

CHAPTER 10

Teamwork

10.1 Introduction

More than ever, engineering schools are requiring their students to work in teams. These teams take the form of collaborative study groups, laboratory groups, design groups as part of individual classes, and design groups participating in extracurricular competitions such as the solar car, human powered vehicle, SAE formula car, concrete canoe, bridge design, Rube Goldberg projects, and many others. This team emphasis in engineering schools mirrors a management philosophy of the use of teams that has swept through the corporate world in the past few decades. Engineering employers, in fact, are the principal drivers for the use of teams in engineering schools. They seek engineering graduates who have team skills as well as technical skills. The purpose of this chapter is to impart a team vision, to show why teams and collaboration are so important to organizational and technical success, and to give practical advice for how to organize and function as a team. If you study this chapter, work through the exercises, and view some of the references, you should have most of the tools you need to be a successful team member and leader while in engineering school. Apply the principles in this chapter to your team experiences while in college and learn from and document each team experience. By so doing, you will have a portfolio of team experiences that will be a valuable part of your résumé. Above all, you will have the satisfaction that comes from being a part of great teams. Teams are fun.

10.2 Engineers Often Work in Teams

A full-page advertisement in *USA Today*, October 14, 1991, states clearly the current highly competitive climate in industry and what Chrysler (now DaimlerChrysler), for example, is doing about it. The use of interdisciplinary teams is an important part of the solution:

No more piece-by-piece, step-by-step production. Now it's teams. Teams of product and manufacturing engineers, designers, planners, financing and marketing people—together from the start It's how we built Dodge Viper from

dream to showroom in three years, a record for U.S. car makers. From now on, all our cars and trucks will be higher quality, built at lower cost and delivered to the market faster. That's what competition is all about.

The greater the problem, the greater the need for the use of teams. Individuals acting alone can solve simple problems, but tough problems require teams. This section lists and then discusses the reasons many organizations have embraced the use of teams. Why is the use of teams so popular today?

- Greater understanding of the power of collaboration.
- Engineers are asked to solve extremely complex problems.
- More factors must be considered in design than ever before.
- Many corporations are international in scope, with design and manufacturing engineering operations spread across the globe.
- Because time to market is extremely important to competitive advantage, "concurrent engineering," inherently a team activity, is widely employed.
- Corporations are increasingly using project management principles.

Power of Collaboration

There is a greater understanding today than ever before of the importance and power of creative collaboration. One recent book on the subject is *Organizing Genius: The Secrets of Creative Collaboration*, by Warren Bennis and Patricia Ward Biederman. Their first chapter is titled "The End of the Great Man," in which they argue that great groups are able to accomplish more than talented individuals acting alone, stating that "None of us is as smart as all of us." They cite a survey by Korn-Ferry (the world's largest executive search firm) and *The Economist* in which respondents were asked who will have the most influence on global organizations in the next ten years. Sixty-one percent of the respondents answered "teams of leaders," whereas 14 percent said "one leader." Individual chapters of their book focus on "great groups." A chapter on the Manhattan Project discusses the development of the atomic bomb during the Second World War by a team of great scientists. One chapter discusses Lockheed's "Skunk Works," developers of the U-2 spy plane, the SR-71 Blackbird, and the F117-A Stealth fighter-bomber used in the Persian Gulf war. Another example is the development of the graphical user interface at Xerox's PARC (Palo Alto Research Center) and its adoption into the Macintosh computer by Steve Jobs and Steve Wozniak. Steve Jobs' goal was to lead his team to create something not just great, but "insanely great," to "put a dent in the universe."

Another recent book on collaboration is *Shared Minds: The New Technologies of Collaboration*, by Michael Schrage. He defines collaboration as "the process of *shared creation*: two or more individuals with complementary skills interacting to create a shared understanding that none had previously possessed or could have come to on their own." He cites examples of collaboration in science (Watson and Crick; Heisenberg, Bohr, Fermi, Pauli, and Schrödinger; Einstein and mathematician Marcel Grossmann), music (Gilbert and Sullivan; Rodgers and Hart; McCartney and Lennon), art

(Monet and Renoir; Van Gogh and Gauguin; Picasso and Braque), and literature (editor Maxwell Perkins and writers F. Scott Fitzgerald and Thomas Wolfe; Ezra Pound and T. S. Eliot).

James Watson and Stanley Crick, winners of the Nobel prize for discovering the double helix structure of DNA credit their collaboration for their success: "Both of us admit rather than doing it ourselves." Crick wrote that "our . . . advantage was that we had physics, in a letter to his contemporary (and rival) Robert Hooke, recognizing his debt to fellow scientists, wrote: "If I have seen further (than you and Descartes) it is by standing on the shoulders of Giants." Modern physics also found its genesis in collaboration. Heisenberg, Bohr, Fermi, Pauli, and Schrödinger, all Nobel laureates for their roles in founding quantum physics, worked, played, and vacationed together as they developed together their revolutionary new ideas.

Today's Complex Problems

Engineers are asked to solve increasingly complex problems. The complexity of mechanical devices has grown rapidly over the past two hundred years. David Ullman, in his text *The Mechanical Design Process*, gives the following examples. In the early 1800s, a musket had 51 parts. The Civil War-era Springfield rifle had 140 parts. The bicycle, first developed in the late 1800s, has over two hundred parts. An automobile has tens of thousands of parts. The Boeing 747 aircraft, with over 5 million components, required over ten thousand person-years of design time. Thousands of designers worked over a three-year period on the project. Most modern design problems involve not only many individual parts, but also many subsystems—mechanical, electrical, controls, thermal, and others—each requiring specialists acting in teams.

