AC 2012-3169: ENHANCING A STUDENT’S ENGINEERING EXPERIENCE THROUGH PARTICIPATION ON STUDENT ORGANIZATIONS

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Enhancing a Student’s Engineering Experience through Participation on Student Organizations

Abstract

Numerous engineering related student organizations exist at colleges throughout the United States. Student organizations such as the American Society of Civil Engineers (ASCE), American Concrete Institute (ACI), Institute of Transportation Engineers (ITE), Society of Hispanic Professional Engineers (SHPE), Society of Women Engineers (SWE), and many others help produce better engineers who are more prepared for entry-level positions upon graduation. These student led, faculty advised, groups provide opportunities for students to take on a leadership role in an organization, develop study groups with other members, connect with industry professionals, and participate on a design team.

Most student organizations are typically led by the top students within an engineering program. Typically, there is a president, vice president, secretary, and treasurer for each of these student groups. The responsibilities for each of these positions provide students with leadership skills that will later be used in engineering practice upon graduation. Other valuable aspects of these organizations are the projects that are performed within each. For example, many organizations participate in regional and national design competitions, such as the ASCE Concrete Canoe and Steel Bridge Competition, while other groups assist their own schools or municipalities with engineering projects or data collection efforts. Another important source of hands-on experience for these student groups is often found through volunteering on community service projects such as Habitat for Humanity or park clean-ups. Regardless of whether the projects are competitive or not, they all have an important role in enhancing a student’s engineering education experience. While some projects help students combine classroom learning (i.e. steel design) with real world applications (i.e. steel bridge design, fabrication, and construction), other projects help introduce the many socio-economic aspects of engineering through a participatory process.

These organizations provide a great opportunity for undergraduate students to form collaborative study groups. Because these organizations are comprised of students in all classes, freshmen through seniors and even graduate students, students are able to work with other students to study for exams and assist in the understanding of homework problems and course content.

Lastly, guest speakers are routinely incorporated into regularly scheduled organizational meetings. These speakers are often industry professionals, local officials, and career development staff. Roundtable discussions between student group members and a panel of young engineers are great ways for students to ask questions about career opportunities, expectations, interview insights, and other queries students may have about school, jobs, and career paths. Such informal meetings with local professionals are good networking opportunities for students, from which internships and job opportunities occasionally materialize.

This paper summarizes the co-benefits of student organizations in engineering programs. Student participation in these groups can greatly enhance the overall
undergraduate educational experience and ultimately lead to students being better prepared for entry-level engineering jobs and beyond.

Introduction

Student led organizations at universities are a large part of the undergraduate experience. From an engineering perspective, engineering professional societies, honor societies, clubs, and the like all play an important role in enhancing student experiences. Student organizations such as the American Society of Civil Engineers (ASCE), American Concrete Institute (ACI), Institute of Transportation Engineers (ITE), Society of Hispanic Professional Engineers (SHPE), Society of Women Engineers (SWE), and many others help produce better engineers that are more prepared for entry-level positions upon graduation by affording them opportunities of leadership roles, study groups, networking with young professionals and industry, and participation on community service and competition projects.

Though faculty typically advise the student organizations, the engineering organizations are run by students. Generally, leadership positions within the organizations (President, Vice President, Secretary, Treasurer, etc…) are filled with top engineering students. Students in these positions learn invaluable “career related” lessons on leading an organization (i.e. project team), managing individuals (i.e. supervising), and teamwork. Students that participate in these organizations, but are not officers, still benefit as long as participation occurs. Generally, students within these organizations also take classes, study, and socialize outside of school together. This provides additional opportunities for support groups to help one another succeed in the engineering curriculum. Another component of participation in these organizations includes the community service and competition projects. Many organizations perform community service projects that correlate to their specific discipline. In addition, students within these organizations generally participate in design competitions competing against schools in their region or even nationally. These design competitions provide a means for students to apply classroom knowledge in a team-based setting.

A primary objective of any engineering program is to prepare students for a career upon graduation. Organizations provide an opportunity for networking with employers, recent graduates, and students from other universities. These networking opportunities often lead to internships, part-time, and full-time employment.

This paper summarizes the co-benefits of student organizations in engineering programs. These co-benefits can be realized through student leadership within the organization and organizational activities. The co-benefits include the following categories:

- Academic Career Benefits;
- Professional Career Benefits; and
- Life Experiences Benefits.

