"You choose between TEAM A, good grades, and a girlfriend - you get to choose two!" - How a culture of exclusion is constructed and maintained in an engineering design competition team

Ms. Cindy E Foor, University of Oklahoma

Cindy E. Foor is the Associate Director/Research Associate for the Research Institute for STEM Education (RISE) at the University of Oklahoma. Her contribution to the multi-disciplinary team lies in qualitative methodologies, cultural theory and the belief that outliers offer great insight into the workings of power. Her research interests include cultural theory, the cultural/historical construction of women's identities and roles in past and present societies, and most recently, equity issues surrounding gender and underrepresented populations in engineering education. She can be contacted at cynthia.e.foor-1@ou.edu.

Dr. Susan E. Walden, University of Oklahoma

Research Institute for STEM Education, Director Sooner Engineering Education Center, Associate Director for Education and Outreach

University of Oklahoma

Dr. Deborah A. Trytten, University of Oklahoma

Dr. Deborah A. Trytten is an Associate Professor of Computer Science at the University of Oklahoma. She holds a doctorate and master's in computer science, and a master's in applied mathematics from Michigan State University. She also holds a B.A. in physics and mathematics from Albion College, in Albion, Michigan. Her research areas include diversity in engineering education, software engineering education, and educational gaming.

Dr. Randa L. Shehab, University of Oklahoma

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Abstract

Engineering student design-build competition teams provide an opportunity for engineering students to practice engineering technical and professional skills. However, as the student quoted in the title states, the opportunity has conditions attached to inclusion and acceptance. Using a case study of TEAM A based on a qualitative-mixed methods design and a cultural constructionist lens, we identify and explain how a culture of exclusion is constructed and maintained in this competition team. Primary data consists of interviews and questionnaire with TEAM A members. Additional data includes competition rules, web sites, institutional and team artifacts.

TEAM A's ethos of commitment drives a culture of exclusion and limits broad participation on the team. Core-committed members accrue the status and highest benefits available to TEAM A members. The demands of being core-committed, including an extraordinary time commitment usually precluding employment, social, and other academic activities, limit access to participation. Students who are unable to make these sacrifices are excluded from the advantages of TEAM A membership. No structural conditions were identified that mitigate this culture of exclusion. The lack of opportunity for participation may contribute to inequities that extend into students' professional lives after college.

Introduction/Background

A key component of undergraduate engineering education is the opportunity for hands-on experiential learning. Student, experiential learning, engineering competition teams (SELECT) provide an opportunity for engineering students to practice engineering technical and professional skills while engaged in competitive, design/build projects. Increasingly, SELECT are fore-fronted as the hallmark of engineering programs and are commonly featured in materials shared with prospective students and donors. Teams, especially successful ones, feature prominently in alumni newsletters, recruiting brochures, outreach and recruiting tours, and promotion of college activities. For example, when a SELECT member interviewed for this project was asked, "(D)o you believe your department, the College of Engineering and the university value SELECT," the student responded "Oh yeah, yeah. For sure, it makes 'em look good. The college always likes to throw out statistics, like, 'Oh, we're number this or number that,' but even then it is just a way to attract students. It definitely attracted me. It worked."

The number of students competing in SELECT has increased over the last 30 years from dozens to many thousands and these teams often garner significant resources from their colleges of engineering and external sponsors. However, in spite of efforts to increase participation of under-represented populations (URP) in engineering programs, participation rates of URP students in many competition teams are exceptionally low, even when normalized for engineering enrollment. Tellingly, if one examines a sampling of materials featuring successful SELECT, the overwhelming preponderance of student images is white and male.

The number and variety of undergraduate engineering student design competitions available a decade ago was documented by Wankat.[1] Numerous publications describe the advantages and disadvantages of SELECT from both faculty and student perspectives on cognitive skills, retention, social/group skills, and communication skills.[2-11] None, however, examine the role of SELECT in providing opportunities for diverse student participation in hands-on experiential learning. In the larger project, of which this study is a part, we seek to identify and explain what factors contribute to cultures of inclusion or exclusion among varied SELECT at our institution compared to corresponding SELECT at other institutions. This case study examines one engineering competition team's organizational culture at our home institution.

