

Team Talk and Learning Project Management

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1. Introduction

The management of team-based multi-disciplinary engineering projects requires a complex set of skills and talents that can be grouped into four categories: technical, administrative, interpersonal, and personal. Engineers often come to their project management positions with excellent technical skills, but need additional training in the other areas to become effective managers.

“The skill that brings an engineer to prominence and results in promotion into a first management position are not necessarily the skills needed in the new management position.¹”

This training often takes place in a more-or-less traditional classroom that focuses on theory with little opportunity for application of knowledge, skill building, and practice². There are no laboratories (or practicums) for courses in management³. This pedagogical omission is troublesome, particularly when one is attempting to learn the interpersonal skills necessary for effective management of multi-disciplinary technical teams. People, who do not behave in well-defined and repeatable ways, immediately push the theory into the “indeterminate zones of uncertainty, uniqueness, and value conflict⁴”. And it follows, to “think like a⁴” manager when working with people in paradoxical cross-functional teams requires a seemingly innate ability to create instinctive strategies and to make spontaneous decisions. This “tacit knowledge⁵” cannot be mastered solely through the textbook or lecture. A combination of theory and structured practice followed by guided reflection is needed to develop the practical competencies required of a professional skilled in the management of multi-disciplinary project teams.

This paper describes a graduate-level engineering management course that incorporates an intensive practicum designed to build these competencies at the tacit level. In particular, we focus our discussion on the use of a sociolinguistic technique called Team Talk⁶, which provided a structure for learning about teams by analyzing their verbal processes.

2. Managing Engineering Design

EGR 686 Managing Engineering Design is a graduate-level engineering course offered at Northern Arizona University (NAU) through the College of Engineering and Technology as part of NAU’s newly created Master of Engineering program. The intent of EGR 686 is to introduce engineering students to the basics of design project management. It is specifically geared towards the activities of a front-line manager of a team of engineering designers.

During the spring of 2000, the three graduate students from EGR 686 were vertically integrated as project managers into NAU’s junior-level multidisciplinary project-driven design class that is called EGR 386 Engineering Design III. This integration, the practicum component of EGR 686, was combined with traditional class time, reflective writings, and mentoring to provide a balance of theory with structured practice and guided reflection.

The vertical integration was accomplished by structuring EGR 386 as a lightweight matrix organization that combined both functional and project priorities as depicted in Figure 1. The graduate students managed the project environment, while the EGR 386 faculty delivered discipline-specific content and managed functional tasks. The three cross-functional project teams consisted of 30 to 35 undergraduate students who came from the various disciplines of civil engineering, computer science and engineering, electrical engineering, environmental engineering, and mechanical engineering. Their project goal was, in one semester, to analyze, model, design, and build one of three scaled-down prototype anaerobic digesters used to process urban sludge.