The academic career benefits are those that help students succeed within the engineering curriculum and can be measured by examining student’s grade point average (GPA), passing of the fundamentals of engineering exam, and involvement and visibility within the engineering program. Professional career benefits include employment opportunities, appraisals and promotion, and professional registration. Lastly, life experience benefits
are those in which students learn to work with and communicate with others. These benefits are much more difficult to measure; however, students in these organizations are exposed to far greater opportunities for success than students not participating.

Background
There is limited literature linking participation in student organizations with long-term academic and professional success. Kuh et. al. (2006) found that the individuals who students choose for friends and spend time with largely affect their college experiences. In a quote by Kuh et. al., “A large part of the impact of college is determined by the extent and content of one’s interactions with major agents of socialization on campus, namely, faculty members and student peers.” Astin (1993) documented peer interactions that promoted learning. These included:

- Discussion of course content with other students;
- Collaboration on group projects;
- Tutoring other students;
- Being a member of a social fraternity or sorority;
- Socializing with someone from a different racial or ethnic group;
- Being elected to a student office; and
- Spending time in student clubs or organizations.

Peer teaching and participation in peer tutorial programs have been shown to have a positive impact on learning. In addition, peer interactions had a positive influence on retention, as students were more likely to stay in school when surrounded by individuals they felt connected with. In addition, there was a connection between students involved in out-of-class experiences (co-curricular activities) and commitment to the institution and to earning a degree.

Engagement in extracurricular activities provides students with opportunities and skills to succeed in higher education (Kuh et. al., 2006). Kuh et. al. found that student engagement in educationally purposeful activities resulted in positive academic outcomes. These results were true regardless of racial or ethnic backgrounds. Engagement was even more effective for first and second year students. Vogt (2008) examined the influence of engineering faculty on the academic self-regulation and achievement of students and went on to find that the environment in which students learn affects a student’s self-assessment, learning behavior, and corresponding academic performance. Though some research has found students participating in student-specific activities are more committed to their institution and education, there is no direct research linking engineering organizations with student success.

Marjorie Nadler discussed benefits students may experience as a result of participation in student led organizations. These benefits include social and leadership skills, improvements in academic achievement, better decision-making skills, improved self confidence, relevance of course topics and curriculum, and improved performance beyond college (Nadler, 1997). Kumar (2012) discusses eight reasons students should join organizations; these include networking, social skills, professional experience, leadership skills, alumni networking, organization and management skills, and friendship and fun. Kumar goes on to discuss the advantages of joining three or four student organizations. However, Kumar also suggest that the student’s role in each of these
organizations should vary. In other words, students should become a member of the leadership team in one or two student organizations but not all of them.

Hawkins (2010) performed a study that examined the grade point average (GPA) of undergraduate students enrolled at Purdue University in the fall 2009 semester to determine if there was a connection between student organizations and GPA. Students were grouped into general students, student organization members, and student organization officers. The average GPA was calculated for each group and statistically analyzed using a two-sample t-test. The results of the study found that the student organization officers earned a significantly higher GPA than regular members of student organizations. Further, student organization participants earned a significantly higher GPA than the general student population not participating in student organizations. The data from this study shows a greater percentage of organization members and officers received a GPA between 3.00 and 4.00. In addition, the data showed that a greater percentage of students that did not participate in student organizations had a GPA less than 3.00 with greater percent differences between the member and non-member groups at GPAs of 1.50 to 2.99. These results are also supported by a study conducted by Wang and Shiveley in 2009 that showed students participating in extracurricular activities had better GPAs than student not participating. This reinforces the hypothesis that student involvement does not result in decreased academic achievement.

When examining the average GPA by gender, Hawkins (2010) found that the greatest improvement of GPA between study groups was for male student officers when compared to only male organization members. A notable increase was observed in the average GPA between general male students and member male students. Female students consistently produced higher GPA for all study groups.