Research Design

Method:

Over the last thirty years as education research has redefined inequality from a standard of "equality of opportunity" to "equality of outcome," case study methodology offered an important avenue to describing and understanding the human interactions, meanings, and processes that constitute real-life institutional settings.[12] The case study is a research strategy focusing on understanding the processes present within single settings by taking advantage of rich empirical data.[13,14] Choosing to study a particular case enables a researcher to bring forth a rich description of the lived experience from the participant's viewpoint and of their intimate world of attitudes and behaviors such as can be gained only by talking with them.[15-17]

Numerous peer-reviewed sources explain qualitative methods in great detail, including the ways in which they meet standards of validity, rigor, and reliability.[18-20] More specifically, authors have addressed these same concerns with case study research, such as methodology,[16,21-23] research design,[24-26] theory application or building,[14,27,28] rigor and reliability,[12,29,30] and generalizability.[20,31]

In case study research, the unit of analysis is a critical factor. The unit of analysis may be a geographical entity such as a state, city, or neighborhood;[32] an organization or institution;[33-35] a

single individual or a class of people;[36-38] or a social entity such as a course, program, collaboration or project.[39-41]

The case study as a research tool has been gaining respect among the engineering education research community over the last 20 years.[36, 42-48] Generally using a unit of analysis of a single student or small group of students, recent examples include case studies built from different types of data collection schema but with a common theme of applying the method to explain educational phenomena as they relate to the contexts in which they occur. This paper reports on one SELECT at a large research university, located in the Southern Plains of the U.S.

Data Sources:

A quality case study uses multiple data sources to examine the historical and social forces that shape the context of the case being examined. Therefore case study methodology allows a researcher to understand a social context such as engineering education from the inside out and the outside in. The study we present here develops primarily from analysis of 10 semi-structured interviews of eight engineering students, but also observations of team activities, examination of team documents, individual academic transcripts and institutional policies, as well as web and social media sites. Initial data collection began in the fall of 2011. Team members were solicited and interviewed between March and September, 2012. Six males and 2 females participated in 1-2 hour semi-structured interviews. Two members interviewed in March (1 male, 1 female) were interviewed again in September following their team's competition.

A Preliminary Questionnaire (PQ) was administered to each student prior to the interview to capture basic demographic/socio-economic data. Participant responses to questions about employment and commuter status are included as data in this report. In addition to team member interviews and PQ, the TEAM A faculty advisor was interviewed both formally and informally. To better understand the structural conditions that might impact team culture, the web presence of the sponsoring professional society, along with major sponsoring corporations were mined for evidence of rules or regulations that would impact participation, as were documents and websites of the university, college of engineering, and individual academic departments.

The interview protocol was designed to elicit responses regarding three pre-identified factor categories: 1) extrinsic influences, 2) team or group dynamics, and 3) individual attributes, motivators and agency. Based on extant literature these categories were hypothesized to play a role in contributing to cultures of inclusion or exclusion within student experiential learning engineering competition teams. Extrinsic factors create the structural conditions of SELECT, e.g. the competition rules and the institution's policies and practices. The interpersonal dynamics within the team define and are defined by the team culture. Team cultures may emphasize a distribution of roles and even gender-based assignments. This specialization within class project

teams has been shown to limit the learning of individuals on the team.[45] Individual attitudes, behaviors, expectations and experiences are altered or reinforced when embedded in cultures of inclusion or exclusion. Not all students' interests and anticipated outcomes are served if a culture of success, defined as winning, rather than a culture focused on learning frames team interactions.

The audio files of individual interviews were analyzed using NVIVO software (http://qsrinternational.com/products.aspx). They were transcribed and coded to macro-level themes (Why did you join your team?) that are aligned with the protocol questions informed by the factor categories. Subsequent micro-coding teased apart the broader themes and provided researchers with discrete data (friends/ peers, team success, type of technology, enhance career, etc.) for analysis.

Data for this paper consist primarily of the responses by our student participants. In some instances, we have included the actual question posed by the interviewer. That text is preceded by the letter "I". Student responses are generally preceded by a member designation assigned to that participant. Due to the number of participants and because this analysis does not pivot around questions of sex or race and ethnicity, we do not include student demographics. Excluding student demographics also helps to protect the identity of the participants. Words or excerpts that appear as quotes represent the actual language of the students. Words or phrases inside parentheses ( ) have been added by authors to add context or clarify participants response. Words or phrases inside square brackets [ ] replace identifying information and are used to ensure anonymity of participants and other entities. A (L) indicates that the participant or interviewer is laughing.

Conceptual Framework:

Case studies integrate contextual and temporal data to provide a rich, nuanced understanding of student pathways particularly when integrated with explanatory theoretical frameworks. While qualitative methods have multiple traditions, contemporary qualitative methods emphasize that cultural understandings, experiences and structures are socially constituted.[49] For this analysis, we take a constructivist stance that views culture as a historically generated human process not a given. A constructivist approach to data collection and analysis views power and inequality as interwoven into all aspects of social life. A cultural construction lens brings into focus the ways that exclusion is maintained, perpetuating privilege and inequality, or conversely inclusion is granted.[50-55] As constructivists, we adopt the approach that organizational culture is not a static monolith, but rather can be unpacked to examine the material (technologies, physical structure, benefits granted), the non-material (identities, communication, jargon) and the symbolic (ceremonies, meanings) elements that people learn, produce and deploy when they commit their energy and labor to the activities of a student competition team.

