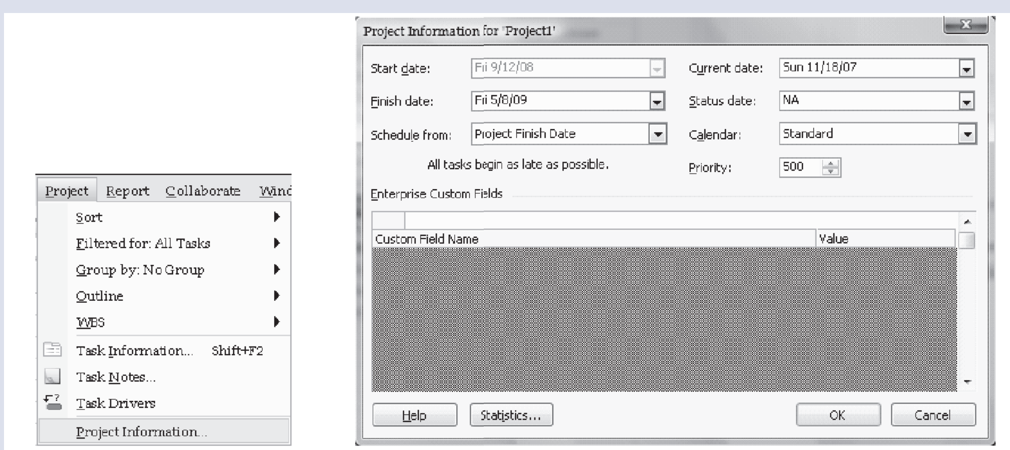
6. Double-click anywhere on Row 12 (Licenses & Permits). The **Task Information** dialog box will appear.



Add *3.5 boxes* of Product A to the task and click **OK**.



7. To view summary information for the project, select **Project** > **Project Information**. The **Project Information for 'Project1'** dialog box will appear.



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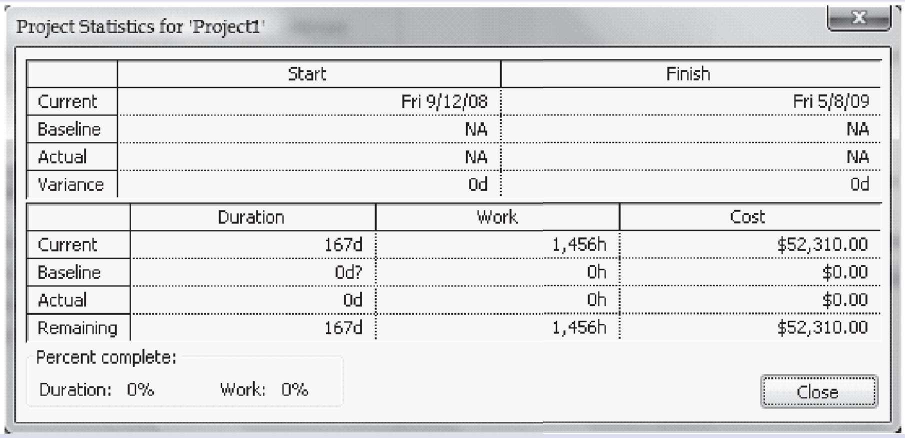
Click on the **Statistics . . .** button. The **Project Statistics for 'Project1'** dialog box will appear. The dialog box contains various key statistics pertaining to our project—i.e., estimated project start and finish dates, estimated duration, estimated number of work hours, and estimated total cost. All of these statistics are calculated by MS Project based on the parameters we have entered so far.



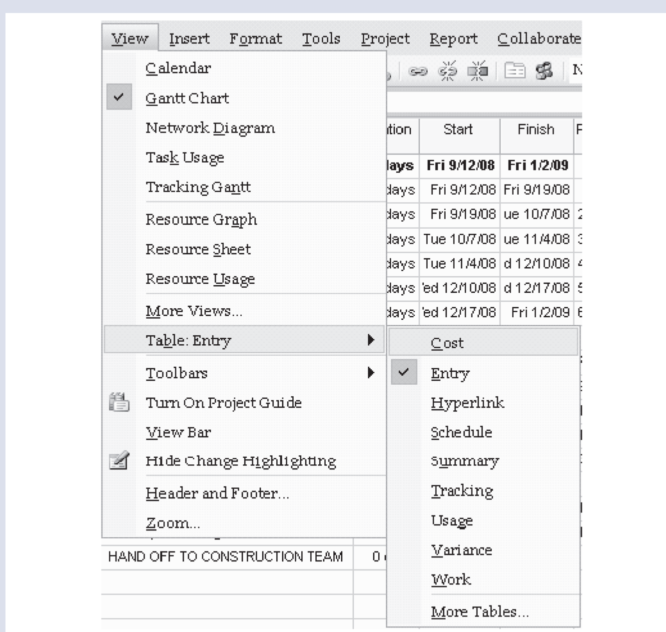
Project Statistics for 'Project1'

