The Capstone Team

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The engineer is the key figure in the material progress of the world. It is his engineering that makes a reality of the potential value of science by translating scientific knowledge into tools, resources, energy and labor to bring them into the service of man … To make contributions of this kind the engineer requires the imagination to visualize the needs of society and to appreciate what is possible as well as the technological and broad social age understanding to bring his vision to reality.

—Sir Eric Ashby

Engineering is the science of economy, of conserving the energy, kinetic and potential, provided and stored up by nature for the use of man. It is the business of engineering to utilize this energy to the best advantage, so that there may be the least possible waste.

—William A. Smith

Chapter Objectives

After studying this chapter, you should be able to:
Understand what a team is.
Compare different types of teams.
Gain insight into the elements of forming a team.
Explain team development and behavior.
Understand the basics of conflict management associated with teams.
Relate ethics to project teams.
Understand how to assess team performance.

The Team

> A team is a small group of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable. [13]

Teams are ubiquitous in industry today. Alexander Graham Bell's and Thomas Alva Edison's experience of working in comparative isolation is gone. Today's engineering projects require technically competent engineers working as team members with other professionals. It is the ability to work in multidisciplinary teams communicating and sharing information that enables them to complete a project on time, within budget, and meeting the intended requirements.

Teams are a part of business and industry. Some teams exist for a longer period and may be considered permanent. Most teams exist to complete a task or project. Researchers [13] write that there are three distinct types of teams:
1. Teams that recommend things.
2. Teams that make or do things.
3. Teams that run things.

Teams are made of individuals whose collective competence and experience is greater than any individual offers. Teams must be planned, supported, and led. Members interact regularly, coordinate work efforts, and engage in healthy conflict. Team members listen to one another and learn to respect each other's opinion even if they disagree. They develop a feeling of loyalty and togetherness.

Traditional Teams in Industry

Most technology companies organize their employees by function, such as engineering, project management, technical writing, production, field service, finance, sales, and marketing. The project team in a standard matrix organization requires a project manager to request needed personnel from each functional group. Each functional manager contributes personnel to the project team. Led by the project manager, the newly formed team gets together and collaborates to meet a goal, such as developing a new product. Each project member adds to the overall project success by bringing his or her specialty skills and competencies to the team. As in most projects, the team receives or creates a specification, a budget, and a schedule. They may be colocated or work from their functional areas. The team is expected to follow established processes and procedures for purchasing material and services, testing, standards usage, quality methods, documentation, training, upper management supervision, etc. They adhere precisely to the organization's policies and procedures related to personnel issues—especially those associated with union shops.

The New United Motor Manufacturing Inc. (NUMMI) plant in Fremont, Calif., opened in 1984 as a joint venture between General Motors (GM) and Toyota. It represented an opportunity for GM to gain technology and insights into Toyota's

production system, and Toyota would learn how to apply its systems and culture to a U.S. workforce. The plant operated until 2010. "Team" was at the heart of the production system. The "Toyota Way" demanded trust and respect in worker teams. They implemented flexible work rules and empowered workers to stop the production line if a problem needed to be fixed; rewarding workers for solving problems in production and improving product quality. (As a footnote, Tesla bought the facility from Toyota and began to produce the Tesla Model S electric sedan in 2012 at the former NUMMI plant.)

Tiger Teams

Unlike traditional teams, skunk works and tiger teams are frequently assembled to deal with special situations that may arise in business and industry. The Tiger Team enters the picture when a crisis emerges. Management quickly assembles a multi-disciplinary team of experts for the purpose of problem solving.

Tiger Teams have been used in aerospace, computer security, and the military. Tiger teams may test an organization's security measures to see how easily they could be penetrated. A 1964 definition of Tiger Teams described them as "a team of undomesticated and uninhibited technical specialists, selected for their experience, energy, and imagination, and assigned to track down relentlessly every possible source of failure in a spacecraft subsystem" [14]. A corporate sponsor must provide the needed resources, especially budget and personnel. The tiger team is a self-contained crew that includes all the skill sets and resources needed to do the assigned work. Team members could be drawn from engineering, operations, finance, legal, and marketing areas. Consultants frequently supplement internal personnel to accomplish a task.