Organizational Structure and Activities
Across the engineering disciplines are many organizations for student participation. These organizations range from honor societies in which students must be invited to participate or more general discipline specific organizations that are open to all students. Figure 1 is an abbreviated list of student organizations (Engineering Student Organizations, 2012):

The organizational structure of many of these student run organizations is similar. Generally, the structure follows the format shown in Figure 2. Typically, the organizations are maintained and operated by students with a faculty advisor overseeing the organizations activities. The student leadership of the organization is broken down in officer positions: President, Vice President, Secretary, and Treasurer. In some cases, additional officer positions are included depending on the size of the organization and the activities for which the organization participates in. For example, the American Society of Civil Engineers (ASCE) student chapter at the University of Colorado Denver (UCD) has two Vice Presidents. One vice president oversees student membership, recruitment, and outreach and another vice president oversees student activities. This is done to spread out responsibilities among several officers, decrease the likelihood “burnout” or “overload,” and minimize the effects of time spent on officer positions negatively affecting school work.
### GENERAL ENGINEERING ORGANIZATIONS

EWB - Engineers Without Borders
SEC - Student Engineers' Council
Tau Beta Pi (Engineering Honor Society)
Theta Tau (Co-ed Professional Engineering Fraternity)

MAES - Soc. of Mexican American Engineers and Scientists
NSBE - Natl. Society of Black Engineers
SHPE - Soc. of Hispanic Professional Engineers
SWE - Soc. of Women Engineers

### AEROSPACE ENGINEERING

Sigma Gamma Tau (Honor Society)
AIAA - Am. Inst. of Aeronautics and Astronautics
AggieSat Lab (Student Satellite Program)

### AGRICULTURAL ENGINEERING

AGSM - Agricultural Systems Mgmt. Club
ASABE - Am. Soc. of Agricultural and Biological Engineers

### BIOMEDICAL ENGINEERING

Alpha Eta Mu Beta (Honor Society)
BMES - Biomedical Engineering Society

### CHEMICAL ENGINEERING

Omega Chi Epsilon (Honor Society)
AIChE - Am. Inst. of Chemical Engineers

### CIVIL ENGINEERING

Chi Epsilon (Honor Society)
ASCE - Am. Soc. of Civil Engineers
Geo-Institute of ASCE (Graduate)
ITE - Inst. of Transportation Engineers

### COMPUTER SCIENCE

Upsilon Pi Epsilon (Honor Society)
ACM - Assn. of Computing Machinery
CSGSA - Computer Science Graduate Student Assn.

### ELECTRICAL & COMPUTER ENGINEERING

Eta Kappa Nu (Honor Society)
eIEEE - Inst. of Electrical and Electronics Engineers

### INDUSTRIAL ENGINEERING

Alpha Pi Mu (Honor Society)
IIE - Inst. of Industrial Engineers

MECHANICAL ENGINEERING

Pi Tau Sigma (Honor Society)
ASME - Am. Soc. of Mechanical Engineers
ASHRAE - Am. Soc. of Heating, Refrigerating and Air-Conditioning Engineers
SAE - Soc. of Automotive Engineers
MA - Materials Advantage
MEGSO - Mechanical Engineering Graduate Student Organization

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**Figure 1. Engineering Student Organizations**

**Figure 2. Organizational Structure of Typical Student Organizations**
**Leadership Roles**

Students that take on the leadership roles, in general, are top students within the program. Whether these students are identified by the faculty advisor or they have been active participants in the organization, the authors’ experiences have shown that these students tend to be active contributors to the engineering program with average to above average GPAs. An example of this is a number of ASCE officers since 2006 at UCD received achievement awards from both the civil engineering department upon graduation and/or the local ASCE professional organization chapter.

Students filling these leadership roles must learn non-technical skills such as people, time management, and most importantly, people management. Often the president supervises the work of the other officers providing tasks. In addition, officers must learn how to handle conflict when it arises. The author recalls an instance when two UCD ASCE officers entered into a conflict regarding an organizational activity. After a brief discussion with the officers, they were able to resolve their conflict and continue working together for the remainder of their officer term. Years later, the author spoke with one of the students, and they mentioned how the conflict was initially difficult for them; however, it was a great learning experience for them in regards to working with other individuals.

In many instances, these officers take on leadership roles after graduation. These leadership positions may be within their job or in professional societies, communities, the work place, etc.

**Organizational Activities**

A student’s engineering experience can be enhanced through participation in organization related activities. Activities may include:

- Regular business meetings;
- Special guest lectures;
- Study groups/review sessions;
- Information meetings;
- Community service;
- Regional and National Competitions; and
- Other activities.