This research is also grounded in a desire to effect change within the existing power structures that result in marginalization of some students. By critiquing the cultural construction evident in this case, we will demonstrate to engineering education stakeholders the importance of a positive and inclusive culture on the recruitment and retention of engineering students, especially students from historically under-represented groups. When we employ the above lenses as a starting point into the analysis of SELECT culture, we find that there are ample opportunities for investigating phenomena that contribute to both inclusion for some and exclusion for others. Phenomena considered in future analysis might include those such as sex, gender, race and ethnicity, and issues such as sex isolation and stereotype threat that arise as a result of majority/minority interaction. However, for this paper, our focus is on the ways in which an ethos of commitment shapes and is shaped by the organizational culture of one SELECT and the ways in which this ethos limits both the number and diversity of students participating on this engineering competition team.

Results and Discussion

General SELECT features:

Student design competitions are managed by professional organizations such as the Society of Automotive Engineers, American Society of Civil Engineers, and American Institute of Chemical Engineers. To participate in these competitions, students form teams to design and build an engineering artifact, usually some kind of vehicle. In addition to the design and build aspects, most competitions also include submitting, and sometimes defending, an engineering presentation, consisting of one or more of a design paper, a poster presentation, or an oral presentation. The sponsoring organizations publish annual guidelines for the design requirements, safety regulations, and competition rules.

These teams may be strictly extra-curricular, co-curricular, or constitute the main focus of a complete course within the degree curriculum, usually a design-focused or capstone course. On our campus, some teams operate under close supervision of a faculty sponsor, while others may be much more like any other student-run organization where members only see their faculty or staff advisor when paperwork needs to be signed.

Identifying funds to support the design and build of the engineering artifact is the responsibility of each team. Budgets and team size vary greatly within and across all student design competitions. One competition team at another university, with fewer than ten members indicated a recent budget in excess of $110,000. Teams secure financial support from their institutions, but also through cash and in-kind donations from friends and family, businesses,

parts and materials suppliers, and alumni. The vehicles, like their professional counterparts, are often covered with decals to recognize their supporters.

Many institutions with teams use photographs or videos of their teams in recruiting brochures, websites, and fund-raising newsletters. The team photos are used to depict students engaged in authentic, hands-on, collaborative learning in a competitive environment. The teams offer opportunities for students to apply and increase technical and professional skills, but while these opportunities are theoretically open to all engineering students, in practice, cultural and attitudinal norms limit who may participate.

For this study, we examine TEAM A as an exemplar case of one highly successful student design team who espouse an open culture, yet have consistently maintained a very limited active membership.

Case study of the culture of TEAM A:

History and Success

Formed in 1994, TEAM A is a university sanctioned volunteer organization. Similar to other student organizations, TEAM A operates under student leadership and is advised by a faculty member who provides technical consultation, but generally takes a hands-off approach. Unlike other student organizations, team activities take place twelve months of the year. Each fall semester the team begins recruiting new members, completing component designs started in the previous summer, fundraising, and initial manufacturing. Team leaders remain on campus over winter break to continue manufacturing and trouble shoot design elements. The spring semester brings deadlines for manufacturing and testing as the team prepares for competitions held in the early summer. Immediately after competition, TEAM A elects leadership for the following year and begins the design, manufacturing, testing, and competition cycle anew. In some years, additional competitions ("just for fun") are attended during the summer to audition next year's key members and give "worthy" members the opportunity to enjoy the fruits of their hard earned labors.

Since 1995, TEAM A has participated in a nationally sponsored competition or international competition every year, except one. From 2009-2011, TEAM A was ranked in the top five in over-all standings in the United States and completed the 2011 competition season in the top ten in world rankings. The perception of team success is instrumental in attracting new members:

> I: What factors went into your decision to participate on the team?
>
> Member 1: I had the time, the team history and the team culture, since we are currently ranked 1st or 2nd, however you want to talk about it. Since we are

ranked that highly in the US, I saw that on the web-site, like it is highly displayed on the front, it will tell you our position currently, so I saw that and it was like 'Wow, it's not a little team, they know what they are doing.'

TEAM A has a larger budget and enjoys greater status with administration than most student organizations. The TEAM A budget for last year was approximately $75,000, more than twice the budget allocated for the college-wide student organization serving all engineering majors and more than twice the budget of any other SELECT at this institution. Institutional funding and resources are solicited annually and secured by team members from the offices of the university president and provost, the college of engineering dean, the main department's director, and the student government association. According to the faculty advisor, 60% of TEAM A's annual budget is derived from the above institutional sources. The remaining 40% is secured in cash and in-kind donations from corporate sponsors and individual donors.

