Teamwork & Problem Solving – Preparation

Before coming to class, do the following:


2. Take the associated quiz on Carmen.
objectives
After completing this chapter, you should be able to
- Understand the benefits of working in a team
- Organize team projects and team member responsibilities
- Communicate and work in a team
- Assess the strengths and weaknesses of your team
- Apply strategies for improving team performance
- Solve problems with team members
- Work in a team effectively
Assume your instructor has assigned a “design” project for the semester. Moreover, your instructor has assigned everyone in the class to work in teams. You probably have worked on team projects in the past. Perhaps your experiences were positive; however, you may have been frustrated at times because not everyone on the team put forth the same amount of effort in completing the project. You may be a bit skeptical about the viability and value of working on a team.

In real life, most engineering projects are accomplished by teams. Think of the space missions. The astronauts would not be able to travel into space without the effort of thousands of engineers, technicians, ground crew, and other support staff. As another example, think of the last movie you watched. The movie “team” included the director, producer, cast, camera operator, costumer, sound effects crew, and many other people who pulled together to develop the successful final product. Automobiles, computers, iPods, cell phones, and countless other everyday products were designed, produced, packaged, marketed, and distributed through a team effort. So if you really want to have a successful career as an engineer or a technologist, you have no choice but to learn to work in a team environment. In fact, you may even find that you enjoy the team atmosphere as you begin to appreciate the way individuals pull together and complement one another to create products that are innovative and timely.

While working on team projects in high school or college classes, you may have experienced less than satisfactory results. In those often dysfunctional teams, task assignments may not have been distributed evenly or team members may not have delivered on promises to complete their tasks. While being on a dysfunctional team is an experience you would like to avoid, being a part of a good team is a rewarding experience. This chapter will outline reasons for working on a team, ways to get started on the road to a successful team, strategies for making your team effective and efficient, and tools for dealing with problems that will inevitably confront you and your team. As with most activities, being prepared for the challenges and opportunities, and having a plan for how to deal with them will improve your chances of success and lead to an enjoyable and productive team experience. Further, learning how to develop successful team environments will prepare you for a future technological career. As you read this chapter, pay particular attention to the sections on organization, time management, and communication, because they are the keys to a successful project—as an individual or as a team.

Why Work in a Group?

In a later chapter, you will learn about creativity and the design process. Many of the projects suggested in that chapter are difficult, if not impossible, to do by yourself. Almost all of them can be enhanced by the interpersonal interaction that comes from being part of a good team and the environment that comes with being a member of a team. Obviously, more team members means more bodies at work (and the likelihood of a better final product); but a team is more than a group of people who divide up a task into manageable parts. The diversity of different life and professional experiences of team members leads to a larger group of ideas and a variety of approaches in solving problems. Team discussions can generate ideas, expand options, and improve the final product. Even questions from naysayers are helpful—both in clarifying ideas and
identifying fatal flaws—before a great deal of time and effort is spent on an idea that ultimately leads to a dead end.

In addition, employers value employees (whether for summer jobs, internships, co-op positions, or full-time jobs after graduation) who can work as a member of a team and who are team players. An engineer rarely works alone. Most projects require a range of training and skills beyond what the most skilled engineer can be expected to do. Even if a project is small enough for a single person to design it from start to finish, engineers rely on information collected or generated by others and need others to fabricate or construct what they design; often engineers rely on others to make sure the project has been built correctly and to identify problems.

Working on a team does not involve personal relationships; a team is based on professional relationships that require you to respect and value the skill sets that other members of the team bring to the project. A team is a group of colleagues who work together to complete an assigned task.

What Does It Mean to Be a Team Player?

Being a good team member takes work. Most people are used to working on their own—making decisions, prioritizing tasks, and being accountable for their own work. Working with others requires a different approach than working alone. To be a successful part of a team, you need to consider several issues. You should be prepared not to be in charge of everything. For some people, this requires a great deal of effort; for other people, it is less taxing. At times, you will be the supervisor; other times you will be supervised. You need to be flexible and understand that a team consisting only of leaders (or only of followers) is not likely to perform well.