An organization does not use tiger teams for every issue that arises. It costs too much. The tiger team represents the best that any group, organization, or government can assemble, to attack a daunting problem. Characteristics in the performance of a Tiger Team are [15]:
- The ability to arrive at multi-dimensional solutions at three levels: technical, process, and human
- The ability to incorporate statistical and scientific methods of problem solving and decision making
- A willingness to break rules, think outside the box, and move beyond existing boundaries
- The ability to maintain a continuous intensity of focus and action orientation from all members, not just the leader, over the entire span of the work
- The capability of addressing complex, multi-faceted tasks and/or projects with narrow margins for error
- The ability to perform within tight timeframes and low risk tolerances to achieve rapid response recovery

Perhaps one of the most well-known tiger teams was the 15 member team to get the Apollo 13 flight in 1970 on the correct path home. NASA lead flight director Gene Kranz told them to solve the problem [16]. As with all tiger teams faced

with adversity and almost insurmountable problems, the leader must create a climate of trust, cooperation, and innovation, and lead with "Can do!" optimism and enthusiasm.

Skunk Works

Skunk works involves a multidisciplinary team assigned to a special project, usually working with advanced technology, limited budgets, and aggressive schedules. The projects are designed and built relatively quickly with minimum management constraints.

During World War 2, America needed an aircraft that could meet and exceed the capabilities of German jets. In 1943, the U.S. War Department hired Lockheed Aircraft to build a working jet fighter prototype in less than six months. A team lead by Kelly Johnson moved forward with minimal bureaucracy and designed and built the aircraft within 143 days [17]. The Skunk Works® name is a Lockheed Martin registered trademark. Johnson used an unconventional organizational management approach. He broke the rules and challenged the system in his effort to improve efficiency and obtain results. His philosophy is spelled out in his "14 rules and practices" [18], which are:

1. The Skunk Works manager must be delegated practically complete control of his program in all aspects. He should report to a division president or higher.
2. Strong but small project offices must be provided by both the military and industry.
3. The number of people having any connection with the project must be restricted in an almost vicious manner. Use a small number of good people (10–25 % compared to the so-called normal systems).
4. A very simple drawing and drawing release system with great flexibility for making changes must be provided.
5. There must be a minimum number of reports required, but important work must be recorded thoroughly.
6. There must be a monthly cost review covering not only what has been spent and committed but also projected costs to the conclusion of the program.
7. The contractor must be delegated and must assume more than normal responsibility to get good vendor bids for subcontract on the project. Commercial bid procedures are very often better than military ones.
8. The inspection system as currently used by the Skunk Works, which has been approved by both the Air Force and Navy, meets the intent of existing military requirements and should be used on new projects. Push more basic inspection responsibility back to subcontractors and vendors. Don't duplicate so much inspection.
9. The contractor must be delegated the authority to test his final product in flight. He can and must test it in the initial stages. If he doesn't, he rapidly loses his competency to design other vehicles.
10. The specifications applying to the hardware must be agreed to well in advance of contracting. The Skunk Works practice of having a specification section stat-

ing clearly which important military specification items will not knowingly be complied with and reasons therefore is highly recommended.

11. Funding a program must be timely so that the contractor doesn't have to keep running to the bank to support government projects.
12. There must be mutual trust between the military project organization and the contractor, the very close cooperation and liaison on a day-to-day basis. This cuts down misunderstanding and correspondence to an absolute minimum.
13. Access by outsiders to the project and its personnel must be strictly controlled by appropriate security measures.
14. Because only a few people will be used in engineering and most other areas, ways must be provided to reward good performance by pay not based on the number of personnel supervised.

The skunk works legacy has continued and has made business history [19]. Organizations use the skunk works-like project process where teams operate independently from the structures of the remainder of the organization in an effort to spark innovation and complete a task in a shorter than traditional time period.

The Motorola Razr phone is a case in point. The team kept the project top-secret, even from their colleagues. They used materials and techniques Motorola had never tried before. They threw out accepted models of what a mobile telephone should look and feel like. The team designed and constructed a phone with the features they wanted—including size. The team decided on a phone that was 13.9 mm thick, which was 40 % thinner than Motorola's slimmest flip-top phones. The 20-person engineering team completed the project in about a year and a half [20].

The Apple Macintosh computer resulted from an initial team of four, headed by Apple cofounder Steve Jobs. Their goal was to make a personal computer easy enough for an ordinary person to use without fear and inexpensive enough to be affordable. Secretly and in a separate facility, the Mac team took 3 years to develop the computer. It featured an intuitive graphic user interface that allowed nonprogrammers to use it almost instantly.

The development of the Ford (F) diesel engine Scorpion was developed in 36 months versus the more common 48 months [21]. Here again, the assembled team moved off-site to "short-circuit" the usual development process.

IBM's first PC was assigned the code name "Acorn." A small skunk works team of engineers, worked at a site in Boca Raton, Florida, to design and build it [22]. On August 12, 1981, after about a year of work, IBM released their new computer with the new name—the IBM PC (personal computer).

The Lockheed Skunk Works process demonstrated a method to rapidly prototype, develop, and produce a wide range of advanced aircraft for the U.S. military. The skunk works process continues and is now synonymous with projects that are designed and built quickly and unconventionally with minimum management constraints.