Regular business meetings are those in which the student organization membership meets to discuss upcoming and proposed activities, status of the organization, and finances. Special guest lectures, such as those shown in Figure 3, provide opportunities for students to observe the work of a professional. These can be extremely valuable in providing an opportunity for undergraduate students to see work being performed by professional engineers as well as the opportunity to network with industry members. A similar activity that the UCD ASCE chapter organizes is a Young Professionals Round-Table. At this meeting, local young professionals attend to answer questions students may have. Generally at this meeting, questions such as what classes benefit you the most, how did you find a job, what is expected my first day of work, etc… are asked by the students. This has proved to be a highly successful event.
A great advantage of student organizations is the potential for students to come together as study groups. Student success increases when they have a support group. Student organizations provide a perfect atmosphere for academic support. First, it is very likely that a number of students within the organization are taking the same math, engineering, and science courses. Second, because the membership of these organizations consists of students classified as freshman up through senior, tutoring of the lower level students by more senior students is ideal. Informational meetings to discuss career opportunities, resume design, and professional development are frequently held by many student organizations. The UCD ASCE student chapter has a member of the university career center speak at one of the meetings to discuss where and how to get a job, resume design, and interview tips. The UCD ITE student group brought together a speaker from the private sector, a speaker from the public sector, as well as an academic to present on their jobs and facilitate a discussion.

Community service by these organizations can be a great method of taking classroom knowledge to practice. For example, members of the ASCE student group can assist the Habitat for Humanity in the construction of houses and take knowledge of structural design and analysis to practice. These types of activities help reinforce the concepts discussed in the classroom. Lastly, participation in regional and national student design competitions such as the ASCE Steel Bridge Competition (Figure 4) can be a valuable experience for the students. Many of these competitions require students to design and construct an engineering discipline product and compete against other university engineering programs. These events require students to apply knowledge learned from the classroom. Typically, the design projects require a substantial amount of time outside of class, thus, student leadership and faculty advisement is critical.
However, the competitive nature of these competitions leads to increased investment and creativity of the students participating in them. Student participation in these activities is vital to the success of the organization. However, students generally benefit from their involvement in these activities.

Figure 4. ASCE Student Steel Bridge Competition

Academic Career Benefits
Students can benefit academically through participation in student organizations. The primary benefits academically are the development of a support system, the potential to better understand course topics, and in turn, the potential to perform better academically (GPA). These benefits can be realized through:

- The development of study groups including students within the same classes;
- Tutoring of lower level students by more senior level students;
- Attendance in special guest lecture sessions;
- Participation in community service projects such as Habitat for Humanity; and
- Participation on regional and national design projects.

Professional Career Benefits
Upon graduation, students that participated in organizations while undergraduate or graduate students garnered the knowledge and tools necessary to have a successful career. These graduates received knowledge of career opportunities, job training and expectations, resume design, and career development meetings and network events as part of their student organization. The professional career benefits can be realized through:

- Leadership positions within the student organizations;
- Attendance in special guest lecture sessions;
- Attendance in networking or “round-table” events;
- Attendance in career development/resume design meetings;
- Networking with former members of the organization who are employed;
- Participation in community service projects such as Habitat for Humanity; and
- Participation on regional and national design projects.

Life Experiences Benefits
Students can also learn life lessons when participating in student organizations. The primary life lessons include: group participation and teamwork, people and time
management, networking, the need for life-long learning, and a connection to a professional organization that will help facilitate such benefits over the course of one’s career. These life experiences benefits are typically realized through:

- Leadership positions within the student organizations;
- Attendance in special guest lecture sessions;
- Attendance in networking or “round-table” events;
- Participation in community service projects such as Habitat for Humanity;
- Participation on regional and national design projects; and
- Balance of classes with participation in student organizations.

**Student Feedback**

Student feedback regarding participation and leadership in student organizations that the authors have advised has been positive. In general, students comment on having great experiences while participating in the student organization activities. Common positive themes among students have included:

- Ability to form study groups with other organization members;
- Ability to meet professionals at student and local chapter meetings (networking);
- Opportunity to participate in a design project competition;
- Opportunity to see valuable guest speakers discuss engineering related projects, management, resume building, and career opportunities; and
- Outside of school “social” gatherings.

Current and former UCD ASCE student officers were surveyed on their experiences as an officer and the effects it had on their academic career as well as their present professional career. The questions asked and their responses are listed below:

**As an officer, do you feel that it helped you academically during your time at UCD?**

“Yes, I do feel that being an officer has helped me academically. I am still pretty young in the civil engineering program and being an officer in ASCE has given me more direction as to what I want to do with my education and where I want to take my civil engineering career. Through involvement with things like the Distinguished Lecture Series and the Steel Bridge Competition I have been exposed to civil engineering concepts outside of the basics learned in the classroom.”