Also be prepared to have some interesting (and some frustrating) encounters with your new work mates. Be prepared to exchange points of view and to learn from those around you. Everyone on a team is responsible for success and is accountable for failure.

Most importantly, prepare to learn how to be a team member. Share your strengths with the team and be willing to contribute. Remember, the combined efforts of all team members should yield a better outcome than the efforts of one individual. Learn new team skills and be adaptable.

Many teams have problems when everyone tries to be in charge or when no one tries to be in charge. The result can be the same: uneven distribution of work, incomplete work, missed deadlines, subpar performance, and frustration. Even though a team is a united effort, each individual is accountable for the overall performance of the team.

Individuals generally react differently in groups than they do on their own. If you miss deadlines or produce inferior work as an individual, you can expect to be held accountable if your work habits are the same when you are part of a team. Conversely, if you produce high-quality work on your own and do the same as part of a team, you will be rewarded accordingly. Remember that team members are accountable first for their individual performance and second for the group’s performance. Keep everyone informed of your progress.

Differences between Teaming in the Classroom and Teaming in the Real World

Selecting personnel and identifying skills are the most important tasks of assembling a team to work on a real-world project. While it may be advantageous to pick people who have worked together previously and who have established a good working relationship,
you need to make sure that all of the skills required for the completion of the project are represented by at least one person on the team. For example, if the team is designing a building, the team must have a member who understands, among other things, the:

- Design of a foundation.
- Design of the structure.
- Design of elevator and/or escalator systems.
- Design of air-conditioning systems.

Additional skills are likely to be on the list if the building is to be made of reinforced concrete, or if it is to be constructed in Alaska or California or Louisiana.

In the real world and in the classroom, the goal is to complete a successful project on time and within budget. However, the skills and training of potential team members in the classroom are all virtually the same (unlike the real world). Furthermore, the primary goal in the classroom is for each member of the team to learn about each task required in the project. Whereas a mechanical engineer is not expected to teach other members of a building-design team how the air-conditioning system works or why the particular components were selected, each member of a classroom team is expected to explain her part of the team project. Unless the team members complete all of the tasks together, each member must teach the rest of the team what she did on her part of the project.

### 4.05 Team Roles

For your team to operate like a “well-oiled machine,” you need to understand that the members must fill specific team roles, if effective collaborative work is to result. Typically, well-functioning teams have a leader, a timekeeper, and a note taker at a minimum. If there are additional team members, assigning someone to the role of devil’s advocate is also a good idea. The team leader does just that—she leads. This does not mean the team leader dictates or makes all of the decisions for the group. The team leader sets the meeting time, sets the agenda for the meeting, and generally keeps the meeting moving. The team leader also makes sure the team stays on target and remains focused on the task at hand.

The note taker keeps a written record of the team’s progress. He or she records what tasks have been assigned to whom and records the expected completion dates of the tasks. The note taker is responsible for sending the minutes of the meeting to all team members. The minutes are a written record of what transpired during the meeting and serve as a reminder of who is responsible for completing what task(s).

The timekeeper makes sure the schedule is maintained and that meetings do not run over the allotted time. If meetings routinely last longer than planned, team members may skip them or resent coming to them—either of which leads to less productive team encounters.

Finally, the role of the devil’s advocate is to challenge ideas without being too overbearing or unpleasant. The devil’s advocate makes sure that all options are considered and that ideas are sound. However, a devil’s advocate should not challenge ideas just for the sake of the challenge; doing this can annoy teammates and detract from the overall effectiveness of the team’s operation.