Many Design Factors

Engineering designers must consider more factors than ever before, including initial price, life cycle costs, performance, aesthetics, overall quality, ergonomics, reliability, maintainability, manufacturability, environmental factors, safety, liability, and acceptance in world markets. Satisfying these criteria requires the collective teamwork of design and manufacturing engineers, marketing, procurement, business, and other personnel. The typical new engineering student, being interested primarily in technical things, tends to believe that engineers work isolated from other factors, always seeking the "best technical solution." This is not true. The very act of engineering involves solving difficult problems, finding technical solutions while considering numerous constraints. Engineers make things happen, they are doers, they solve problems, while interacting with many entities within the culture of complex organizations. Often acting at organizational boundaries, engineers are technical experts who, to be truly effective, must understand economics, management, marketing, and the dynamics of the business enterprise.

International Scope

Many corporations are international in scope, with design and manufacturing engineering operations spread across the globe. These operations require teams to work together who may never physically meet. Instead, they meet and share data via electronic means. For example, it is not unusual for design engineers in the United States to collaborate on a design with Japanese engineers for a product that will be manufactured in China. Manufacturing personnel from the Chinese plant also contribute to the project. As another example, software engineers in the U.S., the U.K., and India may collaborate on a software project literally around the clock and around the world. At any time during a 24-hour period, programmers in some part of the world will be working on the product.

Time to Market and Concurrent Engineering

"Concurrent engineering," inherently a team activity, is widely employed in order to achieve better designs and to bring products to market more quickly. Time to market is the total time needed to plan, prototype, procure materials, create marketing strategies, devise tooling, put into production, and bring to market a new product. In the traditional company, each of these steps is done serially, one at a time. It is a relay race, with only one person running at a time, passing the baton to the next runner. The design engineer "tosses a design over the wall" to a manufacturing engineer who may not have seen it yet. She then "tosses it over the wall" to procurement personnel, and so on. Concurrent engineering, on the other hand, is a parallel operation. Like rugby, all of the players run together, side by side, tossing the ball back and forth. Marketing, manufacturing, and procurement personnel are involved from the beginning of the design phase. The use of teams, as well as new technologies such as CAD/CAM, rapid prototyping, shared data, and advanced communications have radically changed the process of engineering. By the use of teams and CAD/CAM technologies, in the face of withering international competition, U.S. auto makers have cut the time needed to bring a new car to market from approximately 5 years to less than 3 years.

Speed—that is, timely delivery of products to the marketplace—is critical for companies to be profitable. Jack Welch, General Electric's widely respected CEO, has said, "we have seen what wins in our marketplaces around the globe: speed, speed, and more speed." Xilinx Corporation has stated that their research shows that a six-month delay in getting to market reduces a product's profitability by a third over its life cycle. An October 25, 1991, *Business Week* article stated: "Reduce product development time to one third, and you will triple profits and triple growth." Figure 10.1, shown below, shows graphically the losses incurred over the lifetime of a product due to delays in bringing the product to market. Early product introduction leads to higher profits because early products bring higher profit margins, are more apt to meet customer needs, and are more likely to capture a larger market share. [This figure was created by Dr. Charles I. Nuese and included in his wisdom-laden book, *Building the*

Right Things Right, on product development.] The figure is fictitious, but it is based on principles Dr. Nuese has observed during his career as an engineer in and as a consultant to the semiconductor industry.

Developing new products is a key to growth and profits. Rubbermaid Corporation, during a recent year, introduced 400 new products—more than one per calendar day! At least one third of Rubbermaid's \$2 billion in annual sales come from products created in the previous 5 years. 3M Corporation CEO L. D. Disimone, facing flat revenues and stiff competition, adopted a business focus of generating 30 percent of revenues from products less than 4 years old. The creative thought processes, the innovation needed to create a steady stream of new ideas, and the expertise to manufacture and bring these to market quickly, are all functions that teams perform well.

It is important for engineering students to understand the importance of speed (without compromising quality). Delays have many negative consequences. Engineering professors who supervise teams should provide incentives to students for early completion of team projects, or at least penalties for failure to meet deadlines. Student teams should recognize the importance of speed, push themselves and their teams to early completion of projects, and document these on their resumes and/or portfolios.

Project Management Is a Team Approach

Project management is widely practiced in industries and government labs. Many graduate engineers discover on their first job that engineers frequently work in project-oriented teams. Unfortunately, most engineering students never take a project management class. Project management principles were developed in the defense industry in the 1950s and

