Conflict in Capstone Design Teams: Sources, Management, and the Role of the Instructor

Ada Hurst and Mehrnaz Mostafapour
University of Waterloo

Team conflict can severely impact capstone design teams' effectiveness and project outcomes. While previous studies have identified common sources of conflict in capstone design project teams, they have mostly relied on instructors accounts of these conflicts. In this paper we present the results of a comprehensive survey of students in the capstone courses of eleven engineering disciplines at a Canadian university. Twenty-two percent of respondents reported having experienced significant conflict in their teams, typically resulting from role ambiguity, ineffective communication, relationship conflict, ineffective project management, and poor team membership behavior. Of those, seventy-six percent reported that team conflict(s) were eventually resolved. Unresolved conflicts were due to teams' passive approach to conflict management, such as not trying to resolve the conflict or not requesting the intervention of the course instructor until very late in the course. Only twenty-six percent of students in conflict-ridden teams reported having notified the instructor; of those, seventy-two percent were satisfied with the instructor's intervention. Those that did not notify the instructor were worried about the impact that "reporting" a teammate would have on him/her and team's future relationship with that teammate. Capstone instructors can constructively assist capstone teams to identify and manage conflict by providing both structured training and need-based interventions.

Corresponding Author: Ada Hurst, adahurst@uwaterloo.ca

Introduction

Accreditation requirements in Canada[1] mandate that engineering capstone design projects be completed in teams. Like all types of teams, most engineering student teams encounter some form of team conflict. How the team manages conflict can have a severe impact on project outcomes and the students' experience in completing the design project.

Capstone instructors and faculty advisors, too, are inevitably impacted by these conflicts, from receiving weak project deliverables by conflict-ridden teams to often having to make significant interventions to help teams resolve their conflicts. Best practices suggest that capstone instructors should take an active role in capstone teams' teamwork through various means, including by pre-emptively promoting good teamwork processes through teaching teamwork skills to students, encouraging students to practice good teamwork, regularly assessing team functioning while promoting individual accountability in teams, and remediating team dysfunction when necessary[2]. However, these interventions can be practiced effectively only if the instructors are knowledgeable about the types of conflicts that occur in student teams.

Previous work has identified the main sources of student teamwork conflicts to be largely due to the teams' inability to make project-related decisions (e.g., about scope), workload imbalance, team members' inability to do assigned work (due to lack of competence or skill), personality "clashes", and miscommunication[3]. However, most of this prior work uses evidence from capstone instructors' accounts of these conflicts[2,3] as opposed to the students' perspective. This approach has a few disadvantages. First, because instructors typically become aware of only the most significant and unresolved team conflicts, less severe conflicts or cases when the team is able to resolve conflicts independently do not readily come to the surface. Given this limitation, it is difficult to assess the effectiveness of the instructors' interventions in resolving team conflicts. In addition, we do not understand what prompts or deters students from reporting conflicts to the course instructor.

As such, the aim of this study was to explore the students' perspectives on the conflicts that they experience in capstone design project teams, and in particular, to answer the following questions:

1. What is the likelihood of conflict in capstone teams?
2. What are the main types of conflict?

3. What is the effect of conflict on the team and individual team members?
4. Are teams able to resolve conflict? If not, why not?
5. What is the likelihood that a team will seek instructor intervention in solving a conflict?
6. Why is or isn't the instructor notified?
7. How effective is the instructor in helping teams resolve conflict?

Method

The data reported in this paper were collected through a large anonymous survey that was administered to fourth year engineering students enrolled in civil, computer, chemical, electrical, management, mechanical, mechatronics, nanotechnology, software, systems design, and multidisciplinary engineering capstone design courses at the University of Waterloo. The survey was sent out through each course's instructor. In some of the programs, survey completion was rewarded with a small bonus mark in the capstone design course. Most of the survey questions were in multiple-choice or Likert scale format and solicited the students' experience in forming and working in their capstone design teams.

A section of the survey – the results of which are reported in this paper - concerned the topic of team conflict and the overall teamwork experience. Students were prompted to comment on the overall team experience in their senior design project and in particular, disclose if they had experienced significant conflict in their teams, whether they had reported the conflict to the course instructor and asked for his/her assistance, and whether the conflict had been ultimately resolved.

Results

The survey was completed by 616 students – approximately a fifty-one percent participation rate. Twenty-two percent of respondents reported that their teams had experienced *significant* conflict.

Sources of conflict

A thematic analysis of the students' responses about their teamwork experiences and the sources of conflict in their teams revealed eight main categories of potential sources of conflict in student teams.