Depending on your personality, you might be naturally inclined toward one role over another. For example, you may naturally be a critic who performs the role of devil’s advocate very well. In the classroom setting, you should try out other team roles, so you can develop additional team skills. You may need to hone your note-taking skills, and filling that role on the team may help your personal development. In classroom projects, team members can rotate roles so everyone has a chance to experience each role. By performing roles that are unfamiliar to you, you learn to appreciate people who work in these roles. Developing an appreciation for and respecting the skills of the other members of your team are the first steps toward your becoming an effective team member.
4.06 Characteristics of an Effective Team

Most successful teams either knowingly or unknowingly operate by certain ground rules that contribute to overall team productivity. Some of these ground rules are described in subsequent sections of this chapter, giving you the opportunity to learn the rules and adapt them to your particular setting and project.

4.06.01 Decisions Made by Consensus

For a diverse team, it will be nearly impossible to get 100 percent agreement on all of the decisions. Trying to achieve this unreachable goal will lead to frustration and poor productivity for the team. **Consensus** means finding an option that all team members will support. It does not mean that all team members would select that option as their first choice, although some of them probably would. When making decisions by consensus, everyone on the team is invited to voice an opinion. Some people may be naturally shy and unwilling to speak up. The team leader should note when a team member has not voiced an opinion and invite the individual to speak up. Silence should not be interpreted as agreement—often it is not. Another important aspect in making team decisions is to consider the data carefully. Decisions made based on feelings, where data is ignored, are usually not optimal.

4.06.02 Everyone Participates

No member of a team should be allowed to sit back and watch others do the work. As mentioned previously, it is important for every member of the team to voice an opinion during meetings. It is just as important for every member of the team to participate in the work of the team. Tasks should be assigned to members based on talents/skills, and no one should be allowed to choose not to do something. The leader is responsible for making sure that every member participates equally in the work of the team. This does not mean that every task needs to be divided into equal parts, but it does mean the overall work should be divided evenly.

4.06.03 Professional Meetings

Team meetings should be productive and engaging. If they are ineffective and a waste of time, team members will likely skip them or not participate fully. This, in turn, will lead to poor-quality work from the team. Team meetings work best when a procedure has been established for the conduct of the meeting and an agenda has been created in advance. The agenda should be prepared by the team leader and e-mailed to participants in advance of team meetings. As a rule of thumb, the agenda should include (1) a review of progress to date, (2) a review and possible revision of the project schedule, and (3) new task assignments for team members as needed. This list is not exhaustive—your agenda will be dictated somewhat by the project you are working on. The timekeeper is responsible for making sure the team follows the agenda so that all items on the agenda are completed within the time allotted for the meeting. Punctuality at team meetings is a necessary ingredient for success. A person who shows up late for a meeting is not being fair to or respectful of her teammates. Attendees should do their best to be on time.

Project Organization—Defining Tasks and Deliverables

Your team was likely formed to work on a project, maybe even a design project. In a subsequent chapter, you will learn about the design process and its various stages. For now, understand that design is an iterative process that proceeds from stage to stage until
completion. At some point in the process, you may have to return to an earlier stage to redo something the team thought was completed. Redoing earlier work is a normal part of the design process, especially in cases where you are trying something new and do not know if your idea or solution will actually work. During each stage, you meet as a team to review your progress and to determine what needs to be done next. In the early stages of the project, you probably made a list of all of the tasks that needed to be done. You should review this list at each meeting because the list will likely change as the project evolves.

Once you are sure you have a complete list of what needs to be done before the next meeting, it is time to make a list of tasks and assign responsibility to the person who will be completing each task. When reviewing the items on the list of tasks to accomplish, you need to determine which tasks depend on the outcome of other tasks. For example, if you are going to machine a part, you need to create a drawing of the part. To create the drawing, you may need to create a solid model of it in your CAD system. Thus, it would be unreasonable to expect someone to do the machining before the modeling work has been done—the task of machining depends on the outcome of the modeling task.