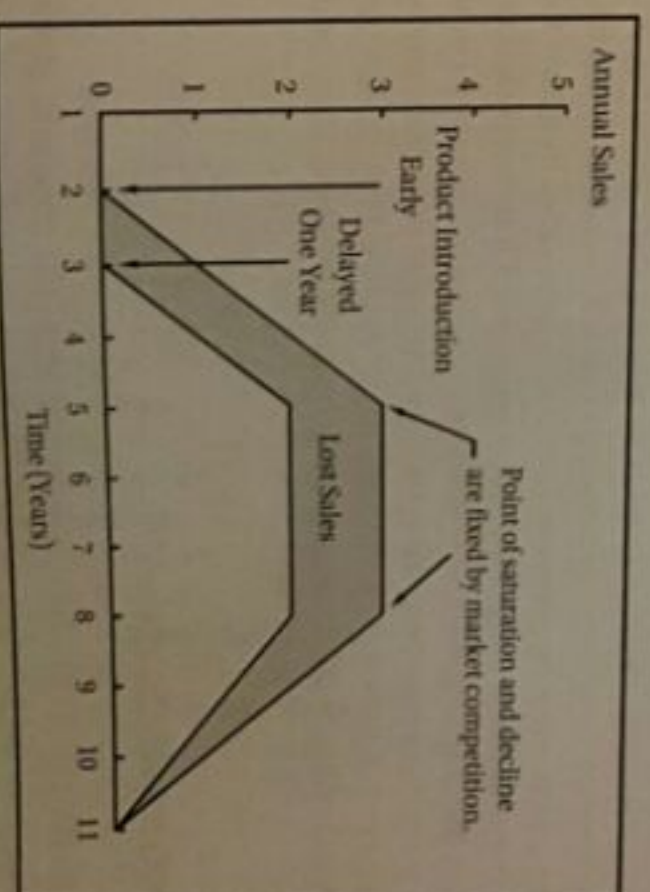


Figure 10.1 The cost of delay in bringing an equivalent new product to market. (Used by permission of Charles I. Nuese.)

before they truly become productive. These stages are titled *forming, storming, norming, performing, and adjourning*. Unfortunately, successfully completing the first four stages and becoming a productive, performing team is not guaranteed. *Many teams in practice never reach the performing stage; they remain mired in the forming, storming, or norming stages.* Every team's challenge is to grow through these stages and achieve "performance."

Stage 1: Forming

The first stage of team development is "forming." In this stage, typical dialogue may consist of the following: "Nice to meet you. Yeah, I'm not sure either why we are here. I'm afraid this might be a lot of work." In the formation stage, team members get acquainted with one another, with the leader (or choose a leader if one is not pre-appointed), with the team's purpose, and with the overall level of commitment (work load) required. Team members begin to learn of one another's personalities, abilities, and talents, but also of one another's weaknesses and idiosyncrasies. Individual team members are typically shy, reserved, self-conscious, and uncertain. A key role of the leader in this stage is to lead team ice-breaker activities, facilitate discussion, encouraging all to speak and quieting some who might tend to dominate the conversation. Another role of the leader is to help the team begin to focus on the task at hand.

Stage 2: Storming

The second stage of team development is "storming." In this stage, typical dialogue (or private thoughts) may consist of the following: "Do I have to work with this team? What did I do to deserve this? There clearly aren't any super-heroes on this team, including that dizzy leader. How are we supposed to solve this messy problem?" During the storming stage, the enormity and complexity of the task begins to sink in, sobering and discouraging the participants. "We are supposed to do what? By when?" Teams are rarely formed to solve easy problems, only very difficult and complex ones. Typically, time schedules are unrealistically short, and budgets are inadequate. Further complicating the issue, teammates have learned enough about their fellow team members to know that there are no super-heroes, no saviors they can count on to do it all. (One person doing all the work is a team failure.) Some team members may not initially "hit it off" well with the others. Cliques or factions may emerge within the team, pitted against others. Since the leader's weaknesses (all leaders have weaknesses) are by now apparent, some individuals or factions may vie for leadership of the team. Though possibly under siege, the leader's role is critical during the storming stage. The leader must help the team to focus on its collective strengths, not weaknesses, and to direct their energies toward the task. To be a successful team, it is not necessary for team members to like one another or to be friends. A professional knows how to work productively with individuals with widely differing backgrounds and personalities. Everyone must learn the art of constructive dialogue and compromise.

Stage 3: Norming

The third stage of team development is "norming." In this stage, typical dialogue (or private thoughts) may consist of the following: "You know, I think we can do it. True, there are no super-heroes, not by a long shot, but once we stopped fighting and started listening to one another, we discovered that these folks have some good ideas. Now if we can just pull these together . . ." "Norms" are shared expectations or rules of conduct. All groups have some kinds of norms, though many times unstated. Do you recall a time you joined a group or team and felt subtle influence to act, dress, look, speak, or work in a particular way? The more a team works together, they tend to converge to some common perspectives and behaviors. During the norming stage, team members begin to accept one another instead of complaining and competing. Rather than focusing on weaknesses and personality differences, they acknowledge and utilize one another's strengths. Individual team members find their place in the group and do their part. Instead of directing energies toward fighting itself, the team directs its collective energy toward the task. The key to this shift of focus is a collective decision to behave in a professional way, to agree upon and adhere to norms. Possible norms include working cooperatively as a team rather than individually, agreeing on the level of effort expected of everyone, conducting effective discussions and meetings, making effective team decisions, and learning to criticize one another's ideas without damaging the person. One suggested norm is that all team members are expected to be at all meetings, or to communicate clearly in the event that he/she cannot attend. During the norming stage, feelings of closeness, interdependence, unity, and cooperation develop among the team. The primary role of the leader during the norming phase is to facilitate the cohesion process. Some team members will lag behind the team core in embracing norms. The leader and others on the team (at this stage leadership is beginning to emerge from others on the team as well) must artfully nudge individuals along toward group accountability and focus on the task.