The preparation of proposal responses to government and private industry procurements is frequently managed as a skunk works effort. A proposal manager has a relatively short timeframe to provide a response. Subject matter experts are quickly brought on board to provide the specialized expertise that supports the development

of the technical approach and related writing. The team has the responsibility for meeting schedule deadlines, conforming to the proposal outline and compliance matrix, developing graphics that support the text, developing management and cost volumes while using a consistent format. A contracts specialist is generally responsible for preparing required forms, clauses, representations, and certifications, which are included in the cost/pricing section. The team members must cooperate in a coordinated effort to understand the client's goals and anticipate the competitors' approaches. A winning proposal team has to do whatever it takes over the typically allotted 30- to 90-day proposal preparatory time period. In this way it is very similar to a skunk works operation.

Capstone Project Team

A capstone project team frequently consists of from 2 to 5 people. Students sometimes take the initiative to form their team in a self-selection process. Other times an instructor or mentor will either randomly assign students to a team or assist students in forming a team.

The capstone team exists for one or two semesters and its members share a common purpose throughout this time. Whether self-selected or pre-selected, the members should be a diverse group and have a broad collective skill and knowledge base. A team composed of like-thinking individuals with similar backgrounds and experience may limit the number and types of possible solutions for creative problem solving.

In many respects, the capstone project team is like a skunk works. Not all of the Kelly Johnson rules apply to the capstone project team, but certainly a subset does. Consider adopting the following set of modified skunk works ground rules for the capstone team:

1. The capstone project team has almost complete control of their project. They report only to the class faculty mentor.
2. The number of people having a connection with the project is restricted to the capstone project team and the project mentor. The capstone team has the option of calling in industry or university consultants for guidance.
3. The capstone project team has great flexibility for making changes but all participants must be notified of a change.
4. The capstone project team has a minimum number of required reports, but important work must be recorded thoroughly. The required reports include a weekly status review, a final semester presentation, and a summary semester report.
5. The capstone project team must set, commit to, and meet milestones to keep momentum going.
6. The capstone project team must keep close tabs on expenditures. The weekly status report should include a cost review covering not only what has been spent and committed but also projected costs.

7. The capstone project team is expected to obtain good vendor bids for material and subcontract work used on the project.
8. The capstone project team must have a well-defined specification before beginning significant work on the project.
9. The capstone project team must develop a test that demonstrates that the final product or service meets the specification.
10. There must be mutual trust and cooperation among the members of the capstone project team and the faculty mentor.
11. The team must meet frequently, distribute responsibility as evenly as possible and offer one another constructive feedback.
12. Have fun and celebrate success!

The team develops performance goals that will enable them to establish, track, and evaluate progress towards completing their project. Teams develop their own rules that outline the expected behaviors of its members including when and how often to meet. One of the most challenging tasks that a team faces is finding meeting times outside of the classroom that are acceptable to all. This is especially true of part-time students working during the day and having availability on particular evenings during the week. Indeed, if the student has children, it quickly becomes a family discussion item that must be resolved. At the end of the process, the team will own and share the team's outcomes—both successes and failures.

Steps in Team Formation

Members of a healthy team encourage listening and respond constructively to views expressed by others. They provide support and recognize the interests and achievements of others. A team's performance includes both individual results and "collective work products" [13]. A collective work product is the result of an output that members work on together, such as documentation, subcontracting, or test results. A collective work product reflects the joint, real contribution of team members.

Bruce Tuckman [23] proposed a 4-stage model of group development, which is applicable to the capstone team process. Broadly, the specific features of each stage are:
1. Forming: The team comes together and gets to know one another; form as a team and begin to understand the task ahead. The team looks to the faculty mentor and other team members for guidance and direction. Initially, little agreement exists on the team's aims. Individual roles and responsibilities are unclear. The faculty mentor responds to questions about the team's purpose, objectives, and external relationships. Processes may be ignored. Rules of behavior are to keep things simple and to avoid controversy. Team members may question the need for the course, and test the system and mentor.

   Team members attempt to become oriented to the tasks as well as to one another. Team discussions center around defining the task scope, how to approach it, and other similar concerns. To grow from this stage to the next, each member must relinquish the comfort of nonthreatening topics and risk the possibility of conflict.

2. Storming: Storming is characterized by competition and conflict in the personal relationships and in the task assignments. Decisions may not come easily. Team members vie for position as they attempt to establish themselves in relation to other team members, the initial team leader, and faculty mentor. Clarity of purpose increases but uncertainties persist. Factions form and there may be power struggles. Some team members may be dissatisfied with the way that work has been distributed. The team needs to focus on its goals to avoid becoming distracted by relationships and emotional issues. Compromise is required to enable progress.