Another consideration when assigning tasks is to determine which tasks can be done by an individual and which require a group effort. If someone on your team has a difficult schedule to work around, you may want to assign individual tasks to that person most of the time (but not always) to accommodate their schedule. In addition to looking at the individual/group effort required of each task, you also should try to estimate the amount of time each task will require for completion. If one group member ends up completing a task that requires ten hours while two other members complete tasks that require one hour each, resentment is likely to build, thereby hindering group progress. However, as stated earlier in this chapter, division of labor for the project should be balanced overall. So if the person assigned the ten-hour task has been a slacker on previous assignments, perhaps that person should complete a significant task the next time one is assigned.

When assigning tasks, you should try to match the talents and abilities of each team member to the requirements of the task. However, you want to rotate duties so one person is not burdened with all of the writing or all of the modeling or all of the calculating (similar to the way the team roles are rotated so everyone has the opportunity to experience each role). As you are thinking about the assignment of tasks, ask yourself the following questions:

- Which team member is best qualified to do the task?
- Who is able to do the task in terms of either time or skill?
- Who is willing to do the task?

You need to make choices between assigning a task to a person who can accomplish it and assigning the task to the best person. The best outcome may not result from the best person being assigned to a task. If the person is overloaded as a result of the task assignment, she may not do a very good job or may not be able to complete the task. Balancing task assignments is key to producing the best possible project. A project may not be the best one a team can produce; rather, it is the best project a team can produce within the limits of available resources.

### 4.08 Time Management—Project Scheduling

Once you have organized your team and started work on your project, you should begin developing a plan for completing the project. Think of the plan as being dynamic, not static, since you are likely to be making changes to the plan as the project unfolds. Think of the initial plan as a flowchart of activities or a calendar of events that should include items such as who was assigned to work on each task and where each task fits in the overall project. When examining the various tasks that make up the
final project, think about the interrelationships between tasks. What task precedes/follows each task? How does information flow from one task to another? In the previous example, modeling was the first task to be accomplished, which was followed by the creation of a drawing, culminating in a fabricated part. The task that precedes and follows each task is well-defined, but the method of communicating information between tasks may not be as straightforward. Ideally, this information flows seamlessly through the CAD software; however, you may need to run file translator routines to move information between tasks.

Perhaps the most important activity in project scheduling is to determine how each task fits within the overall project and when each task should be completed for your project to end successfully. Usually when you are organizing your project, you can begin at the beginning or you can begin at the end. If you start at the beginning, the organization of the project can be done in a cyclic manner. As a team, ask the following questions:

1. What needs to be done first?
2. What do we need to know before we can do WhatNeedsToBeDoneFirst (WNTBDF)?
3. Now that we have a new WNTBDF, repeat step 2.

Sometimes it is more efficient to begin by considering the final deliverable for the project (product, design, prototype, sketch, etc.). You then work backward through the process, identifying what needs to happen before a specific task can be accomplished. Another way of thinking about this is to consider all of the other tasks that must be completed before a specific task can be accomplished. When organizing your project from the beginning or the end, you also need to consider who will be completing each task—you cannot establish a timeline without considering the realities of everyone’s schedule.

Sometimes the result of this activity is to discover that the timeline for your well-planned project does not match the deadlines established by your client (or instructor). In this case, you must revisit the task list and eliminate tasks or compress the time to complete each task. In other words, you must determine how good of a project you can deliver in the time allowed. Even in the real world, you do not always have enough time to produce the best design (or the client does not have enough money to build the best product). The goal is to produce the best product within the constraints given. These constraints are usually time, money, materials, and talent.

By now, you may have realized that the schedule for your project and the organization of tasks in your project (presented in the previous section) are linked. The following sections include information on two tools you may find useful as you organize and plan your project: the Gantt chart and the Critical Path Method.