Stage 4: Performing

The fourth stage of team development is "performing." In this stage, typical dialogue (or private thoughts) may consist of the following: "This is a fun team. We still have a long way to go, but we have a great plan. Everyone is pulling together and working hard. No super-heroes, but we're a super team." In this stage, teams accomplish much. They have a shared, clear vision. Responsibilities are distributed. Individual team members accept and execute their specific tasks in accordance to the planned schedule. They are individually committed, and hold one another accountable. On the other hand, there is also a blurring of roles. Team members "pitch in" to help one another, doing whatever it takes for the team to be successful. In a performing team, so many team members have taken such significant responsibility for the team's success that the spotlight is rarely on a single leader anymore. Typically, whoever initially led the team is almost indistinguishable from the rest of the team.

Stage 3: Norming

The third stage of team development is "norming." In this stage, typical dialogue (or private thoughts) may consist of the following: "You know, I think we can do it. True, there are no super-heroes, not by a long shot, but once we stopped fighting and started listening to one another, we discovered that these folks have some good ideas. Now if we can just pull these together . . ." "Norms" are shared expectations or rules of conduct. All groups have some kinds of norms, though many times unstated. Do you recall a time you joined a group or team and felt subtle influence to act, dress, look, speak, or work in a particular way? The more a team works together, they tend to converge to some common perspectives and behaviors. During the norming stage, team members begin to accept one another instead of complaining and competing. Rather than focusing on weaknesses and personality differences, they acknowledge and utilize one another's strengths. Individual team members find their place in the group and do their part. Instead of directing energies toward fighting itself, the team directs its collective energy toward the task. The key to this shift of focus is a collective decision to behave in a professional way, to agree upon and adhere to norms. Possible norms include working cooperatively as a team rather than individually, agreeing on the level of effort expected of everyone, conducting effective discussions and meetings, making effective team decisions, and learning to criticize one another's ideas without damaging the person. One suggested norm is that all team members are expected to be at all meetings, or to communicate clearly in the event that he/she cannot attend. During the norming stage, feelings of closeness, interdependence, unity, and cooperation develop among the team. The primary role of the leader during the norming phase is to facilitate the cohesion process. Some team members will lag behind the team core in embracing norms. The leader and others on the team (at this stage leadership is beginning to emerge from others on the team as well) must artfully nudge individuals along toward group accountability and focus on the task.

Stage 4: Performing

The fourth stage of team development is "performing." In this stage, typical dialogue (or private thoughts) may consist of the following: "This is a fun team. We still have a long way to go, but we have a great plan. Everyone is pulling together and working hard. No super-heroes, but we're a super team." In this stage, teams accomplish much. They have a shared, clear vision. Responsibilities are distributed. Individual team members accept and execute their specific tasks in accordance to the planned schedule. They are individually committed, and hold one another accountable. On the other hand, there is also a blurring of roles. Team members "pitch in" to help one another, doing whatever it takes for the team to be successful. In a performing team, so many team members have taken such significant responsibility for the team's success that the spotlight is rarely on a single leader anymore. Typically, whoever initially led the team is almost indistinguishable from the rest of the team.

Stage 5: Adjourning

The fifth and final stage of team development is "adjourning." Because teams are typically assembled for a specific purpose or project, there is a definite time when the team is disbanded when that goal is accomplished. If the team was successful, there is a definite feeling of accomplishment, even euphoria, by the team members. On the other hand, an under-performing team will typically feel anger or disappointment upon adjournment.

These stages, originally set forth by Bruce W. Tuckman in 1965, appear in some form in most books that discuss teams. Some leave off the final step, adjourning. Others switch the order and give the steps as forming, conforming (instead of "norming"), storming, and performing.

10.4 What Makes a Successful Team?

Have you ever been a member of a great team? It's a great experience, isn't it? On the other hand, how many of you have ever been part of an unsuccessful team? It was a disappointing experience, wasn't it? How do you measure or evaluate a team's success or lack thereof? What specific factors make a team successful? What factors cause a team to fail?

First it is important to define what a team is and is not. A team is not the same as a group. The term "group" implies little more than several individuals in some proximity to one another. The term "team," on the other hand, implies much more. A team is two or more persons who work together to achieve a common purpose. The two main elements of this definition are "purpose" and "working together."

All teams have a purpose and a personality. A team's purpose is its task, the reason the team was formed. Its personality is its people and how the team members work together. Different teams have their own style, approach, dynamic, and ways of communicating that are different than other teams. For example, some teams are serious, formal, and businesslike, whereas others are more informal, casual, and fun-loving. Some teams are composed of friends, others are not. Friendship, though desirable, is not a necessary requirement for a team to be successful. Commitment to a common purpose and to working together is required. Regardless of style or personality, a team must have professionalism. A team's professionalism ensures that its personality promotes productive progress toward its purpose.

Attributes of a Successful Team

The successful team should have the following attributes:

1. A common goal or purpose. Team members are individually committed to that purpose.
2. Leadership. Though one member may be appointed or voted as the team leader, ideally every team member should contribute to the leadership of the team.

3. Each member makes unique contributions to the team's project. A climate exists in the team that recognizes and appropriately utilizes the individual talents/abilities of the team members.
4. Effective team communication: Regular, effective meetings; honest, open discussion. Ability to make decisions.
5. Creative spark. There's excitement and creative energy. Team members inspire, energize, and bring out the best in one another. A "can do" attitude. This creative spark fuels collaborative efforts and enables a team to rise above the sum of its individual members.
6. Harmonious relationships among team members. Team members are respectful, encouraging, and positive about one another and the work. If conflicts arise, there are peacemakers on the team. The team's work is both productive and fun.
7. Effective planning and use of resources. This involves appropriate breakdown of the tasks and effective utilization of resources (people, time, money).