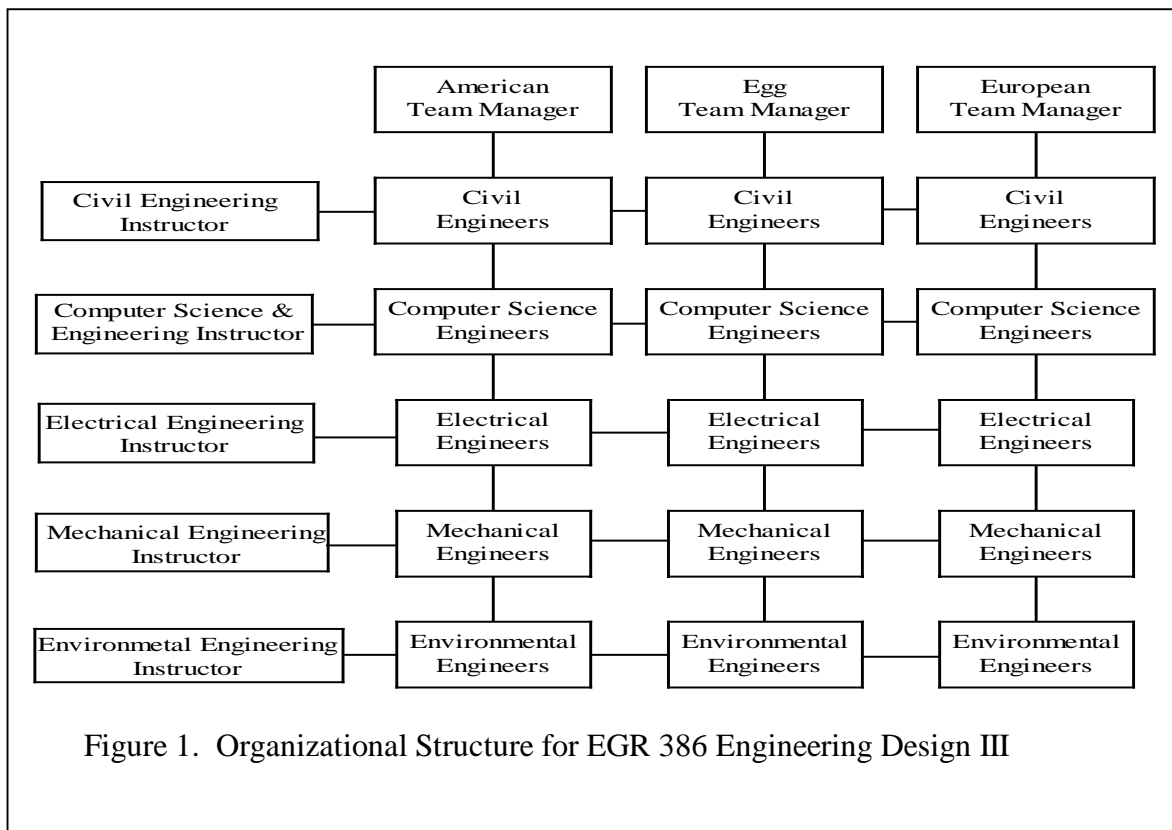


Figure 1. Organizational Structure for EGR 386 Engineering Design III

At least once a week, the undergraduate project teams came together formally to discuss the project: reporting on functional status, discussing interface problems, identifying new project tasks, and assigning short-term discipline responsibilities. The EGR 686 students managed this, helping the undergraduate students bring their project in on time and within budget, while maintaining an effective collaborative multi-disciplinary team.

3. Team Talk

Without question, the hardest job the EGR 686 students had during their practicum was understanding the paradoxical dynamics of their respective teams and then managing this complex interpersonal environment. To overcome these challenges, the graduate students used a structured monitoring technique called Team Talk.

Team Talk is a systematic technique developed by Anne Donnellon ⁶ to analyze what is actually happening in teams by listening to the talk of teams and categorizing that talk into six dimensions. Her basic premise is:

“Talk reveals the team dynamics as well as the pressures of the organization on the team and its members. But team talk does more than just reveal team dynamics; it creates them. The language that team members use as they work together has consequences.”

The six key dimensions of teams and their talk as identified by Dr. Donnellon ⁶ include:

- Identification – what group, functional or project, do team members identify with. The challenge for a manager of a cross-functional team is to impose a new and shared identify on members with discipline loyalties and functional values. A nominal team is one whose members identify with their discipline and/or function, and not with the project team.
- Interdependence – whether team members felt independent from or interdependent with one another. The defining feature of a real team is a shared responsibility and dependency upon each other to get the job done.
- Power differentiation – how team members display and use the differences in their organizational power. Displays of power in a team produces numerous negative effects ranging from the suppression of opinions to conformity of behavior. A team with a low differentiation of power among its members is a real team.
- Social distance – whether team members feel close to or distant from one another socially. Social closeness in teams serves multiple purposes: reduces attention on calculating, monitoring, and altering social debts; increases attention on task accomplishment; and reinforces team identity. A real team is one where members are socially close.
- Conflict management tactics – whether members use the tactics of force or collaboration to manage their conflicts. The existence of tactics, particularly collaborative ones that attempt to meet all concerns and needs, distinguishes a real team from a nominal one.
- Negotiation process – whether a team uses a win-lose or a win-win process. These two processes span the continuum of negotiation behavior from competition in a nominal team to integration in a real team.

4. Team Talk Results

Over a time frame of approximately four weeks during the spring 2000 semester, the graduate students learned about and applied the Team Talk techniques to their respective teams. They listened to their teams' conversation and took notes on the specific linguistic behaviors. They analyzed their data using the Team Talk audit – a guide for cueing in on specific words, syntax, turn talking, topic changing, and hesitations – to assess their team in each of the six dimensions.

Based upon the team's behavior in these dimensions, the graduate students were then able to determine their team's profile from one of five descriptors ranging from collaborativeⁱ to doomedⁱⁱ. But, more importantly the graduate students were able to identify key issues and to diagnose teamwork problems through Team Talk.

Their Team Talk analyses of their respective EGR 386 teams are summarized below – each team identified by digester shapeⁱⁱⁱ. These analyses are insightful relative to how the undergraduates form and work as a team and how the organizational features of EGR 386 and the curricular environment in engineering at NAU impact the teaming of the multi-disciplinary students.

a. The American Team – Managed and Analyzed by Charles Bersbach

I believe my team's profiles is emergent^{iv}.

The American team members identify mostly with their functional areas as evidenced by statements like “the mechanical engineers need...the environmental engineering students will give us those equations.”

The saving grace this semester was that the American team was strongly interdependent – a result of the extremely integrated project and the explicit linking of individual grades to project success. The desire for good grades (coupled with peer accountability) forced the undergraduates work as a together as a team.