Institutional investment in competition teams helps ensure opportunities for engineering students to practice engineering technical and professional skills while engaged in competitive experiential learning design/build projects. Additional returns on investment can be realized when competition teams win at the highest level. When asked if he/she believed the college of engineering and the university value the competition team this participant responded:

Member 2: Yeah definitely, like I said before they sell it quite a bit. They realize, one, how beneficial it is to students. Otherwise, they have no reason for selling it to students repeatedly after they are already here. And two, I think they realize what a great recruitment tool it is. You can get additional funding (donations to the college) if you have a nationally recognized team, it is a lot easier to get additional funding, potentially, if more students are aware of that sort of thing. [Home department] values it also for all the same reasons.

TEAM A's longevity, popularity and success combine to provide a portal of opportunity for students to gain hands on engineering experience in a competitive environment. Successful teams provide a concrete example of engineering excellence that the institutions may foreground for recruitment and fund raising purposes.

Constructing the Current Culture

Extrinsic influences create the structural conditions of SELECT. These extrinsic factors include the rules and guidelines from the sponsoring organization that govern the competition, as well as institutional policies imposed on the teams. The 100+ page rules and guidelines for this particular competition do not include any requirements for diversity in team composition. The only restrictions are that team members must be 18 years of age, be enrolled as degree seeking

undergraduate or graduate students in a college or university, be members of the sponsoring professional society, and have medical insurance. Team members who have graduated during the seven (7) month period prior to the competition remain eligible to participate. These rules only govern the composition of team members participating at organizationally sanctioned competitions and do not impact local team composition. How teams are structured, funded, populated and valued are left to individual universities' or departments' discretion.

Institutional policies, as well as corporate and private sponsorship requirements could play an important role in shaping conditions that impact cultures of inclusion or exclusion in TEAM A. To date, no institutional polices have been identified that require any SELECT at our institution to exhibit an inclusive culture as a condition for funding or sponsorship. TEAM A members who have budget responsibilities and direct contact with institutional funding sources do not report any funding requirements, "any strings attached," that would impact the team's culture. As a voluntary student organization TEAM A is required to have a constitution or by-laws, which at a minimum define policies and procedure for the operation of the organization. A copy of the TEAM A constitution provided to our research team did not include any guidelines for team composition or participation. Of the three factor categories that were hypothesized to contribute to cultures of inclusion and exclusion, the extrinsic factors have been found to have no influence toward the construction of an inclusive culture on TEAM A.

The remaining factor categories of team structure and dynamics, and individual attitudes, motivators, and agency are examined together for TEAM A. The members who volunteered to be interviewed are so indoctrinated into the team culture that team dynamics and individual attitudes are difficult to differentiate.
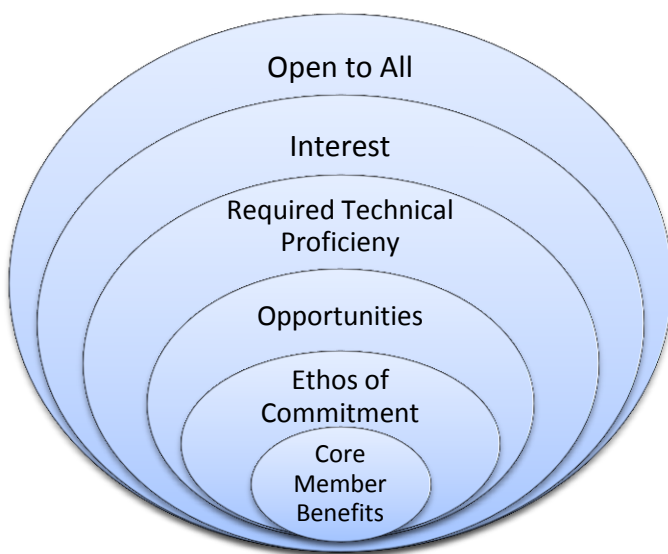

Figure 1: Illustration of the cultural constraints that restrict access to the benefits of membership.

Figure 1 graphically illustrates how the culture TEAM A members described produces an exclusive membership. The labels for the increasingly restrictive portals through which students must fit derive from the students' language used to describe their team environment and are highlighted in the discussions below.

In theory and pronouncement, membership in TEAM A is *open to any undergraduate student* at the university. However, practical,

technical and logistical requirements embedded in the culture of TEAM A constrict the portal through which a student must proceed to attain the status and benefits of membership.

New members are recruited each year through assorted avenues and technologies. Flyers are posted around the campus announcing team meeting times and locations. The team representatives and competition vehicle are stationed outside student housing during fall semester Welcome Week activities to showcase the team and answer questions. Invitations to participate are posted on the team website and Facebook page. Team representatives attend freshmen engineering classes to provide information and recruit new members. These efforts generally produce 50 – 100 *interested* "new guys" at the first meetings of the fall semester. Year in and year out, from an average attendance of 75 potential new members, participation on TEAM A dwindles to approximately seven to ten core members plus ten to fifteen peripheral members. One member states, "I think there are some people who are generally interested but kind of begin to see how much work it is and how much dedication it takes and realize they don't want to do it." (Member 3)

Current members recognize that retention beyond acknowledged interest is an on-going issue that threatens the stability and success of the team. Interest in the team does not imply any *technical proficiency* that can be applied to the team goals.