Team Member Attributes

Individual team members of the successful team should have these attributes:

1. Attendance: Attends all team meetings, arriving on time or early. Dependable, like clockwork. Faithful, reliable. Communicates in advance if cannot attend a meeting.
2. Responsible: Accepts responsibility for tasks and completes them on time, needing no reminders nor cajoling. Has a spirit of excellence, yet is not overly perfectionistic.
3. Abilities: Possesses abilities the team needs, and contributes these abilities fully to the team's purpose. Does not withhold self or draw back. Actively communicates at team meetings.
4. Creative, Energetic. Acts as an energy source, not a sink. Brings energy to the team. Conveys a sense of excitement about being part of the team. Has a "can do" attitude about the team's task. Has creative energy and helps spark the creative efforts of everyone else.
5. Personality: Contributes positively to the team environment and personality. Has positive attitudes, encourages others. Acts as a peacemaker if conflict arises. Helps the team reach consensus and make good decisions. Helps create a team environment that is both productive and fun. Brings out the best in the other team members.

10.5 Team Leadership

The Need for Leadership

Every successful human endeavor involving collective action requires leadership. Great teams need great leadership. Without leadership, humans tend to drift

apart, act alone, and lose purpose. They may work on the same project, but their efforts, without synchronization and coordination, interfere with rather than build on one another. Without coordinated direction, people become discouraged, frustrations build, and conflicts ensue. Money is wasted, time schedules deteriorate, but the greatest loss is a loss of human potential. A failed team effort leaves a bitter taste not easily forgotten. Incomparably sweet, on the other hand, is the thrill of team success.

The Leader's Role

The leader ensures that the team remains focused on its purpose and that it develops and maintains a positive team personality. He challenges and leads the team to high performance and professionalism. With one hand he builds the team, with the other he builds the project. In support of these objectives, the leader must do the following:

1. Focus on the purpose: Help the team remain focused on its purpose.
2. Be a team builder: The leader may actively work on some project tasks himself, but his most important task is the team, not the project. He builds, equips, and coordinates the team so they can accomplish their purpose and succeed as a team.
3. Plan well and effectively utilize resources (people, time, money). He assesses and utilizes effectively the team members' abilities.
4. Run effective meetings. Ensure that the team meets together regularly and that the meetings are productive.
5. Communicate effectively. The leader effectively communicates the team vision and purpose. He also effectively praises good work and gives effective guidance for improvement of substandard performance.
6. Promote team harmony by fostering a positive environment. If team members focus on one another's strengths instead of weaknesses, conflicts are less likely to arise. Conflict is not necessarily evil, however. The effective leader must not be afraid of conflict. He should view conflicts as an opportunity to improve team performance and personality, and to refocus it on its purpose.
7. Foster high levels of performance, creativity, and professionalism. Have a high vision. Challenge team members to do the impossible, to think creatively, and to stimulate one another to high performance.

The Entire Team Leads, Too

Every team needs all the leadership it can get. Most teams have a single individual who is either voted or appointed as its leader. In the best teams, however, many members contribute leadership in ways that support and complement the appointed leader. Like the appointed leader, every member should focus on the purpose, build the team, plan, recognize the gifts of others, contribute to effective meetings, communicate well, promote a harmonious team environment, and be creative. Ideally, every member, together with the leader, should build the team with one hand and labor on the project

with the other hand. Noted author John Maxwell defines leadership in this way: "Leadership is influence." Every team member, from his/her position on the team, has the opportunity to considerably influence the team's performance. How important is the leadership from the entire team? It is possible to have a truly outstanding leader, but if the team chooses to use its influence to not follow the leader, to undermine the leader, and to promote team disunity, the team will fail. Conversely, a team with a relatively weak appointed leader can be greatly successful if the team members pitch in and use their influence to build the team. Ultimately, the entire team—both the members and the appointed leader—must work together to build a great team. It takes a team to make a great team.

Leadership Styles

According to Schermerhorn, "leadership style is a recurring pattern of behaviors exhibited by a leader." It is the tendency of a leader to act or to relate to people in a particular way. There are two general categories of leadership style—task-oriented leaders and people-oriented leaders. A **task-oriented leader** is highly concerned about the team's purpose and task at hand. He likes to plan, carefully define the work, assign specific task responsibilities, set clear work standards, urge task completion, and carefully monitor results. A **people-oriented leader** is warm and supportive toward team members, develops rapport with the team, respects the feelings of followers, is sensitive to followers' needs, and shows trust in followers.

For a team, is one style of leadership better than another? A successful team needs both styles of leadership in some proportion. Earlier it was stated that a team has a purpose and a personality. The team must be task-oriented, but it also must cultivate a team personality and a positive environment in which team performance can flourish. This is further evidence for the need for individual team members to provide leadership that complements the leadership of the appointed leader. If the appointed leader tends to be more task-oriented, the team can balance this with a people-orientation. If the appointed leader is people-oriented, he will likely need individuals on the team to assist in details of task management. The best leaders welcome complementary leadership from the teams.