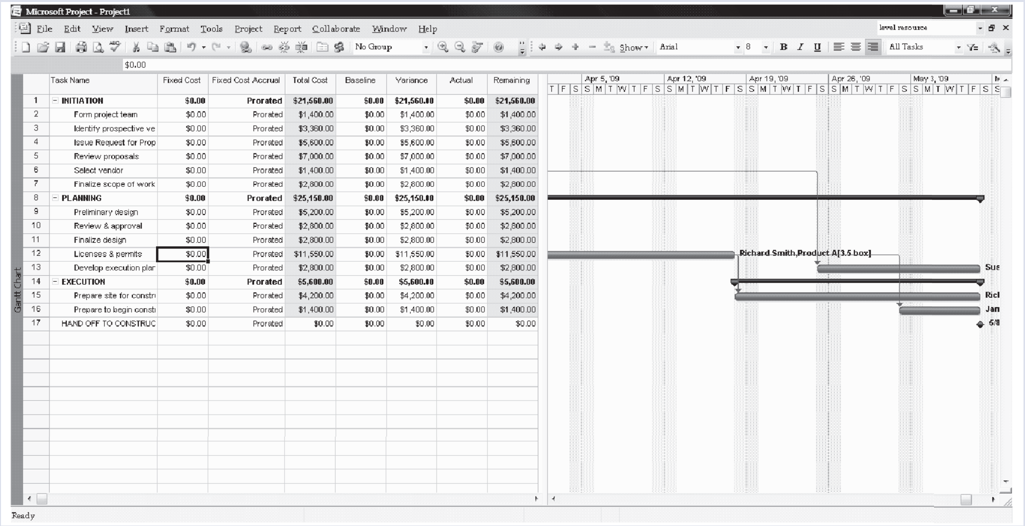
	Start	Finish
Current	Fri 9/12/08	Fri 5/8/09
Baseline	NA	NA
Actual	NA	NA
Variance	0d	0d

	Duration	Work	Cost
Current	167d	1,456h	$52,310.00
Baseline	0d?	0h	$0.00
Actual	0d	0h	$0.00
Remaining	167d	1,456h	$52,310.00

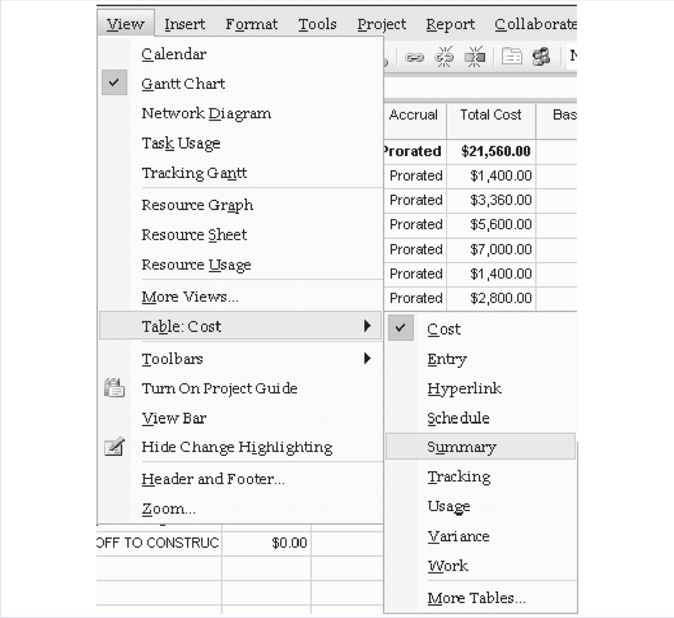
Percent complete:
Duration: 0% Work: 0%
Close

Click on the **Close** button when you are done reviewing the project statistics.
To a more detailed breakdown of the estimated cost, select **View** > **Table: Entry** > **Cost**.