Power differentiation was low – all students were on the same level. Even those students with a strong presence did not abuse their relational power, but spoke up as a merely *representatives* of their functional areas.

The team was socially close. Most team members have been in the same classes for a number of years and know each other fairly well. Nicknames and slang terminology was used frequently. Also expressions of admiration and implications of team membership were common.

For resolution of conflict, the American team used compromises about 60% to 70% of the time, and collaboration the remainder of the time. Compromise, a less time intensive and the ‘quick fix’ approach, was used for those decisions deemed less important. For the really important issues, however, the team understood the need for a collaborative process. Looking back, I now

ⁱ A collaborative team, as characterized by Donnellon⁶, is one that scores as a “real” team within the six dimensions. Its members identify themselves with the team. There is a shared perception of interdependence, low power differentiation, and social closeness. The team uses collaborative conflict management techniques and negotiates a win-win framework.

ⁱⁱ In contrast, a doomed team is one where members do not identify with each other and feel no need to work together. The members feel no social closeness. Power differentiation is high and most decisions are deferred to and made by the most powerful.

ⁱⁱⁱ These shapes include: (1) the traditional American cylindrical digester that is squat – wider than it is tall, (2) the European cylindrical shape that is sleek in profile - taller than it is wide, and (3) the innovative Egg-shape digester that makes use of its unique geometrical properties to enhance mixing performance.

^{iv} An emergent team is a team that identifies with the team project, has a moderate degree of interdependence, low to moderate power differentiation, moderate social distance, some use of collaborative tactics for managing conflicts, and win-win negotiating.

believe that the quick resolutions made through compromise ended up causing real problems – these were the decisions that haunted the team during project implementation. If I could go back to the beginning of the semester with the knowledge I have now, I would make sure the team used collaborative conflict resolution techniques. Decisions would have taken longer, but they would have been more complete, more thorough, and would have probably led to a much sleeker design.

The American team used a win-win negotiation process a majority of the time. In general, this team was very good at reforming disagreements after hearing another's viewpoint. Everyone tried to understand the whole picture prior to making a decision that benefited the team.

b. Huevos Grandes (the Egg Team) – Managed and Analyzed by Katherine H. Carels

I believe that Huevos Grandes is an emergent team.

At the beginning of the semester, the students sat together in their functional groups. As the semester draws to a close and we have a physical object that signifies our purpose, the students are identifying with the team. It's not the mechanical engineers or the computer science students, but the TEAM that is working. I think that it was smart that the team selected a name – Huevos Grandes – for themselves. It gives us a unique identity that crosses the disciplines that the name The Egg Team does not provide.

Huevos Grandes has moderate to strong team interdependency. The functional groups are keenly aware that their individual professors (the functional managers) expect different things. This has worked to differentiate the functional groups more than anything else does. For example, comments like "I have an exam in my functional area tomorrow, therefore, I have to study and won't be able to help with..." were common and impacted the teamwork negatively.

Power differentiation for Huevos Grandes is neither high nor low, but in the middle. From my own, probably biased opinion, it seems that the females on the team are less power differentiated than the males. It is more common to hear the females make apologies and disclaimers and to be polite. The males were more likely to interrupt each other and to utter challenges. However, and this is interesting, the males rarely interrupted the females.

Huevos Grandes is definitely a socially close group. The students came into the semester knowing each other from within their disciplines, but not across the disciplines. As the semester wore on, however, friendships developed across functions. I've seen cross-functional groups in the hall eating donuts together and chatting about their summer internships. They call each other from the digester lab when cross-functional questions arise. They say things like "I know you can do it, I understand, and I see your direction."

Huevos Grandes only employed conflict resolution techniques or negotiation strategies on a very limited basis. The one major negotiation I was involved with started out rather adversarial, but quickly turned into a discussion about the best way to make something work better.

c. The European Team – Managed and Analyzed by James Howard

The European team was between adversarial^v and emergent.

It was interesting to see what the different functional groups identified with. The more effective groups, like the mechanical and electrical engineers, identified with the team. The less effective groups, like the civil and computer science engineers, identified with their functional demands and little else. The civil engineers had little pride in their work, especially in comparison to the Egg team. It took them too long to remove the digester forms, the resulting prototype was ugly, and the pipe placement was sloppy.

In contrast, the electrical and mechanical engineers were very dependent upon each other, and worked effectively together. They had their arguments, but they got the job done. The computer science and engineering students should have been more dependent upon the other disciplines, especially upon the electrical engineers. As a result, the computer science part of the project did not interface as well as it should have.

Overall, power differentiation was low on our team. There were, however, two members who had a lot of personal power and the team did suffer some as a result. Both of these students had trouble with other people's ideas and were incapable of compromise. The morale of some students suffered because of these two individuals.