> Member 2: You really have to prove yourself, really have to prove yourself. Yeah, I mean that is something I have talked with people on the team about, possibly trying to change just because we lose so many. You know a lot of the members complain about lack of (new) members. Other competition teams have like 60 members and that puts us at a disadvantage. Only thing I can think of is that first meeting, though they are all freshmen, we start out with 60 members. I would say the worst part is trying to be established and getting people to really help you, provide you with the things you need to succeed before you know them initially.

Although described by faculty as experiential learning opportunities, the quote above demonstrates that to be accepted into the team a student needs to come with knowledge and skills ("to prove yourself). The team culture emphasizes that the students are present to serve team goals, not that the team exists to serve student learning. As indicated in the quotes above and below, a significant obstacle to participation that new members, and particularly freshmen, must overcome is the lack of technical proficiency or the confidence to seek guidance and instruction. Students who lack technical confidence, are not extroverts or are not English speakers have a particularly difficult time engaging. When asked if it is difficult for freshmen to break into TEAM A, one of the core members noted:

Member 3: Yeah, yeah I think it is. You know, it is both a positive and a negative of it being such a close knit environment. Once you are a part of it, it is wonderful, but it can be difficult to kind of break in and earn the respect of everyone. I noticed that when I joined, I never felt unwelcomed or unwanted or anything, but it was kind of difficult to make that transition from being just a guy who shows up to work every now and then to a fully accepted member.

Team members recognize that individuals who wish to get involved must assert themselves in order to gain the hands-on experience necessary to acquire the skills that will make them valued members. When asked if a student who was introverted might have a difficult time inserting him/herself, this member responded:

Member 4: Yeah, I would say so unless they had someone they know on the team to help them out. I've seen a few introverted people who have fallen off the wagon through the semester, just because, like at the beginning, there's like eight people but we only have one machine. So you have to speak up and tell someone, 'Hey, I want to try and make it this time or I would like to set it up.' And so if you don't do that, you don't learn the skills and you just keep getting set back each week.

The words used by this student to describe attrition assign fault to the students that left the team (fell off the wagon) instead of recognizing team culture that pushed them away. This perspective is reminiscent of prevailing attitudes among engineering educators toward students who leave engineering majors.

The *opportunities* for participation come through team meetings and team work days. Students who express interest through the team social media sites are informed of the next meeting time and building. Team meetings are held in the evenings twice a week to discuss team business, educate new members, and to critique component designs. Saturdays are "work" days when all members meet in the TEAM A workspace in the central engineering design building to work on design, manufacturing and testing of vehicle components. Work days are typically 10 -12 hours days and serve as the site where "new guys" model the behavior of "older guys," that is they begin to adopt attitudes, styles of dress, speech and behavior that they perceive to be characteristic of established members. An additional vehicle for reproducing the team culture exists in the form of a book written by a former team member (we have not cited this book in the references to protect the identity of the team). Through myth and rhetoric, this book extolls the ethos of commitment and glorifies the sacrifices necessary to achieve core-member benefits. Member 5 offers the following explanation:

One of our alumni, [name deleted] wrote a book about it recently, like how much dedication a person needs to be a leader on the team and he recommended we get

a couple of copies and get the new people to read it, the freshman coming in, so they can understand what we (system leads) are going through. I know last year as a freshman I didn't think it was going to be how it is. I thought it was going to be easier and less time consuming.

These acts of identity construction and confirmation are central to the neophyte's movement from the border to the center of any subculture.[56]

Maximizing the opportunities to participate requires making choices about time priorities and relationships. For married, parenting, commuting, or self-supporting students, participation at a level necessary to gain acceptance can be extremely difficult to manage. Dedicating one entire Saturday, much less many of them over a semester, would interfere with employment and family responsibilities. Of the members interviewed for this report on a predominantly commuting campus, only one lives more than five minutes from campus. None are responsible for dependent family members.

For most members, TEAM A is the only extra-curricular activity in which they are engaged:

> Member 3: The friends that I have on the [TEAM A] were really my fraternity. I really felt like, you know we spend 80 hours a week together, work together, play together, go on trips together, it really became almost a family at the end.

The use of the word fraternity implies several dimensions of exclusion: membership is by invitation only; invitees must pass through a pledge stage and initiation to become accepted members of an elite brotherhood; devotion to the group above all else is expected; and the culture is an unwelcoming or objectifying environment for females.