4.08.01 Gantt Charts

When working in teams, it is essential to establish a well-thought-out plan for completing the project. If you are working on a project as an individual, the planning stage is not nearly as critical, since no one else is depending on you to complete a task to an acceptable level of quality within a certain time frame. One useful tool to help you organize your project, assigning a timeline for the completion of various tasks, is a Gantt chart. A Gantt chart is a table that lists the tasks in the leftmost column that must be completed, and it identifies the dates across the top row by which each task must be completed. Shading indicates the times for working on each of the project tasks. Without a detailed plan that lays out due dates and establishes a timeline, most projects get bogged down in trivial details and important tasks are delayed. This will often put the success of the project in jeopardy of being completed on time. Figure 4.01 shows a simple Gantt chart for a student project in reverse engineering, a topic that will be discussed in more detail in a subsequent chapter.
Note that each of the major task headings can be broken down further and a Gantt chart created for each major task. For example, Figure 4.02 shows a new Gantt chart created just for the last task listed in the previous Gantt chart.

### 4.08.02 Critical Path Method

The **critical path method (CPM)** is used in project scheduling to determine the least amount of time needed to complete a given project. CPM is also used to determine which activities are most critical to the on-time completion of the project (hence, the name) and which activities are not as critical to the overall project schedule. The **critical path** includes the sequence of the activities that have the longest duration. When these...
activities are strung together on the critical path, you can determine the shortest possible duration of the project. Activities that are not on the critical path can be allowed to “float” with regard to schedule, which will not impact completion of the overall project.

The CPM is like a flowchart for the project. It helps everyone visualize what has been accomplished, in what stage of the project the team is (what percentage is complete, whether the project is ahead or behind schedule, etc.), and what needs to be done next at each step of the project. If names are associated with each task, the CPM can also serve as a reminder of who is waiting for a finished task before that person can begin the next task. The information required to construct a CPM diagram is:

- A list of all activities required to complete the project.
- The amount of time each activity will take to complete.
- The dependencies between tasks (i.e., what task relies on the completion of another task before it can be started).

As an example of a CPM, consider a project broken down into six major activities. The task breakdown is characterized as follows:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
<th>Depends on</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 days</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>4 days</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>6 days</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>5 days</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>2 days</td>
<td>2, 4</td>
</tr>
<tr>
<td>6</td>
<td>8 days</td>
<td>3, 5</td>
</tr>
</tbody>
</table>

The critical path diagram for this project can be constructed as shown in Figure 4.03. Note that arrows are used to show forward progress through the project, and dependencies between tasks are shown graphically. For this example, there are three possible “paths” through the project from start to finish, as shown in Figure 4.04. The first path includes Activities 1, 2, 3, and 6. This path has a total duration of 20 days. The second path includes Activities 1, 2, 5, and 6 with a duration of 16 days. The final path includes Activities 1, 4, 5, and 6 with a duration of 17 days. The critical path is the first one (with Activities 1, 2, 3, and 6) because this path has the longest duration. Based on the critical path, the shortest possible completion schedule for the project is 20 days; anything less than this is impossible.

Each activity on the critical path is now a critical activity; that is, if any of the activities are not completed on time, the overall time needed to complete the project will be lengthened. This means that Activity 4 and Activity 5 (the only activities not on the critical path) have some float time—if they are not completed on time, the overall project will still be on schedule. If you are a project manager, this information shows you where to concentrate your efforts. If it looks as though Activity 4 is beginning to interfere with Activity 3, you can suspend work on Activity 4 for a short while to make sure Activity 3 proceeds unhindered. Or if Activity 2 starts to flounder, you can shift resources away from Activity 4 to make sure the critical activity (Activity 2) is completed on schedule.

FIGURE 4.03. Critical path diagram.
Because completion of any project is dynamic rather than static, as with Gantt charts, you should review your critical path diagram periodically to ensure that it still accurately reflects the realities of your project.