   As the team members attempt to organize, conflict may arise. Individuals have to bend and mold their feelings, ideas, attitudes, and beliefs to suit the team. Although conflicts may or may not surface, they will exist. Members may voice dissatisfaction about the project selected or the tasks assigned to them. Questions will arise about who is going to be responsible for what, what the schedule is, and what the internal evaluation criteria are. There may be conflict over leadership, structure, power, and authority. There may be wide swings in members' behavior based on the stress associated with emerging issues. Because of the discomfort generated during this stage, some members may remain completely silent while others attempt to dominate.

   In order to progress to the next stage, group members must move towards a problem-solving mentality. Important traits in helping teams move on to the next stage may be their abilities to listen, negotiate, and conciliate.

3. Norming: Eventually agreement is reached on how the team operates. Team members acknowledge all members' contributions. Members are willing to change their preconceived ideas or opinions on the basis of facts presented by other members, and they actively ask questions of one another. Leadership may be shared, and factions dissolve. When members begin to know—and identify with—one another, the level of trust in their personal relations contributes to the development of group cohesion. The "*I*" disappears and the "we" appears. It is during this stage of development (assuming the group gets this far) that people begin to experience a sense of team belonging as a result of resolving conflicts.

   Team members share information, feelings, and ideas. They solicit and give feedback to one another, and explore actions related to the task. During the norming stage, team members' interactions are characterized by openness and sharing of information on both a personal and task level. They feel good about being part of an effective group.

   However, be careful there can be a downside to a cohesive group. Teams in the norming phase increase their commitment to the team. As cohesion increases, performance norms are established and members tend to want to increase conformity to the standards that are set. High conformity may incur groupthink.

   Groupthink [24] occurs when a group makes faulty decisions because group pressures lead to a deterioration of "mental efficiency and reality testing." Groups affected by groupthink ignore alternatives. A group is especially vulnerable to groupthink when its members have similar backgrounds, when the group is insulated from outside opinions, and when there are no clear rules for decision making.

The effects of groupthink may reduce innovation and effective decision making. The team may become uninspired to think independently or to consider ideas or solutions that run counter to those supported by the majority of the team.

4. Performing: The team practices and begins to get good at what it is doing. Participants become effective in meeting objectives. In this stage, people can work independently, in subgroups, or as a total unit with equal facility. Their roles and authorities adjust to the team's changing needs. The performing stage is marked by interdependence in personal relations and problem solving. The team is most productive. Individual members have become self-assured. Members are both task oriented and people oriented. A team identity exists, team morale is high, and team loyalty is strong. The team focuses on solving problems and emphasizes achievement.

Tuckman together with Jensen [25] added a fifth stage (adjourning) years later.

5. Adjourning: Projects end and so does the team. After the team has successfully (or unsuccessfully, in some cases) completed their task, they must disband. Participants disengage from the team and move on. Typically in the college capstone environment this would involve a final presentation with recognition for everyone's participation and achievement. In just a few short days after the presentation the team members graduate and say their personal goodbyes. Students graduate with a new degree and move on to face new challenges. They are confronted with the task of finding a job or moving to the next step in their current position. Concluding a team effort in industry can create some apprehension because the former team members are concerned about their next assignment.

The Tuckman model tells us that over time a team develops and grows in ability and trust. The members' behavior changes through the experience. While the team experiences ups and downs, the model does not predict when the team goes through the phases or even if the team will experience every phase. However, the science of organizational behavior suggests that the Tuckman model is representative of the process that your team will experience. Bonebright states that "It is, perhaps, unlikely that a model with similar impact will come out of the new literature." [26]

One thing is certain—the team's priority is to finish satisfactorily so that each member can obtain his or her degree. The team has no choice but to work together and succeed. In the process, members will learn a good deal about themselves, teamwork, and the developed product, service, or process.

Team Conflict Management

Common Causes of Conflict

Tuckman discussed the idea of conflict in the storming phase. Anticipate team conflict. People are different and putting people with different backgrounds, personalities, and experiences together will necessarily yield a variety of opinions, insights, and ideas. More often than not, the people's diversity leads to better decision making.

If everyone agreed completely with one another and knew the same information they might have little to contribute.

For an effective team that will reach its goals, the team members must have a shared understanding of what they are striving to achieve, as well as clear objectives. The team members need to keep personal conflict to a minimum. Personality conflict, may lead to a lack of cooperation, a lack of communication between members and unprofessional behavior that can directly affect the entire group. Team members must understand the rudiments of solving problems caused by conflict, before conflict becomes a major obstacle to completing its work.