When asked if there were costs involved in participating on the team, Member 1 responded: "My social life, I kind of make the joke that I don't have a social life because I have a degree that matters. I can't sit in class and do homework because I sit in class and do [TEAM A] stuff." Some members have sacrificed personal relationships, grades and health in order to devote the necessary time to team activities.

> Member 2: The most difficult thing about being on [TEAM A] is probably just the hours, trying to coordinate between trying to have a girlfriend. You know there is a saying that goes **'you choose between good grades, [TEAM A] or girlfriend and you can pick two.'** I think it is just kind of a joke but it is fairly accurate. It is a pretty big commitment, especially if you really want to get involved and really be an active member of the team. So, sometimes I regret having to choose, having to prioritize other things.

As this unofficial team motto suggests, the over-riding rhetoric is always from a masculine viewpoint. The saying is not: "you can't have a social life," or "you can't have a partner," it is specific to a male perspective of not being able to have a girlfriend.

If a student must work, attending evening meetings and recurring Saturday workdays can be nearly impossible. In fact, **none** of the 8 TEAM A students interviewed worked either part time or full time. One core member interviewed "thought, believed, kind of remember" that a non-core member worked at a retail store, based on her/his unavailability for meetings and Saturday work days. For students who must work during the school year, participation is problematic.

> I: Did you look at getting involved in TEAM A when you first transferred to OU?
>
> Member 4: Work prevented me from getting involved. The main TEAM A work days are on Saturdays, that is the schedule when everyone should be coming in to work on stuff and I was working (at another job) all weekend. I would try to participate, but after a month I fell off and stopped attending meetings.
>
> I: What is it about this semester (last semester of member's senior year) allows you to participate?
>
> Member 4: I got more scholarships that help pay for my housing and everything. I don't have to work at all.

Students who are able to commit and stay involved at the highest level are recognized by peers as "core-committed members." Core members spend an average of 30 to 40 hours per week on TEAM A related activities. One core member reported working 80 hours per week during peak manufacturing and testing time. When asked if being on TEAM A was equivalent to a full time job, Member 5 responded that it was indeed equivalent, so much so that "I don't think I would be able to work outside of TEAM A." Member 6 reported "As far as hours go, I can't really put a finger on it. It is basically whenever I am not in classes or sleeping or eating." In other words, being a core committed member of TEAM A IS the students' job. Being a core committed member of TEAM A is only possible because students do not have to work, do not commute great distances, and forego other personal or extra-curricular activity.

Team members understand that only complete commitment makes it possible to gain full membership and a position of leadership in the core committed group. However, it is also this *ethos of commitment* that drives many potential members away. When asked, "(D)id you understand the time commitment when you first joined?" Member 7 responded:

> See, the guys in charge of [TEAM A] were always around, they were always up here and I was like "how do they do that?" So, I knew to be at that level you must

always be around. I used to have this thought "if I am not committing as much time as they are then they are not going to be happy with what I commit." I think that scares people off because they don't want to seem like that lazy person. I think that is a turn off to some people, like "that is too much time, I don't have that time, I care about my grades, I want to do other things." So people think you can't do [TEAM A] and other things, which is kind of true you know if you really want to get involved…So that is why I want to fully focus on [TEAM A] because I want to be a leader on [TEAM A]. I feel like I can commit 30-50 hours per week.

This quote demonstrates how the ethos of commitment is produced and reproduced in the culture of this team. New members recognize the obsessive commitment of the team leaders when they come in and understand that to reach leadership positions they have to demonstrate that same level of passion.

Mikesell notes in his discussion of the mini-Baja team at his university:[11]

Participation in Baja tends to be an "all or nothing" affair. Though Baja leaders try to encourage students who would like to contribute but cannot match the other's ardent devotion, the less committed students often feel unwelcome among the brotherhood of zealots. On this veteran team pursuing excellence and continuous improvement, it is difficult for a new student to jump in and contribute.

So it is with TEAM A. To gain peer-recognized status, to become a core member, a student must demonstrate an ethos of commitment and become one of the "brotherhood of zealots":

I: So commitment is kind of the first priority?

Member 1: Yes, like my freshman year I didn't necessarily commit fully because I had a girlfriend that lived back in [hometown] I was often gone every other weekend. My commitment dropped over time, but now that I am not seeing girlfriend anymore my commitment is fully to [TEAM A].

I: And that is recognized?

Member 1: Yeah and that's the reason a lot of the time people don't respect you as much, when you don't commit.

I: Is it more important to be viewed as fully committed or an excellent engineer?

Member 1: Both, but a fully committed bad engineer is not good either. We have a few (L).

I: So full commitment doesn't necessarily make up for being a poor engineer?

Member 1: (L) you turn a blind eye a bit more. But if you're an excellent engineer and don't commit, you're just as bad.