10.6 Team Organizational Structures

Some engineering design teams are asked to create an organizational chart. Preparing this chart gives the team the opportunity to define roles and to give thought to the relationship between the team and the team leader. Most student teams, in part because they don't know any better, default to a traditional team structure such as is given in the first block in the figure below. This structure is easy to draw, but it may or may not accurately represent the best way the team should operate. It implies a strong leader who largely directs the actions of the group, possibly with little participation or discussion

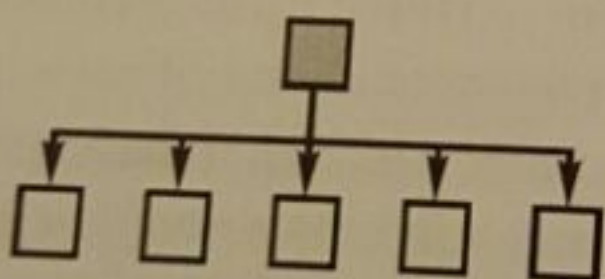
from the other team members. It suggests separation between the leader and the other team members.

The second structure portrays a participative leadership/team model in which the leader is positioned in close proximity, with short, direct communication paths to all of the members. The figure implies direct accountability of the leader to all of the members and dependence of the leader on the participation of all the members.

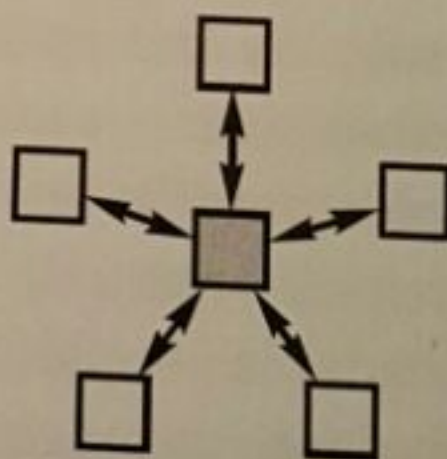
The third structure is similar to the second except it emphasizes the leader's role as a working member of the team. It suggests a flat structure where the leader is an equal rather than a hierarchical structure where the leader is above the team. For this structure it is easy to visualize the leadership function shifting around the ring from member to member as situations arise needing the special expertise of individual members.

The fourth structure shows the relationship between a student team and its instructor. The student team may be a design group, a research team, or a collaborative study unit. The instructor, though not part of the team, will be nearby and will serve as an important resource to the team. He may be asked to advise the team on administrative issues, to act as a technical consultant, or to assist in intervention or disciplinary action for a non-performing team member. All teams—in industry, in the university, and in private organizations—ultimately operate under the authority of a leader or administrator.

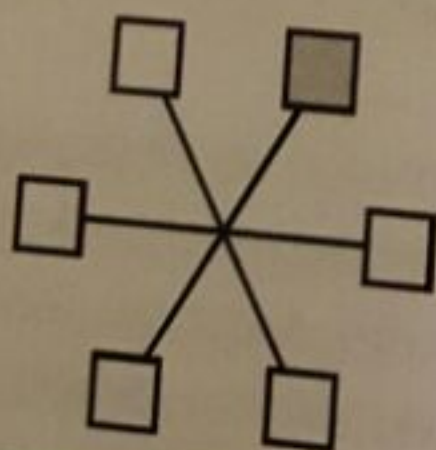
1. Traditional Team Structure:
Top-down direction from leader.



2. Participative Team Structure: The leader is accountable to team members, receives input from members, gives direction to members.



3. Shared Leadership Team Structure:
The leader is also a participating team member; the leadership function may be rotated among team members.



4. The relationship between a student-directed team and their instructor.

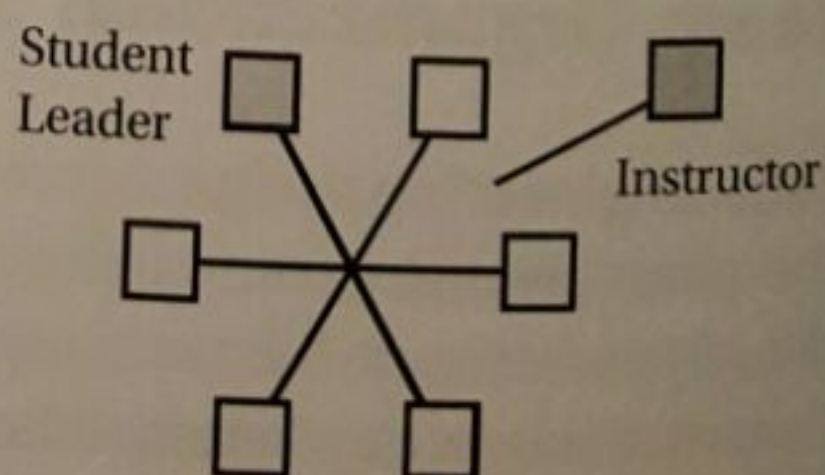


Figure 10.2 Possible team structures.

There is no one "right" structure. None of these structures is inherently good or evil. Examining these example structures gives the team the opportunity to define roles and to give thought to the relationship between the team and the team leader. A team needs to choose a structure that effectively models how they want to work as a team. The ultimate success of the team then hinges upon the team and its leader(s) working together to accomplish the team's purpose. As a team works, they may find that their operational structure may shift periodically in response to different situations and challenges that they face.

10.7 Effective Decision Making

Every team makes decisions in order to accomplish its work. The ability to make high-quality decisions in a timely manner is a mark of a great team. Not surprisingly, the *process* of how decisions are made greatly affects the *quality* of these decisions. Unfortunately, most teams arrive at decisions without even knowing how they did it. In this section, we present a variety of ways in which decisions are typically made and discuss their advantages and disadvantages. Though it is recommended that a team decide in advance what decision-making process it will use, the best teams use a variety of different means of making decisions depending on the decision circumstances. The following classification of ways teams make decisions is summarized from a section in the book, *Why Teams Don't Work*, by Harvey Robbins and Michael Finley.