About half of the European team was socially close (the mechanical and electrical engineers) and the other half distant.

Conflicts were generally resolved through collaborations. For example, a major conflict between the electrical and environmental engineers on how to measure percent mixed volume was resolved after many hours of discussion between these two groups.

The European team used win/lose forms of negotiation far too often. "We have always said..." was a common comment. The electrical engineers bore the brunt of these situations, yet they were always able to modify their work to affect a win/win situation.

5. Conclusions

Prior to the use of Team Talk, the graduate students did not recognize the variety of issues that can contribute to interpersonal team tensions. After the exercise of learning about and using Team Talk, however, these graduate students gained a systematic awareness of the unique dynamics of their respective teams. Their ability to diagnose team behaviors and assess team performance was enhanced. They were able to clearly link and explain project successes and failures in terms of team dynamics. The Team Talk technique proved to be an effective tool for developing tacit knowledge of interpersonal management in a time efficient and orderly way.

^v Adversarial teams are distinctive from the other types of teams in that there is a high differentiation of power, the members are socially distant, conflict management techniques are not collaborative, and negotiation is within a win-lose framework.

“Team dynamics and behavior were lost on me prior to this class. (Through Team Talk) I now feel that I can listen and watch and tell a great deal about how the group is really functioning.^{vi}”

In addition to the development of interpersonal management skills, the Team Talk analyses provided a great deal of useful information on organizational changes or refinements that are needed to make the EGR 386 experience a more positive and richer one for all junior-level students. The graduate students’ observations suggested the following changes for EGR 386:

- less emphasis on discipline-specific content,
- more uniformity in the course requirements across the functions (e.g. the spring 2000 version had computer science and engineering students taking tests on discipline-specific content, while the civil and environmental engineering students were busy writing 20-page research reports), and
- more guidance and support in the technical aspects of the project.

The practicum component of EGR 686 was a very successful learning structure. The skills and knowledge required to manage in a technical-project, team-based environment requires not only technical skill, but encompasses cognitive and value dimensions and cultural and social processes. The practicum, achieved by vertically integrating the graduate students as real project managers of multi-disciplinary teams of undergraduate engineers, combined with classroom discussions of related literature and one-on-one mentoring effectively developed these skills and knowledge at a tacit level. The graduate students truly learned how to “think like a” manager.

“There is nothing like learning by doing. My least favorite thing about this class (EGR 686) was not getting to spend as much time with the EGR 386 students as I would of liked. I am very happy I took this class, and I have learned more in it than in any class I have taken as a graduate student.^{vii}”

“Most of the learning I did this semester was through the practicum. I feel that a hands-on management approach is the best way to learn. It was a tough experience, but an excellent way to relate the written material to real world situations. On paper, management tools and techniques seem simple to understand and use, but it takes practice to really understand all the little nuances of those techniques. They aren’t nearly as simple as they seem on paper.^{viii}”

On the other hand, this type of environment – learning while doing – in front of a crowd of possibly less than forgiving students who are dependent upon you to “do it right”, can be risky and even threatening. As much as by happenstance as by thoughtful planning, the following strategies were employed to minimize these fears and to build a positive experience:

- The EGR 386 students were educated on what EGR 686 was about, and what was being required of the graduated students.

^{vi}Reported by Katherine Carels in her course postmortem report.

^{vii} Reported by James Howard in his course postmortem report.

^{viii} Reported by Charles Bersbach in his course postmortem report.

- The EGR 386 students were educated about the processes of project management in the team setting, thereby developing an appreciation for graduate students' role and the challenges they faced.
- The EGR 686 instructor closely observed the team environments, provided timely feedback and guidance to the EGR 686 students and directly supported their efforts at all times. In addition, the EGR 686 instructor with help from the EGR 386 faculty set up organizational procedures (like contributing to the grading of team deliverables) that worked to fully integrate the EGR 686 students as important players in the junior design class.
- The EGR 386 instructors were openly respectful of the project management role and of the graduate students. There was an open, two-way communication between the two groups where both project and student information was passed freely back and forth. Even though each EGR 386 instructor had different technical objectives, these instructors were always supportive of the project and the project teams. Their evaluation of individual student performance was well balanced between project performance and discipline-specific requirements.

6. Epilogue

Although the practicum format of EGR 686 Managing Engineering Design was a success, the opportunity to offer this course in this format is no longer available. The EGR 386 instructors, which includes the lead author of this paper, have yielded to the demands of technical content in lieu of the multi-disciplinary teaming and the professional skill development that accompany this environment. EGR 386 will be offered in the spring of 2001 as separate, more traditional, discipline-specific design courses. The large multi-disciplinary design project that provided the management practicum is, for the time being, gone. This is unfortunate.

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