9. For a summary view of the project tasks, select **View** > **Table: Cost** > **Summary**.



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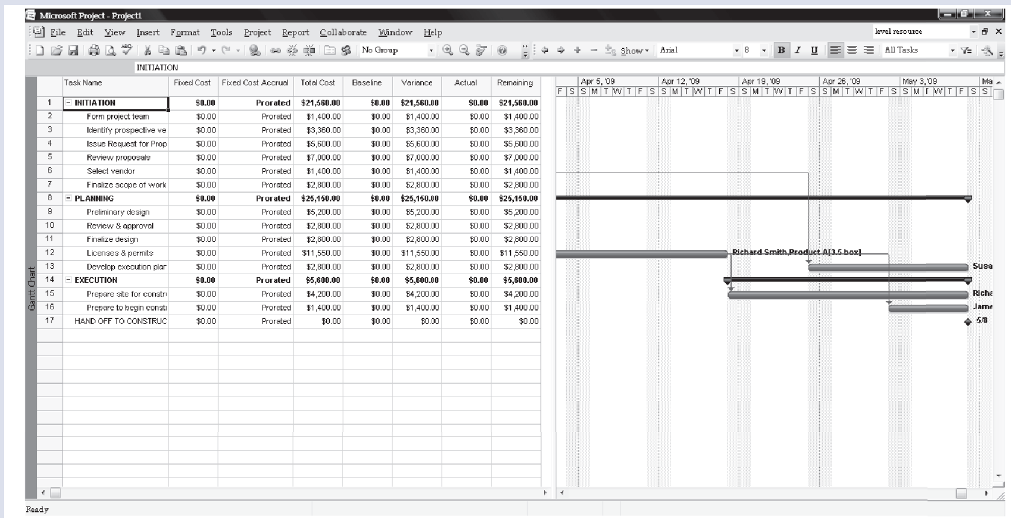

	Task Name	Fixed Cost	Fixed Cost Accrual	Total Cost	Baseline	Variance	Actual	Remaining
1	**INITIATION**	**$0.00**	**Prorated**	**$21,560.00**	**$0.00**	**$21,560.00**	**$0.00**	**$21,560.00**
2	Form project team	$0.00	Prorated	$1,400.00	$0.00	$1,400.00	$0.00	$1,400.00
3	Identify prospective ve	$0.00	Prorated	$3,360.00	$0.00	$3,360.00	$0.00	$3,360.00
4	Issue Request for Prop	$0.00	Prorated	$5,600.00	$0.00	$5,600.00	$0.00	$5,600.00
5	Review proposals	$0.00	Prorated	$7,000.00	$0.00	$7,000.00	$0.00	$7,000.00
6	Select vendor	$0.00	Prorated	$1,400.00	$0.00	$1,400.00	$0.00	$1,400.00
7	Finalize scope of work	$0.00	Prorated	$2,800.00	$0.00	$2,800.00	$0.00	$2,800.00
8	**PLANNING**	**$0.00**	**Prorated**	**$25,150.00**	**$0.00**	**$25,150.00**	**$0.00**	**$25,150.00**
9	Preliminary design	$0.00	Prorated	$5,200.00	$0.00	$5,200.00	$0.00	$5,200.00
10	Review & approval	$0.00	Prorated	$2,800.00	$0.00	$2,800.00	$0.00	$2,800.00
11	Finalize design	$0.00	Prorated	$2,800.00	$0.00	$2,800.00	$0.00	$2,800.00
12	Licenses & permits	$0.00	Prorated	$11,550.00	$0.00	$11,550.00	$0.00	$11,550.00
13	Develop execution plar	$0.00	Prorated	$2,800.00	$0.00	$2,800.00	$0.00	$2,800.00
14	**EXECUTION**	**$0.00**	**Prorated**	**$5,600.00**	**$0.00**	**$5,600.00**	**$0.00**	**$5,600.00**
15	Prepare site for constr	$0.00	Prorated	$4,200.00	$0.00	$4,200.00	$0.00	$4,200.00
16	Prepare to begin const	$0.00	Prorated	$1,400.00	$0.00	$1,400.00	$0.00	$1,400.00
17	HAND OFF TO CONSTRUC	$0.00	Prorated	$0.00	$0.00	$0.00	$0.00	$0.00

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