As these passages demonstrate, new members seeking acceptance or those wishing to achieve core status must take all opportunities to "be around" and must identify with the ethos of commitment. To "appear lazy" will lead to a negative reputation and difficulties with status advancement, and ultimately could result in responsibilities being withdrawn. The perception that last year's captain had lost commitment to the team was troubling enough that he/she was removed as team captain half way through the school year. Team members' opinions about whether the captain deserved removal were split, but the end result was that the mere perception of lack of commitment in a culture that values commitment above skill proved impossible to overcome.

Primarily through observing the actions of older members, new members attempt to embody this culture of commitment and in so doing continue the cycle. Only those members who exhibit complete commitment can become leaders whom the future initiates eventually will emulate.

In the recent past the number of core members has been as high as 15 and as low as six, but consistently remains seven to ten. Thus through these cultural constraints, TEAM A effectively limits status and benefits attainment to roughly ten percent (10%) of the students who express interest in this design project at the beginning of the year.

The denial of opportunity to attain core member status is also a denial of opportunity to receive the ***benefits of core membership***. Core members derive benefits not available to non-core members or engineering students at large. These benefits include: affirming or informing the choice of an engineering career, practicing hands-on engineering, acquiring formal and informal knowledge that eases the pathway to retention and graduation, accessing potential employers at national and international competitions, building a stronger résumé and interview portfolio, interacting with faculty and high level institutional administrators, and potentially using the vehicle as one's senior capstone project. These benefits accrue as a result of the capital that core members are able to invest in TEAM A. That capital is commitment.

The students are emphatic in their perceptions of the benefits they receive from their status on TEAM A.

Member 6: I think that is one of the big benefits of being on the team. I mean I've always known I wanted to be an engineer from a young age probably because of influence from family, but I wasn't truly sure what certain engineers could do, but being on the team shows that you can do a wide variety of things. Before I switched to [engineering major] and I was looking at the other engineering majors I was like 'ehhh, I don't know what [current engineering major] would do. My Dad is [XYZ] engineering, my uncle I think is [XYZ] engineering, and I think my grandpa was a [ZYX]. It has definitely helped reaffirm the fact that I am an engineer and that is what I am doing, that is what I want my career to be.

Member 2: The learning opportunity is actually comparable to being in an internship. You probably learn as much or more if you actively participate on [TEAM A] compared to like a hands-on internship like I had. That's what I just really enjoy, learning the theory and the things you're just not exposed to in class. For instance, like heat transfer, I'm taking heat transfer now and there are a lot of kids struggling with it and I just love being able to work on other homework in class and be actively listening then sit down and knock out my homework in about an hour or less, whereas most people are spending 4 and 5 hours on it. I would say it is probably mostly because of the team. [TEAM A] has definitely been the main reason for that.

Member 3: Probably the biggest thing is the hands-on experience. Actually having the experience of running different analysis and stuff you wouldn't normally do in class. I know a lot of employers really love it, they know you have experience with team work and leadership and the technical skills. A lot of them look at it almost like an indication of your commitment and dedication to things.

The national and international competitions are the culmination of year-long efforts for TEAM A. Travel is usually subsidized by the budget, allowing students to travel to locations they might not otherwise be able to. Team leaders determine which members will be most valuable to the team's efforts at competition and select who will travel to competitions. The total number of competition participants is limited by budget constraints, but the currency for individual consideration is commitment. Participation at competition signals to other team members that one is a core-member of the team. While competitions provide students with the ultimate hands-on engineering experience in a fun and competitive environment, there are additional benefits associated with close encounters with industry leaders and future employers.

Member 6: I've been told and I have seen at competition last year several of our seniors and head designers were offered jobs, multiple offers, some of them on the spot and some of them were 'give me a call and let's set up an interview', some of them were 'send me your resume.' Some of the guys printed their resumes on a printer we took and handed

them to the recruiter the next day. There are a lot of employers out there that are attending those competitions, such as [manufacturing company] and [manufacturing company]. A lot of the event judges are people involved in the industry. The chief design judge is head of a [manufacturing] company.

Member 5: Participation on the team is a big pretty flag on one's resume. I know [manufacturing company] recruits people from [this university] and if they don't see TEAM A they won't even take you into account. They say if you want to work for [manufacturing company] you basically have to be on the team. I know we have had several people who work at [manufacturing company] who have said that, I can't say for sure, it may be myth, but that is the perception. I know professors in class have said, "if you want to work with [specific technology] join this team [TEAM A] because that will be the biggest help for you."

Students who are excluded from core membership in TEAM A because their life positions prevent them from being fully committed to the team are not only excluded from the learning opportunities available, but also from employment opportunities. This culture of exclusion imparts far-reaching consequences beyond the undergraduate degree experience.