Common causes of conflict within a team include the following:
- Disagreements in the technical approach
- Intolerance for mistakes
- Using alternate methods for accomplishing a task
- Lack of trust
- Different cultures, values, attitudes, languages, vocabularies, and perceptions
- Lack of meeting time
- Differences in objectives and different understandings of productive work
- Team members failing to meet their assigned work tasks in a timely fashion
- Scarcity of resources (finance, equipment, facilities, etc.)
- Disagreements about needs, goals, priorities, and interests
- Poor communication
- Lack of clarity in roles and responsibilities
- Hoarding rather than sharing knowledge
  Other symptoms of team conflict also include:
- Gossip
- Not returning phone calls, texts, or e-mails
- Not responding to requests for information
- Hostility
- Excessive complaining
- Finger pointing
- Verbal abuse
- Not attending required meetings
- Absenteeism
- Physical violence
- Sexual harassment

People have different styles of communication, different political or religious views and different cultural backgrounds. In our diverse society, the possibility of these differences leading to conflict exists, and the team must be alert to prevent and resolve situations where conflict arises.

Teams formed in large university environments will likely be quite diverse with respect to age, gender, ethnic background, race, religion, language, and nationality. There may be significant cultural differences in the form of values, beliefs, attitudes, behaviors, and other intangibles that influence the team's interactions and may lead to nontechnical disagreements. Team members must put personality disagreements aside for the good of the project effort.

Conflict can be an effective means for everyone to grow, learn, and become more productive if it is resolved. Ongoing unresolved conflict may impede the team's efforts to complete the project. People frequently use one or more of the following options for managing conflict include the following:

- Avoidance—withdrawing from or ignoring conflict.
- Smoothing—playing down differences to ease conflict.
- Compromise—giving up something to gain something.
- Collaboration—mutual problem solving.
- Confrontation—verbalizing disagreements.
- Appeal to team objectives—highlighting the mutual need to reach a higher goal.
- Third-party intervention—asking an objective third party (project mentor) to mediate.

When team members think that progress is stalled or that the team members are not working well together, then meet and talk about it. The conflict resolution process begins by first acknowledging that there is a problem and moving towards defining the issue. Discussing a problem at an early stage can prevent small issues from escalating into major problems.

The team has to communicate in a clear and nonblaming manner. Gather data and separate fact from conjecture or assumptions. Make certain that every team member has the most recent information. Each team member should try to understand the other person's viewpoint. Attack problems not each other. Confirm that team members understand the team's goals and their individual roles.

Sometimes things don't go as planned. Treat a failure as an opportunity for team growth. In a nonthreatening way apply the "5 Whys" strategy. Discuss the problem and ask: "Why?" and "What caused this problem?" The answer to the first "why" will prompt another "why" and the answer to the second "why" will prompt another and so on. For example, if a Web site goes down ask:

Question	Possible response
Why was the Web site down?	The CPU utilization on all the front-end server went to 100 %
Why did the CPU usage increase to 100 %?	New code was added and it contained an infinite loop
Why did it contain an infinite loop?	The code was not completely tested
Why was the code not completely tested?	A new employee wrote the code and was not trained in software code test and verification methods

By posing the why question and examining the responses, we discover that the problem lies not so much with the newly developed code but with the organization's new employee training program. Appropriate corrective action can then be taken.

Repeating "why" several times helps to uncover the root cause of the problem and move towards correcting it. Although called the 5 Whys technique it does not necessarily have to be 5 Whys. It can for example be 4, 6, or 7. Other benefits of 5 Whys are the following:

- Easy to use and requires no advanced mathematics or tools.
- Separates symptoms from causes and identifies the root cause of a problem.
- Fosters teamwork.
- Inexpensive. It is a guided, team-focused exercise. There are no additional costs.

However, the 5 Whys method is not a perfect root cause approach to finding solutions to problems. It may not work well for complicated problems or problems with multiple causes.

When confronted with a technical or business issue that stumps the team, seek help. Review the availability of resources and whom team members might contact for guidance and support. Always start with the team's faculty mentor. In a large college or university there are a host of people with special skills of which the team could avail itself. Consider contacting adjunct faculty, traditional faculty, teaching and research assistants, laboratory assistants, and administrators. Be sure to consider contacting other departments if the need arises. Doing this will develop team member's relationship and political skills.

Hopefully, team members learn to overcome the deadly effects of procrastination. Every team member will likely tolerate some amount of inconvenience and delay—but each individual will have to set priorities in their personal lives to accommodate the overall team goals.

Many nontraditional students attend college while balancing the stresses of a family and a job. Work-study-life balance exacts huge demands and responsibilities on people's lives. Stress is an inevitable part of being a student. There is no silver bullet to use as a guide to assist a student to overcome the effects of stress. Plan and account for time—from the few hours blocked off for sleep, to the daily commute and lunch break.