Consensus. A decision by consensus is a decision in which all the team members find common ground. It does not necessarily mean a unanimous vote, but it does mean that everyone had an opportunity to express their views and to hear the views of others. The process of open sharing of ideas often leads to better, more creative solutions. Unfortunately, achieving consensus can take much time and become unwieldy for larger teams.

Majority. Another way to make a decision is by majority vote. Take a vote and whatever receives the most votes wins. The advantage of this approach is that it takes less time than reaching consensus. Its disadvantage is that it provides for less creative dialogue than consensus, and there will always be a faction—the minority—who lose the vote and may become alienated.

Minority. Sometimes a small subset of the team—for example, a subcommittee—makes the decision. The advantage of this is that it may expedite the decision. Its disadvantage is that there is less overall team communication, and some team members may be prevented from making contributions to the decision.

Averaging. Averaging is compromise in its worst form; it's the way Congress and some committees arrive at decisions. Averaging is often accomplished with haggling, bargaining, cajoling, and manipulation. Usually no one is happy except the moderates. The

advantage of averaging is that the extreme opinions tend to cancel one another out. The disadvantages of this are that there is often little productive discussion (as in consensus), and that the least informed can cancel the votes of the knowledgeable.

Expert. When facing a difficult decision, there is no substitute for expertise. If there is an expert on the team, he/she may be asked to make a decision. If a team lacks an expert on a particular issue, which is often the case, the best teams recognize this and seek the advice of an expert. The advantage of this is that theoretically, the decision is made with accurate, expert knowledge. The disadvantage of this is that it is possible to locate two experts who, when given the same information, disagree on the best course of action. How is a team assured that the expert gives them the best advice? Team members may be divided on which expert to consult, as well as on their assessment of the expert's credentials.

Authority Rule without Discussion. This occurs when there is a strong leader who makes decisions without discussing the details with or seeking advice from the team. This works well with small decisions, particularly of an administrative nature, with decisions that must be made quickly, and with decisions that the team is not well qualified to contribute to, anyway. There are many disadvantages to this approach, however. The greatest is that the team's trust in its leader will be undermined. They will perceive that the leader doesn't trust them and is trying to circumvent them. If one person is continually taking it upon himself to make all the decisions, or if the team is abrogating its responsibility to act together and by default, forcing the decision onto an individual, then this is a group, not a team. It is a loose aggregation of individuals, a dysfunctional team.

Authority Rule with Discussion. This can be a very effective way of making decisions. It is understood from the outset that the final decision will be made by one person—the leader or a delegated decision-maker—but the leader first seeks team input. The team meets and discusses the issue. Many, but perhaps not all, viewpoints are heard. Now, more fully informed, the appointed individual makes the decision. The advantage of this method is that the team members, being made part of the process, feel valued. They are more likely to be committed to the result. This type of decision-making process requires a leader and a team with excellent communication skills, and a leader who is willing to make decisions.

10.8 Attitudes Toward Team Experiences

If you have an opportunity to become part of a team, how should you approach it? What should your attitudes be?

1. Determine to give your best to help the team grow as a team and to accomplish its purpose. Don't just tolerate the team experience.

2. Do not expect to have perfect teammates. You're not perfect; neither are they. Don't fret that your friends are not on your team. Make friends with those on your team.
3. Be careful about first impressions of your team. Some team members may seem to know all the right things to say, but you may never see them again. Others might at first look like losers, but in the long run they are the ones who always attend meetings, make steady contributions, and ensure the success of the team. Be careful about selecting a leader at the very first team meeting. Sometimes the person who seems at first to be the most qualified to lead will never make the commitment necessary to be the leader. Look for commitment in a leader.
4. Be a leader. If you are not the appointed leader, give your support to the leader and lead from your position on the team. Don't be scared off by team experiences in the past where the leader did all the work. Be a leader who encourages and grows other leaders.
5. Help the team achieve its own unique identity and personality. A team is a kind of corporation, a living entity with special chemistry and personality. No team is just like any other team. Every team is formed at a unique time and setting, with different people and a different purpose. Being part of a productive team that sparkles with energy, personality and enthusiasm is one of the rewards of teamwork. Being part of a great team is a great memory.
6. Be patient. Foster team growth, and give it time to grow. Teammates are at first aliens, unsure of one another and of the team's purpose. Watch for and help the team grow through the stages of Forming, Storming, Norming, and Performing.
7. Evaluate and grade yourself and your team's performance. Document its successes and failures. Dedicate yourself to be one who understands teams and who acts as a catalyst, one who helps the team perform at a high level. Note team experiences in your undergraduate portfolio, especially times when you took a leadership role. Prepare to communicate these experiences to prospective employers.

10.9 Documenting Team Performance

Gain the Most from Team Experiences by Critical Evaluation

The primary aim of this chapter has been to give you tools and insights into teams that will significantly increase the probability of you being part of (and being an active leader in) great teams. You will likely be involved in many teams during your college years, in your professional life, and in volunteer capacities. Teams are everywhere, but few know how to make teams work. For teams, Voltaire's words are applicable: "Common sense is not so common." If you work hard to be uncommonly sensible about teams, you will be of great value to an employer. Approach every team experience as an opportunity to learn and to grow as a team member and leader. An excellent way to gain the most

aspect of the project effort: Sally took primary lead on the final report, George led in the creation of the Instruction Manual, Ahmad led in the AutoCAD Drawings and the PowerPoint presentation, and Jaime led in the project construction. Though their contribution percentages vary, there is little evidence that their grades should be adjusted downward; they each deserve, it appears, the team grade. Joe, on the other hand, contributed nothing, and deserves a grade penalty. Chances are, the 10 percent is a gift from his teammates.