Conclusions: Implications for engineering education policy

Student, experiential learning, engineering competition teams provide an opportunity for engineering students to practice engineering technical and professional skills while engaged in competitive, experiential learning, design/build projects. Participation in SELECT has been positively linked to cognitive gains, enhanced technical proficiency and social/group skills. However, though participation on SELECT is presented as an open opportunity for all students, not all students have an equal opportunity to participate. Through a critical analysis of the constructions of culture in the case of TEAM A, we find that the team culture restricts a declared-open educational community to only those students who have the freedom and assertiveness to insert themselves into the organization and reject other aspects of student life. Whether an interested individual selects and seeks out membership or is actually recruited by an established member, it is necessary to consider issues such as proximity, life circumstances and even chance in the construction of opportunity for membership.

Opportunities for participation can be impacted both negatively and positively by extrinsic considerations. Of our hypothesized factor categories, extrinsic influences currently exhibit little impact on creating a positive TEAM A culture. The use by institutions of SELECT as the embodiment of the institutional identity of engineering excellence to potential donors places an intense spotlight on teams and undue pressure to win. Under this microscope, TEAM A reacted

by elevating a culture founded on an ethos of commitment to the team and its goal of winning. In this case, increasing visibility and promotion contributed to a perception of increased pressure to excel and a corresponding escalation of the requirements for commitment.

Another extrinsic factor that narrows the portal of opportunity for participation on this SELECT relates to its design as an extra-curricular activity. As a voluntary student organization, the structure of TEAM A is determined by the goal of competing in and winning a prestigious national competition. Wankat found that when competitions are not aligned with courses, students who voluntarily join a team for competition "don't have a life."[1] The time commitment for "voluntary" participation far exceeds time requirements for competitions aligned with courses. Internal expectations of students and the pressures experienced meeting those expectations are often greater than in course aligned competitions. Without the extrinsic faculty oversight associated with a course, the ethos of commitment is allowed to dominate the culture of this SELECT.

Extrinsic factors alone do not constrain opportunities for inclusion. The other factor categories, team or group dynamics and individual attributes, motivators and agency, were the predominant influences on the exclusive nature of this team. We discovered that the individual members are so immersed into the team culture that they are unwilling or unable to challenge the status quo – the driving forces in TEAM A result from assimilated group-think.

Structure, ideology, and agency are complexly interwoven to form culture. SELECT are organizations with cultures. Organizational culture represents the values, norms, and beliefs internalized by organizational members that shape the behaviors and attitudes that are **rewarded**.[57] Cultural practices and beliefs can create boundaries into and through organizations. These boundaries can be material, social and/or symbolic. The pervasive ethos of commitment operates in TEAM A as a boundary, limiting the participation of most students AND rewarding the few who can devote 30-50 hours per week to team activities.

The ethos of commitment is only possible because certain material conditions necessary for participation have been met. Those students who do not work, do not commute great distances, can forego responsibilities to relationships and other commitments and become part of the "brotherhood of zealots" derive benefits that accrue as a result of the ethos of commitment. Students whose life circumstances do not permit ample unencumbered time such that they can demonstrate adequate commitment are excluded from full membership. The ethos of commitment acts as a sorting agent, producing and reproducing status, but also producing and reproducing inequality of opportunity and outcome.

To ensure that a broader range of interested students can fully participate on SELECT and reap the academic and professional benefits that accrue through participation, institutions should

consider a nexus of appropriate policies and practices to support an inclusive culture for all students. Moderating institutional promotion of team images and competition performance might impact team goals and chemistry and thereby open opportunities for students whose level of commitment cannot meet current expectations. Competition teams organized and funded as voluntary student organizations should adhere to the policies that guide those organizations. Guidelines for acquiring institutional funding should include diversity and inclusiveness training as well as pro-active leadership development. Faculty advisors can play a stronger role in constructing team cultures that are inclusive and grounded in the desire to learn and not win at all costs. More departments could consider aligning design competitions with course requirements, thereby appropriately allocating faculty workload for the time oversight requires.

This case study is constructed and presented as an example of how SELECT culture has the potential to limit opportunities for a broad range of students. By using a case study, we demonstrate that a certain phenomenon exists and invite stakeholders in SELECT to critically examine local teams for similar phenomena. As a case study, this work should not be examined expecting generalizability; however, within the finite limits of human experience, if this ethos exists in one SELECT, it most likely exists in other SELECT.

Institutions must examine the role they play in promoting SELECT as the hallmark of engineering programs. National conversations about changing the messages regarding engineering have focused on several aspects including the need to foreground role models that appeal to all potential students so that young people can "see themselves" as engineers. The lack of diversity in SELECT very loudly counters messages of inclusion and opportunity.

Furthermore, students who participate on a SELECT composed of other students with the same backgrounds, experiences, ways of thinking, etc. are deprived of the opportunity to fully develop the necessary professional skills for working with people from different backgrounds and perspectives. A positive and inclusive culture is critical for the recruitment and retention of engineering students whose life experiences are as deep, rich and diverse as the solutions they will provide.

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