Hopefully, by the time people have reached the capstone course he or she will have learned to balance the responsibilities associated with their personal life. Family members and friends will have learned to accept a person's unavailability some evenings and weekends. Nonetheless, there is considerable stress involved in telling a boss that you are not available for travel or that you can't work too many weekends. Be sure to inform your employer, friends, clients, and family about your schedule. The capstone class involves time in class, but the fact is that most of the work is done outside of the classroom—both independently and with the team. The good part is that it will be over in one or two terms. Then life will return to normalcy.

With appropriate planning, the team has the skills and abilities to perform the requisite tasks and it will not need to resort to obtaining additional assistance. However, if the team lacks certain skills and abilities to meet project goals, then consider outsourcing. Exchange a person's knowledge and abilities with another team to help one another out.

Be sensitive to time management. Prepare a schedule collaboratively and be realistic in the team's consideration of the time required to meet goals and deadlines. Give positive feedback to one another regularly when someone has completed a task that moves the schedule along. We all appreciate an "atta boy" or "atta girl" every now and then.

Above all, talk and negotiate with one another and try to identify solutions to problems that arise. State issues positively. Instead of describing why something cannot be done, take the upbeat route. Follow the Johnny Mercer lyrics:

You've got to accentuate the positive
Eliminate the negative
And latch on to the affirmative
Don't mess with Mister In-Between

Discuss what can be done and what each team member is willing to do. Come to a realistic assessment of what can be done within the team's technical, budget, and time considerations. Encourage the expression of differing viewpoints and promote honest dialogue. Express thoughts in a way that does not assign blame.

Put personality conflicts aside and work effectively with one other for the duration of the project. Regardless of negative personal feelings towards a team member, get over it! Team members don't have to love one another but they do have to be cordial and cooperate with one another. Team members should maintain a high level of flexibility and perform a variety of tasks as needed. After the project is over, the team can move on with their life. Remember that the capstone project is a limited duration activity. Getting it done is everyone's priority!

Cultural Styles and Conflict

Team members in industry work in increasingly diverse environments: in terms of age, gender, race, language, sexual preferences, and nationality. Beyond these differences, there are also deep cultural differences that influence the way conflict is handled.

College, university, and workforce teams are increasingly diverse. The team environment may consist of people of different races, religions, nationalities, economic backgrounds, and speaking different native languages. Cultural differences may influence the way solutions are approached. Culture may be defined as the shared set of values, beliefs, norms, customs, attitudes, behaviors, and social structures that guide people's interactions daily.

Some cultures value the group (collectivists) above the individual (individualists). Group conformity and commitment is maintained at the expense of personal interests. Harmony, getting along, and maintaining "face" are thought of as crucial.

The dominant culture in the USA, Canada, Western Europe, Australia, and New Zealand is individualistic, while collectivism predominates in much of the remainder of the world [27].

Individualists and collectivists view conflict differently. Collectivists place a high value on getting along and may view conflict as a sign of social failure. Their society has a low comfort levels with conflict situations—especially of an interpersonal nature.

While many individualists also feel discomfort with conflict, it is regarded as an inevitable part of life that must be dealt with. Conflict with another team member is not necessarily something about which to be ashamed. Understand that it will happen and deal with it. What are the cross-cultural differences in your team? How does it affect your team's performance? How does the team deal with these differences?

Hofstede suggests five dimensions to national culture that may help a cross-cultural team understand one another [28, 29]. These can be summarized as:

1. Hierarchy: Some cultures and consequently possibly a team member emphasize the leader. Individuals may expect the team leader to provide direction and make decisions. Individuals within these cultures tend to be accepting of rules and may not question authority.

At the other end of the continuum are cultures that place a lot of emphasis on team involvement, with wide consultation and group decision-making being common. Questioning authority is likely to be accepted or even encouraged in these cultures.

2. Ambiguity: At one end of the continuum are cultures that encourage risk taking; in these cultures individuals are likely to feel very comfortable trying new and different ways of approaching things. At the other end of the continuum are cultures that place more value on routine, regulation, and formality. Individuals in these cultures are likely to prefer tried and tested ways of doing things rather than taking risks with unknown methodologies.

3. Individualism: This dimension relates to the extent to which the individual values self-determination. In an individualistic culture people will place a lot of value on individual success and the need to look after oneself. At the other end of the dimension are collectivist cultures in which individuals will place more value on group loyalty and serving the interests of the group.

4. Achievement-orientation: Hofstede [28, 29] describes one end of this dimension as masculine and the other end as feminine because it relates to values that have traditionally been associated with gender in western society. A culture at the masculine end of the continuum will be very achievement-oriented, valuing things such as success, achievement, and money. At the other end of the continuum are cultures that place more value on aspects such as quality of life, interpersonal harmony, and sharing.