### 4.09 Communication

Following is a discussion about communication between the team and the outside world and communication among members of the team. Each member of the team must communicate openly and honestly during task assignments (Do I agree with the plan? Do I have other commitments that will interfere with the timeline? Can I commit...
enough time to the task? Do I have the skills required to complete the task alone?). A team member’s silence is usually interpreted as agreement with the plan, or at least acceptance of the plan. Most problems between team members result from a lack of open and honest communication.

4.09.01 Agreeing How to Communicate

E-mailing, chatting, and text messaging are useful modes of communication, and you have probably used all of them; however, regular face-to-face meetings are essential for a team’s successful communication. Electronic modes of communication can be used, but nothing takes the place of face-to-face meetings. Because no one has time for an unnecessary or poorly conducted meeting, when team members do meet, they want the meetings to be productive. Decide early in the project how often the team needs to convene to conduct its business. Team members have other obligations, and the team project will get only a portion of their time. Having a regularly scheduled meeting time enables all team members to plan their activities around project time.

Not all information is shared in meetings; and the options of e-mail, notes, memos, and voice mail are appropriate under the right circumstances. All team members need to agree on how to communicate.

In your initial team meeting, find out how the team wants to handle communication. How much time do members have for meetings? Does everyone have e-mail? How often do they check it? Is voice mail reliable? The value of written records of team meetings and decisions cannot be overemphasized. By investing whatever time is needed to agree on how to communicate, team members will save time during the course of the project.

Documentation is essential after meetings. The note taker’s responsibility is to summarize the conduct of the meeting and communicate his or her notes to the rest of the group. Sometimes the team keeps a bound notebook of team-meeting notes, with the notebook passed from one note taker to the next (when team roles are being rotated). Usually the note taker will convert meeting notes to an electronic document and e-mail them to all team members, summarizing the following:

- Did we say what needed to be said?
- Did we begin and end on time?
- What was decided?
- What tasks were assigned?
- Who is responsible for each task?
- What questions still need to be answered?
- What must be done before the next meeting?

After the note taker e-mails the document out for review, you should look over the notes carefully, making comments if any points conflict with how you remember the meeting. If you do not take the time to review the notes or if you do not bother to raise objections with the notes as written, the notes will become the permanent record of what transpired at the meeting. Once again, silence is interpreted as agreement. You cannot come back later to say that you did not know you were responsible for completing a task when that assignment was included in the meeting notes that you agreed (either actively or passively) were complete and accurate.

4.09.02 Communicating Outside Meetings

As the team’s level of trust increases, the need for face-to-face meetings may decline. Alternative modes of communication can be used to keep members informed of progress, changes, and the need for team meetings. The team should also decide how members unable to meet with the entire group will communicate with the team, as well as how the team will communicate meeting results to absent members. Progress
reports should include information about what is or is not happening. Sometimes what is not happening is as important as what is actually taking place. Other points to include in a progress report include pointing out tasks that need immediate attention or changes that need to be made. One of the most important parts of a progress report is recommendations for what needs to be done to get a task or an activity back on track.

A **process check**, another way of communicating in face-to-face meetings or in electronic forms of communication, can help move the team (or individuals) toward improved performance. Usually, a process check is a reflection of:

- What the team members did well that they want to continue doing.
- What did not go as well as the team would have liked.
- What the team can do to improve the things they want to improve and not detract from the things they think are going well.

The team should periodically conduct a process check at the beginning or end of a team meeting; doing so will help resolve people’s differences and reinforce good feelings. Either way, a process check facilitates a professional, functioning team.

### 4.09.03 Communicating with the Outside World

A key to effective teamwork is effective communication. In the previous sections, you learned how to communicate with other team members. In reality, teams also need to be able to communicate with the outside world. In a university setting, the outside world may include instructors and classmates. In the working world, the outside world may consist of bosses, coworkers, clients, and/or the general public. The modes with which your team might need to communicate include progress reports, final reports, final design documentation, and project presentations.