Table 10.2 Team Member Report Card

<i>Criteria</i>	<i>Team Member</i>				
	<i>Ahmad</i>	<i>George</i>	<i>Jaime</i>	<i>Joe</i>	<i>Sally</i>
1. Attendance: Attends all team meetings, arriving on-time or early. Dependable, faithful, reliable.					
2. Responsible: Gladly accepts work and gets it done. Spirit of excellence.					
3. Has abilities the team needs. Makes the most of abilities. Gives fully, doesn't hold back. Communicates.					
4. Creative. Energetic. Brings energy, excitement to team. "Can do" attitude. Sparks creativity in others.					
5. Personality: Positive attitudes, encourages others. Seeks consensus. Fun. Brings out best in others. Peacemaker. Water, not gasoline, on fires.					

Average Grade:

Grading Scale: 5 - Always; 4 - Mostly; 3 - Sometimes; 2 - Rarely; 1 - Never

Table 10.3 Team Member Contributions on Primary Semester Projects

<i>Team Members</i>	<i>AutoCAD Drawings</i>	<i>Project Construction</i>	<i>Instruction Manual</i>	<i>Final Report</i>	<i>Power Point Presentation</i>	<i>Total Indiv. Contribution</i>
						135%
Sally	0%	15%	45%	60%	15%	10%
Joe	0%	5%	0%	5%	0%	105%
George	10%	15%	55%	15%	10%	155%
Ahmad	75%	10%	0%	10%	15%	95%
Jaime	15%	55%	0%	10%	15%	500%
	100%	100%	100%	100%	100%	

REFERENCES

- Bennis, Warren, and Biederman, Patricia Ward, *Organizing Genius: The Secrets of Creative Collaboration*, Addison-Wesley, 1997.
- Katzenbach, Jon R., and Smith, Douglas K., *The Wisdom of Teams: Creating the High-Performance Organization*, HarperBusiness, 1993.
- Nuese, Charles J., *Building the Right Things Right: A New Model for Product and Technology Development*, Quality Resources, 1995.
- Robbins, Harvey A., and Finley, Michael, *Why Teams Don't Work: What Went Wrong and How to Make it Right*, Peterson's/Pacesetter Books, Princeton, New Jersey, 1995.
- Schermerhorn Jr., John R., *Management*, Fifth Edition, John Wiley and Sons, 1996.
- Scholtes, Peter R., Joiner, Brian L., and Streibel, Barbara J., *The TEAM Handbook*, Second Edition, Oriel Incorporated, 1996.
- Schrage, Michael, *Shared Minds: The New Technologies of Collaboration*, Random House, New York, 1990.
- Tuckman, Bruce W., "Developmental Sequence in Small Groups," *Psychological Bulletin*, vol. 63 (1965), pp. 384-389.
- Ullman, David G., *The Mechanical Design Process*, Second Edition, McGraw-Hill, 1997.
- Whetten, David A., and Cameron, Kim S., *Developing Management Skills*, Third Edition, Harper Collins, 1995.

EXERCISES AND ACTIVITIES

- 10.1 Some individuals consider teams as the answer to all human and organizational problems. Conversely, some individuals asked to participate on teams think that being part of a team is a pain. Comment on these propositions.
- 10.2 From your perspective, is it easy or hard for humans to work together as teams? Does it come naturally, like falling out of bed, or is a lot of work involved in making a great team?
- 10.3 Describe in your own words the growth stages of a team. Give at least two examples from your own team development experiences. Have you been a part of a team that developed to a certain point and stalled? A team that progressed quickly to a productive, performing team? A team that experienced prolonged rocky periods but ultimately made it to the performing stage? If possible, note factors that led to the success and failure of these teams.
- 10.4 With a team of three to five people, role play a sample of conversation(s) and team behaviors for each of the five team growth stages: Forming, Storming, Norming, Performing, Adjourning.

- 10.5 With a team of three to five people, role play a sample of conversation(s) and team behaviors for teams making decisions by consensus and three other decision-making methods given in the chapter.
- 10.6 There are two quotes (source unknown) based on the T.E.A.M acronym: "Together Excellence, Apart Mediocrity," and "Together Everyone Achieves Much." These communicate the message that by working together humans can achieve more than what they could achieve working alone. Other quotes related to this are "The whole is greater than the sum of the parts," and "None of us is as smart as all of us." Do you believe that this is true? Why, or why not? Does it depend on the situation? Are some problems more suited to teams? Give examples.
- 10.7 Look up the word "synergy" in a college dictionary and give its basic meaning and its root meaning from the Greek. In an introductory biology textbook look up examples of "synergism." Write and briefly describe three examples of synergism from the biological world. Discuss lessons that humans can learn from these biological examples.
- 10.8 There are a number of historical examples where individuals have collaborated and accomplished what likely was not possible if they acted alone. Have you ever been part of a fruitful collaboration? If so, what? Why was it fruitful? Or have you been part of a failed collaboration? If so, why?