5. Long-term orientation: At one end of the continuum are cultures that focus on long-term rewards; at the other end are cultures that are more concerned with immediate gain.

A country's cultural values are reflected along a continuum of these five dimensions [28]. Individuals' expectations and behaviors are likely to be influenced by their country's cultural values. For example, according to his research, team members from a country that is high on individualism are likely to:

– Expect to take a role in deciding the team's direction.
– Be prepared to question a team leader's decisions.
– Feel comfortable trying different approaches.
– Focus on achieving their own personal goals, with the view that successful completion of those will facilitate group success.

On the other hand, team members from a country that is low on individualism are likely to:

– Expect a clear hierarchical team structure, with a clear team leadership.
– Be highly disciplined.
– Focus on providing support to other team members to ensure that the overall team outcome is achieved.

The dominant value system of a country is not always at the extreme of one end of the continuum. For example, one country in Hofstede's [28, 29] research falls somewhere in the middle of the power distance and uncertainty avoidance dimensions, suggesting a strong need for hierarchy, but also a tendency to break rules when needed.

Hofstede's [28, 29] framework is useful to help us to think about how misunderstandings may occur within work teams. For example, imagine an international team that is being led by someone from a cultural background that values hierarchy. That leader may expect to make decisions without consulting her/his team members. This may damage the relationship with those team members from cultures at the opposite end of the continuum who expect to be consulted and make joint decisions.

Nonnative speakers of a language may have difficulty working in a second language. Native speakers may understand more definitions for words than second language speakers, which means nuances may be lost. In areas such as engineering, manufacturing, and regulatory compliance, these nuances may be quite important. Regional language, jokes, jargon, acronyms, and sports analogies may be difficult for a nonnative speaker to grasp. Nonnative speakers may require more time to respond to the discussion. If possible hold face-to-face meetings to help gain insight into nonverbal cues that might indicate that a person has a difference of opinion or has some additional thoughts about a subject. Intended or not tone of voice, intonation, body posture, body gestures, facial expressions, and pauses between words conveys information. Successful team integration requires acceptance and understanding of cultural differences within the team while focusing on common objectives.

Conflict will arise from time to time. How the team chooses to respond can be the difference between project success and failure.

Ethics in Project Teams

Project teams require open communication. Participants must recognize their own biases and control them. Honesty in every way must be the byword. Team members should not mislead stakeholders by omission or vagueness. Don't hide behind jargon. If a question is asked to which you don't know the answer respond by saying that you will research it—if you think the point is valid. But don't commit to something that you will not do. The integrity of the team's operation requires each member to step up and take responsibility for his or her work and actions. It will take a long time for the team to regain confidence lost as a result of a team member's misleading or mistrustful behavior. Be guided by the idea of doing the right thing.

Encourage open reporting of "bad news." There cannot be ethical teamwork where individuals are afraid to speak up. Use positive reinforcement. Thank people for notifying you of an error. Each team member should strongly encourage ethical behaviors, such as refusing to allow derogatory remarks in any form. Think about what it means to be a good team player. A set of guidelines might include the following:
- Attend meetings. Show up on time and be prepared to contribute to activities.
- Thoroughly complete tasks and submit work according to the agreed upon schedule.
- Assist other teammates, when asked.
- Listen.
- Participate in team deliberations.
- Respect individual differences (ethnicity, gender, religion, politics, etc.).

- Solve problems in a positive manner.
- Demonstrate reliability.
- Accept responsibility for your actions.
- Communicate transparently—be truthful.
- Accept continuous improvement—be open to new ideas and better ways to do things, consistently examining your methods and welcoming feedback to "find a better way."
- Treat others with dignity, fairness, respect, and courtesy.
- Know when to stop advocating for your position. It may hurt to have your pet idea rejected by the team after all that honest effort. However, don't let hurt feelings goad you into talking badly about teammates. Conversely, don't think or talk negatively about yourself if the team chooses a different idea or direction.
- Honor and maintain the confidentiality and privacy of colleague, customer, client, and employer information.

Project Team Peer and Self Evaluation

A positive attribute of the capstone team process is that teamwork competencies can be acquired during team-based activities. Classes with lectures focusing on individualized tasks do not afford this benefit. Who knows the team better than its members? Who better should evaluate the team than the members of the team? Grading a team is difficult at best. If only the faculty mentor evaluates the team it may not be a fair reflection of an individual's work. After all, a significant portion of the work is completed outside the classroom. Consequently, some faculty have begun to use a peer review and self-evaluation instrument as a major component of the grading rubric. The CATME project began in 2003 with the development of an instrument for self and peer evaluation and team management called the Comprehensive Assessment of Team Member Effectiveness (https://engineering.purdue.edu/CATME/). Others have also sought an effective evaluation instrument to assess individual contributions and overall team performance (see for example [30–32]).