When preparing a progress report, focus on the status of the project and any obstacles the team has encountered. Typically, a progress report is prepared for an instructor or boss, so the points must be clear and direct. Progress reports are meant to give an overview of the progress since the last report, so shorter is probably better as long as all necessary details are included. If your team has identified additional resources that are necessary for the successful completion of the project, these resources should be identified in the progress report as well. In final reports to the client or boss, you should provide the details of your design. Final reports are typically several pages in length (depending on the project) and outline the choices you made, the analysis you performed, and any test results you obtained. Design documentation usually includes drawings, specifications, and the details of any analysis you performed. Your design documentation should show how you arrived at the answer(s) you did. Presentations should show the highlights of your project. Usually, you will be given separate instructions from your professor about her expectations for a group presentation. Make sure you adhere to any guidelines you are given. If you are going to make a group presentation, you should practice at least once as a team to make sure you stay within the time limit and cover all necessary points.

For classroom projects, you will probably need to convey to your instructor how each person on the team contributed to the overall project. Specifically, you may be asked to address the following:

- Who contributed?
- What did each person contribute?
- How much credit does each person deserve?

Be honest and fair in your appraisal of your teammates’ work on the project, as well as in your appraisal of your own work. Giving someone a pass that does not deserve one is not fair to the rest of the team, nor is judging someone too harshly.
4.10 Tools for Dealing with Personnel Issues

The following sections will give you tools for avoiding problems usually attributed to team members who become difficult to work with because of a personality trait that does not adapt well to team work or because the team member is not properly committed to completing the assignment. Keeping everyone motivated is best done proactively rather than reactively.

4.10.01 Team Contract

A team contract (also known as a code of conduct, an agreement to cooperate, or rules of engagement) is a formal written document, which should be readily available during all team meetings. The document should be established only after careful, thorough, and honest discussion by all team members. The contract lists the rules the team agrees to live by. Often team members need to revise a contract once they spend enough time working together that they (and others on the team) discover pet peeves. A good method for establishing a contract is to ask each member to bring to a team meeting a list of two or three of the biggest problems they encountered while members of previous teams. At the meeting, the team should consider each item in a round-robin fashion, until all members’ lists have been exhausted. The resulting contract is a list of rules/agreements that, if followed, will incorporate the items on each person’s list. This means that if everyone follows the rules in the contract, no one will violate any pet peeve or cause any of the previously experienced team-related problems.

Changes to the contract may be required as the team progresses, because well-meaning members, in spite of their best intentions, revert to inappropriate behavior. However, this does not have to mean an end to the team. Although revised contracts often include rewards and penalties to assist members in bringing about the desired behavior, you want to avoid coercing a member into accepting a contract. It is imperative that everyone on the team be treated with respect and that all disagreements are viewed as legitimate. Benjamin Franklin, upon the signing of the Declaration of Independence, said, “We must . . . all hang together or, most assuredly, we shall all hang separately.” This quote applies to teams as well.

4.10.02 Publication of the Rules

Once you have determined how to operate as a team, write down the agreed-upon rules. Figure 4.05 shows a sample team contract established by a student project group. Once you have created the contract, make sure every team member receives a copy and use the ground rules as a tool for effective communication and teamwork. Establishing, revisiting, and revising (if necessary) a contract can start the team out on the right foot or keep the team on track as crunch time materializes. Make sure all members support the rules. If you find that the rules are not working, change them, making sure everyone agrees to the new set of rules.

4.10.03 Signature Sheet and Task Credit Matrix

You should include a signature sheet with every assignment, whether it is requested by your instructor or not. On the sheet, explain that the individuals’ signatures mean that the individuals participated in the assignment, have a general understanding of the entire submission, and are deserving of the credit indicated on the task credit matrix.