– Current UCD ASCE Officer

“As a learning tool and preparation for the real world, I think it is invaluable.”

– Current UCD ASCE Officer

*I think being involved in the organization, in general, is one of the best things to do while in school. You’re able to interact with fellow peers and faculty and gain a lot from it (friendship, jobs, internships, homework buddy, etc.). It makes school much more interesting and fun. For me, it has been a blast being involved. Looking back, when I started school, I wasn’t involved whatsoever and school was just that, school; something I had to do. Then, something clicked/changed and I
actually enjoyed learning, being more open and wanted to extend my knowledge past the four years. I've met a lot of great people and that probably wouldn't have happened if I stayed in my bubble.

– Current UCD ASCE Member

How has being an officer helped with your leadership skills and confidence as an engineer?

“More importantly, though, I think being an officer has helped me with my leadership skills. Given that I have a reserved demeanor, taking on the role of an officer has provided me the opportunity to hone my leadership skills and take charge both in and out of the classroom. Academically, I have held myself to a high standard so that I can be a leader and resource to my peers in the classroom. Outside of the classroom setting, my goal as an officer has been to be approachable and knowledgeable about ASCE and the civil engineering program at UCD. I have gotten to know a lot of people that I normally would have been too shy to talk to, which has made my academic experience at UCD more fulfilling.

– Current UCD ASCE Member

“I would have to say that taking part in an organization as an officer helped me learn lots of things that I wouldn't have normally learned in a classroom. One of the major benefits that it had in my academics was that it taught me leadership skills that I was able to use in my group projects. As for now in the professional world, it helps me understand a lot of decisions that my leaders have to make to run the projects and the business itself. I'm also more self motivated because I have more ownership towards my work.”

– Former UCD ASCE Member

Did the organization help you network or find a job?

“One thing I have wanted to improve on is networking. As an officer, I have had the opportunity to network with my peers, professors, and even professionals in the civil engineering community. I am hoping that with my new-found confidence and leadership, I will be able to approach job hunting with more enthusiasm and assurance.

– Current UCD ASCE Member

Did being an officer help you with your professional career?

“Other than the leadership experienced I have gained through the organization involvement, I've also learned the importance of networking within the engineering community. Having been an officer of many organizations at school and all the accomplishments my group had during those time definitely was a big factor when applying for jobs. In conclusion, my involvement in these organizations has helped me both in my academics and my professional career.”
“I think being an officer can be of great benefit in my professional career because I would have some insight in running a company or just being part of a company successfully.”

— Current UCD ASCE Officer

“In my current job, my coworkers, my managers, and even I have noticed a difference in the way I conduct myself. I take initiative, make decisions, resolve conflicts, and take on responsibility. When I first started I was timid, but now I am considered the shift lead and my managers rely on me to take charge and get things done. I believe my involvement as an officer in ASCE has contributed to that confidence and leadership ability.”

— Current UCD ASCE Officer

Conclusions
With many engineering related student organizations at colleges and universities throughout the United States, the opportunity exists to enhance student experiences, provide greater learning opportunities for students, and aid in their professional development. Student organizations help produce engineers who are more prepared for entry-level positions upon graduation by providing opportunities for students to take on leadership roles in an organization, develop study groups with other members, connect with industry professionals, and participate on design teams. In addition, many of these student organizations are chapters within much larger, industry–run, regional and national organizations. Thus, the networking within the parent organizations is extremely beneficial for students.

Participation in these organizations can benefit students in three areas: academically, professionally, and through life lessons. Students participating in regular membership meetings, guest lectures, study groups, and on design projects will be exposed to more out-of-class learning and peer support, thereby, performing better academically. The special guest lectures, design projects, community service, networking, and leadership opportunities provide additional benefits for students upon graduation. The knowledge and professional development learned through these activities help fabricate better prepared individuals for a successful career in engineering. Lastly, students can learn valuable life lessons by participating in student organizations. Important lessons related to people and time management are a major part of these organizations.

Ultimately, student participation in organizations can greatly enhance the overall educational experience and ultimately lead to students being better prepared for entry-level engineering jobs and beyond.
Bibliography