The faculty mentor should inform team members at the beginning of the semester that a peer evaluation will take place that will emphasize team process and individual contributions in addition to project performance. These measures are different from most courses that student's take. Keep in mind that evaluation is a qualitative judgment intended to provide feedback for improvement. The evaluation instrument is a tool to foster teamwork competencies such as communication, leadership, collaboration, and interpersonal relations. These qualities can be acquired during team-based activities. A mid-semester process check as well as an end of semester evaluation can be used to assist the team in improving its performance.

The Peer and Team Evaluation Instrument in Table 2.1 is adapted from material developed by Wilson [30]. The evaluation criteria in Table 2.1 address individual contributions to the team. Before using the instrument, the class should discuss and modify, add or delete criteria based on class consensus.

Table 2.1 Peer and team evaluation instrument

No.	Task	Self	Student name 1	Student name 2	Student name 3
1	Attendance at team meetings: Present at all team meetings except where a previous commitment conflicted with the time and the absence was agreed upon with team members				
2	Planning and Task definition: Helped develop and support the Work Breakdown Structure (WBS) and schedule				
3	Technical support: Provided technically creative and insightful ideas to the effort				
4	Timeliness: Completed all assigned tasks in a timely manner				
5	Collaboration: Made a genuine effort to work effectively with others. Shared ideas openly with fellow team members. Open-minded, objective, respected other's ideas, positive				
6	Effort: Exhibited a high level of interest and commitment to the project				
7	Contribution of skills: Obtained results using competencies, resources, and materials				
8	Contribution of ideas: Provided creative and innovative ideas for group discussion				
9	Oral Communication: Spoke clearly, succinctly during presentations and responded knowledgeably to questions				
10	Written Communication Contributions: Preparation of the specification				
11	Written Communication Contributions: Preparation of presentations				
12	Written Communication Contributions: Preparation of the preliminary proposal				
13	Written Communication Contributions: Preparation of the final project documents				
14	Test: Contributed to the product, service, process, or system test				
15	Problem solving: Defined issue. Set priorities. Developed and implemented solution. Monitored progress and adjust direction as needed				
	Total				

Rating Scale:

1. Did not contribute in this way.
2. Willing, but contribution not very successful or useful.
3. Average contribution. Did what was required.
4. Significant or above average contribution. Did more than required.
5. Outstanding contribution. Did much more than was required. Made a great difference to the team and to the project.

Other Comments:

Each peer and self-evaluation criteria was assigned a five-point Likert scale from almost never (1) to almost always (5). Team members should insert a value (from 1 to 5) into the appropriate box for each of the 15 items measured. The maximum individual score is 75. Write in each team member's name across the top including your own, and then rate each person in the categories using the number system given. This evaluation must be done anonymously and in private. The team should not see the ratings until all team members have completed the evaluation. Be honest with yourself and in evaluating others. Very few people are all 1's or all 5's. The results of the peer review can be given to the faculty mentor who would then distribute the information to each team member to be read in private. Alternatively, the faculty mentor can post the evaluation instrument on the Web site SurveyMonkey. com and request each team member to complete the evaluation form. The anonymous responses can then be downloaded by the faculty mentor and distributed to the team for their review.

When completing the evaluation, disregard your general impressions and concentrate on one category at a time. Carefully review the category description. Think about instances that are typical of each team member's work and behavior. Do not be influenced by unusual situations that may not be typical. Determine the rating that best describes the team member's accomplishments in that area and enter the selected rating number. If a factor has not been observed during the rating period, enter NA for not applicable. If team members wish, comment at the end of the evaluation to further describe a rating.

Self- and peer-evaluation pushes students to take responsibility for their effort and participation and, therefore, for the success of their team. Peer review leads to collegial feedback and reflective thought and action. Team members are in the best position to comment on peer effort, quality of technical content, materials, class presentation. Evaluations which are conducted during the capstone learning experience are often called formative. Evaluations which are conducted at or near the end of the capstone learning experience, and which provide a retrospective view of the overall value of that experience are summative. In all cases, the evaluation results indicate the changes, if any, that members of the team need to make.

The peer review process is difficult. We all take pride in the work we do and the products we create. We don't like to admit that we are not as good as we think we are and we don't like to have other people tell us about our shortcomings. Conducting successful self and peer reviews requires us to overcome this natural resistance to critique others and ourselves. We all have egos and team members must demonstrate compassion and sensitivity for colleagues during the review process. Team success depends on helping each other do the best job possible.