The task credit matrix is a table that lists each member on the team, each task, and indicates how the credit should be shared among the members of the team. If a team member does not deserve credit for the project, he or she should not be allowed to
sign the signature sheet and a zero should be entered in the task credit matrix. It is not expected that each member will have contributed to each task. What is expected is that the team split the work fairly and that each individual deserves credit. Note that the credit does not have to be equal, although ideally (and usually) it is. Your team may decide to weight different tasks, based on the amount of effort or contribution required. You also may decide to split the tables, one for the task breakdown (to aid the instructor in knowing to whom to direct questions) and a second expressing the team’s desire for distribution of points or credit. Often instructors will allow the team this privilege.

4.11 Chapter Summary

In this chapter, you learned about the importance of teams in engineering and in working on student projects. You learned about organizing a team and assigning roles for efficient, effective team meetings. The need to rotate roles among members was also discussed. You learned about the keys to successful team meetings and about organizing projects for optimal teamwork. The critical path method and Gantt charts were introduced as tools to help keep a project moving forward and for maintaining a reasonable project schedule. Finally, you learned about the importance of communication when working on a team. Two types of communication were discussed: internal communication among team members and external communication for working with other people, such as bosses and instructors.

Sample Contract

1. All members will attend meetings or notify the team by e-mail or phone in advance of anticipated absences.
2. All members will be fully engaged in team meetings and will not work on other assignments during meetings.
3. All members will complete assigned tasks by agreed-upon deadlines.
4. Major decisions will be subject to group discussion and consensus or majority vote.
5. The roles of recorder and timekeeper will rotate on a weekly rotational basis (all members will take their turn — NO EXCEPTIONS).
6. The team meetings will occur only at the regularly scheduled (weekly) time or with at least a two-day notice.
4.12 glossary of key terms

**agenda:** The list of topics for discussion/action at a team meeting.

**consensus:** A process of decision making where an option is chosen that everyone supports.

**critical path:** The sequence of activities in a project that have the longest duration.

**critical path method (CPM):** A tool for determining the least amount of time in which a project can be completed.

**devil’s advocate:** The team member who challenges ideas to ensure that all options are considered by the group.

**Gantt chart:** A tool for scheduling a project timeline.

**note taker:** The person who records the actions discussed and taken at team meetings and then prepares the formal written notes for the meeting.

**process check:** A method for resolving differences and making adjustments in team performance.

**task credit matrix:** A table that lists all team members and their efforts on project tasks.

**team contract:** The rules under which a team agrees to operate (also known as a code of conduct, an agreement to cooperate, or rules of engagement).

**team leader:** The person who calls the meetings, sets the agenda, and maintains the focus of team meetings.

**team roles:** The roles that team members fill to ensure maximum effectiveness for a team.

**timekeeper:** The person who keeps track of the meeting agenda, keeping the team on track to complete all necessary items within the allotted time frame.

4.13 questions for review

1. What are some of the advantages of working in teams?
2. What are some disadvantages of working in teams?
3. What are some important member roles that all teams should include, and what are the responsibilities of each role?
4. How should tasks be assigned in a team project?
5. In what ways is the Critical Path Method useful to the successful completion of a project?
6. What can be done to ensure that the workload in a project is fairly distributed among the team members?
7. What are some methods that can be used to ensure that all team members contribute equally to the team effort?
8. What can be done to solve the problem of a non-performing team member?
9. What can be done to ensure effective communication within a team?

4.14 problems

1. In a memo to your instructor, describe the team roles outlined in this chapter.
2. In a memo to your instructor, describe an unsatisfactory team experience you encountered previously.
3. Meet with your team and develop a code of conduct for future team meetings.
4. Create a Gantt chart for the steps (and timeline) you would take to secure a summer job. Some of the tasks might include writing a resume, looking online for opportunities, and preparing letters.
5. If you have been assigned a project by your instructor, create a Gantt chart for its completion.
6. Create a critical path diagram for planning and hosting a surprise birthday party for your mother or another family member.