First, students reported that there was at times **lack of clarity on team members' roles and expectations.** This included significant asymmetry or discrepancy in team members' topics of interest, working styles, and expectations on project and grade outcomes, leading to conflicts about the project topic, scope, and timeline.

Another source of conflict was **ineffective communication** in the team. In addition to general instances where there was a lack of communication between team members in the team, students also identified other, more specific instances of this type of conflict, including cases when:

- Team members did not use professional language and gave personal comments rather than technical and project-related ones.
- Team members did not respond to messages, or preferred different communication channels altogether, such as Facebook Messenger, text messages, phone calls, etc., and as a result, were not very responsive to the communication channel that was not their preference.
- Team members did not pay attention to what was said in meetings, leading to misinterpretation and misunderstandings later.
- The team encountered knowledge translation problems in multidisciplinary teams, leading to miscommunication.

Some of the conflicts were **relationship-based**. These were typically caused by members gossiping about other team members, making efforts to exclude a member from team decisions, and general clashes of personality between team members. In some rare instances, it was noted that "difficult" team members were suffering from mental health issues.

Other conflicts were due to **ineffective project management** by the team. Some students reported that their teams did not set practical objectives in a timely manner and did not assign buffer times for unexpected problems/last minute mistakes. As a result, teams had to change the direction or the scope of the project multiple times and throughout the project, leading to frustration and problems that ignited arguments between team members.

Some students reported that some of their team members generally **lacked team membership behavior.** These team members did not contribute to the team or collaborate well with other team members, as exemplified by behaviors such as social loafing and not delivering the assigned tasks and expectations to a satisfactory degree, missing team meetings, working only individually, not providing support for other team members when needed, showing egocentric behavior and ignoring others' opinions, and generally disengaging from the team.

A number of the factors that students cited as leading to conflict in their teams were external in nature. For example, some students reported that conflict in their teams was a direct result of **ineffective course design,** and in particular the lack of clarity about the expected course deliverables. Students also pointed at other **"logistical"** issues such budgetary and financial problems, lack of access to needed technologies and resources, technical setbacks and hardware failures, and legal/regulatory problems. A final general theme of

conflict sources that emerged included **circumstantial factors** (not at all directly related to the team), such as competing priorities (job hunting, having other deadlines, finding graduate schools) and family problems that distracted some of the team members from their teamwork. In these cases, other team members were forced to compromise and take on additional roles.

Resolving conflict

Of the students who reported having experienced significant conflict their teams, a majority (76%) reported that their teams were ultimately able to solve the conflict. Those who reported that they were not able to do so were further asked for the reason in a short answer format. A number of main themes emerge from the analysis of their answers:

- The team did not act to resolve the conflict early enough. Some teams reported not notifying the instructor until it was too late. Others simply did not realize that a team member was being problematic (e.g., producing low-quality work or not pulling their weight) until very late in the course.
- A problematic team member limited communication with other team members so effectively that the team simply never had a chance to confront him/her and attempt to resolve the problem.
- A team member experienced conflict with another team member but believed the rest of the team members would not see the same issue. In this case, too, an opportunity to resolve the conflict was not created.
- In many cases, team members simply decided to not address the conflict (the team "just lived with it"); they simply picked up the slack or reduced the scope of the project to accommodate for the reduced manpower available in the team.

Role of the course instructor

Students who responded that they had experienced conflict in their teams were further asked if the instructor was notified of the conflict, and if so, if they were satisfied with the instructor's handling of the problem. Only twenty-six percent reported that they notified the instructor; of those a large majority (72%) were satisfied with how the instructor handled the issue. Students were not directly asked why they did not notify the instructor, but some reasons emerge in their answers to other questions, especially with respect to why conflict was not resolved:

- Some students reported that they saw notifying the instructor as the very last resort, reasoning that the act of bringing the instructor into the team's internal strife would irrevocably elevate the seriousness of the

issue, hurt friendships, and likely affect the "offending" team member's final grade in the course.
- Students also did not want to report poor teamwork behavior for fear of how this might appear to others in the team (e.g., being labeled "whiny" or "bossy")
- Some students believed the instructors did not have the ability to resolve conflict. For example, one student reported that even though he/she notified the instructor of the conflict, the instructor simply directed them to other resources, such as counselling services.
- Some instructors seemed to have taken a "hands-off" approach to team conflict, leaving it to teams to work on their own on team issues. In some programs, all team members received the same grade in the capstone course, regardless of contribution.
- Some instructors seemed to utilize a warning system, which was seen by some students as too lenient. Team members that were not pulling their weight or producing low-quality work were not always motivated to do better even after repeated warnings.

Impact of conflict on team members

When studying conflicts, we often look at the effects of conflict on team performance; however, in this study, we also looked at the experiences of individuals who were in the teams that experienced conflict, through a phenomenological lens. Specifically, we looked at the experiences of students who self-reported being identified as the source of conflict by other team members, as well as students who were in teams where another team member was identified as a social loafer.

In the case of the former group, we looked specifically at the students who said they were perceived as lacking adequate technical skills in their team. These students reported experiencing verbal abuse and passive-aggressive behavior by their team members. The extent to which these students experienced these behaviors varied based on their perceived incompetency by other team members. They expressed that these behaviors deeply influenced their perception of self and to some degree their mental health.

On the other hand, students who reported being in teams where other team members were social loafers expressed that they felt frustrated and demotivated because of what they judged to be a lack of fairness.

Both sides also expressed sadness over losing friendships that could have lasted if these team problems had not occurred.

Conclusions and recommendations

Our survey of a very large engineering graduating class enrolled in eleven (discipline-based) capstone design courses revealed that approximately one out of four

respondents had experienced some form of significant conflict in their capstone design team experiences. Conflict is a common occurrence in teams and can be constructive in building team processes and meeting the team's objectives. In fact, of those teams that experienced conflict, almost three out of four were able to resolve the conflict. This demonstrates that by senior year, most students have gained the skills to identify and manage conflicts in teams.

An important question arises with regards to the role the capstone course instructor can take in helping a team overcome conflict. According to our survey results, approximately three in four teams chooses not to notify the instructor at all, with the most common reasons provided ranging from a fear of irreparably breaking the internal team "trust" by involving formal authority, to a belief that the instructor would not be able to resolve the conflict. The former reason seems to be the biggest bind in which teams find themselves with regards to reporting conflict to the course instructor. Students only notify the instructor if a team member displays extremely poor team behavior. They also believe that if an instructor becomes involved, and especially if the bad team member is "punished" in some way (e.g., with lower grades), there would be no chance of ever restoring friendship with that particular team member. Students do not believe that instructor interference would necessarily lead to the team member beginning to cooperate again with the team. Therefore, from the students' perspective, whether or not the instructor is notified of a conflict in a team, the end outcomes are very similar: a poor team experience and performance.

So what can instructors do to more constructively assist capstone teams identify and manage conflicts? Prior work in the literature has suggested that instructors become trained – through workshops and other kinds of instructional media – to support capstone teams in their decision making processes, project management and work distribution, and conflict management[3]. Similarly, training of faculty advisors to effectively manage and facilitate team processes has shown promising results[4]. Instructors can also promote good teamwork by setting an example on how professionals behave in teams (through their own interactions with student teams), motivating students through positive reinforcement (by setting expectations for, recognizing and rewarding effective team processes and behaviors)[2].

Furthermore, previous work shows the impact of teamwork training on teamwork effectiveness[5,6]. Providing students with training on effective teamwork behavior and the potential problems that they may face in their teams during their capstone design projects can enable them to employ preventative measures and effective resolution strategies to address problems when they arise.

References

1. Engineers Canada (2017) Accreditation Criteria and Procedures. Available at: https://engineerscanada.ca/sites/default/files/accreditation-criteria-procedures-2016-final.pdf. Accessed April 3, 2018.
2. Ohland, M. W., Giurintano, D., Novoselich, B., Brackin, P., & Sangelkar, S. (2015). Supporting Capstone Teams: Lessons from Research on Motivation. *International Journal of Engineering Education,* 31(6B), pp.1748-1759.
3. Paretti, M. C., Pembridge, J. J., Brozina, S. C., Lutz, B. D., & Phanthanousy, J. N. (2013). Mentoring Team Conflicts in Capstone Design: Problems and Solutions. *Proceedings of the 120th American Society of Engineering Education Annual Conference & Exposition.*
4. Taylor, D. G., Magleby, S. P., Todd, R. H., & Parkinson, A. R. (2001). Training Faculty to Coach Capstone Design Teams. *International Journal of Engineering Education*, 17(4-5), pp. 353-358.
5. Dunne, E., Rawlins, M. (2000). Bridging the Gap between Industry and Higher Education: Training Academics to Promote Student Teamwork. *Innovations in Education and Teaching International*, 37(4), pp. 361-71.
6. Volpe, C.E., Cannon-Bowers, J. A., Salas, E., & Spector, P.E. (1996). The impact of cross-training on team functioning: An empirical investigation. *Human Factors*, 38(1), pp. 87-100.