AC 2011-975: ENGINEERING FOR AMERICAN COMMUNITIES: ENGAGING ENGINEERING STUDENTS IN MULTIDISCIPLINARY ALTRUISTIC ENGINEERING DESIGN PROJECTS

Malinda S Zarske, University of Colorado, Boulder

MALINDA SCHAEFER ZARSKE is a doctoral candidate at the University of Colorado Boulder in engineering education. Her research interests include engineering student learning, diversity and recruitment. Her current research is centered on the impacts of project-based service-learning on student identity, recruitment, and retention in engineering. She is a Co-Director of the Engineering for American Communities student organization, on the development team as well as a content editor for the TeachEngineering.org digital library, and has co-created and co-taught engineering elective courses for both high school and undergraduate students through CU-Boulder's Integrated Teaching and Learning Program. A former middle and high school math and science teacher, she received her MAT in secondary science from the Johns Hopkins University and her MS in civil engineering from CU-Boulder.

Lauren A Rockenbaugh, University of Colorado, Boulder

Lauren Rockenbaugh is a PhD student at the University of Colorado at Boulder. Her research involves project-based service learning and student motivation. Lauren is also the co-director of Engineering for American Communities, a multidisciplinary engineering student organization whose mission is to perform entrepreneurial engineering design work to create affordable living innovations for people in need in local communities.

Daria A Kotys-Schwartz, University of Colorado, Boulder

DARIA KOTYS-SCHWARTZ is the Faculty Director for the Mesa State College-University of Colorado Mechanical Engineering Partnership Program and an Instructor in the Department of Mechanical Engineering at the University of Colorado Boulder. She received BS and MS degrees in Mechanical Engineering from The Ohio State University and a PhD in Mechanical Engineering from the University of Colorado Boulder. Dr. Kotys-Schwartz has focused her research in engineering epistemology, engineering student learning, retention and diversity. She is currently investigating the use of Oral Discourse Method for conceptual development in engineering, the impact of a four-year hands-on design curriculum in engineering, the effects of service learning in engineering education, and informal learning in engineering.

Derek T Reamon, University of Colorado, Boulder

DEREK REAMON is Co-Director of the Integrated Teaching and Learning Program, and a Senior Instructor in the Department of Mechanical Engineering at the University of Colorado Boulder. He received his PhD in Educational Interface Design from Stanford University and has won numerous outstanding teaching awards. Dr. Reamon's research interests encompass the foundations of educational theory, the practical issues involved in curricular improvement, and the assessment techniques required to measure the effectiveness of new methods.

Engineering for American Communities: Engaging engineering students in multidisciplinary altruistic engineering design projects

Newly graduated engineers often find themselves working in teams of people very different from themselves, where they must engage in more integrative thinking and entrepreneurship. ABET criteria establishes guidelines for universities to teach about the impact of engineering solutions in a global, economic, environmental, and societal context, and the National Academy of Engineering's *Engineer of 2020* recommends graduating engineers be well-trained in communication, leadership, and the ability to work in multicultural settings. Nonetheless, many engineering college graduates find that their first or second post-graduation engineering job requires a set of skills different than what they learned from the formal classroom during their undergraduate engineering career[1,2].

Engineering for American Communities (EFAC) is a multidisciplinary engineering student organization whose mission is to perform entrepreneurial engineering design work to create affordable living innovations for people in need in local communities. The motivation behind EFAC is to provide engineering students with "real world" opportunities, through a voluntary student organization, that address the dynamic and global nature of engineering profession and practice. EFAC engages students in authentic design projects with real community clients, while building essential professional skills.

EFAC's core team currently consists of dedicated undergraduate and graduate students from multiple engineering departments across the College of Engineering and Applied Science at the University of Colorado Boulder. The demonstrated success of our first client project has set the course for future projects, allowing us to replicate this authentic learning experience for more students from our community and create a model that is replicable at other engineering institutions. This paper discusses the design and evolution of EFAC, a multidisciplinary service-based extracurricular student organization. Insights on organizational structure, project acquisition, student/client assessment, and lessons learned are presented.

Who is EFAC?

Engineering for American Communities (EFAC) is a recently formed Affiliated Student Organization housed within the College of Engineering and Applied Science (CEAS) at the University of Colorado Boulder (UCB), whose mission is to perform innovative, low-cost engineering design work for people in need in local communities. Today's world is a global market and a place of rapid technological change[3]. The motivation behind EFAC is to provide engineering students with academic opportunities that respond to major shifts in the engineering profession and practice[2,4]. Upon graduation, engineers find themselves working in diverse teams where they must engage in more entrepreneurship and integrative thinking[2]. Currently, there are limited opportunities for our engineering students to participate in service-learning experiences that increase these "real world" skills. EFAC is designed to meet this need – students engage in authentic design work with real community clients, to hone their technical design skills while practicing essential professional skills, such as teamwork, communication, leadership, project management, and commitment to service.

The core concept of EFAC is similar to that of *Engineers Without Borders* (EWB), a program founded at the University of Colorado Boulder that has earned local, national, and global recognition and provides engineered solutions to meet the basic needs of impoverished people around the world[5]. Our EWB students, however, struggle with the high costs of participation, primarily due to the travel expenses required to meet with and deliver products to clients around the world. EFAC differs from EWB in the fact that the student organization focuses on addressing the needs of the local communities in the Colorado Front Range region who could benefit from affordable engineered solutions. Instead of sending students overseas to complete service-learning projects, we are applying our resources close to home. This will allow us to positively impact hundreds of students and dozens of communities with a budget that is less restrictive than EWB. Our "do more with less" approach yields higher returns on our project investments.

EFAC is also modeled after other service-based programs such as Purdue University's *Engineering Projects in Community Service* (EPICS) program that serves local communities with social entrepreneurship projects[6,7,8]. EFAC follows the emphasis on multidisciplinary teams and start-to-finish design process for local community partners central to the EPICS program[8]. However, EFAC differs from EPICS in that it is an extracurricular volunteer organization instead of a for-credit, multiple year experience. This type of organization is for-the-students, led-by-the-students. The flexibility to complete a project of their choosing for a local, high-need community client without the added stress of adding more credits to an already-full workload works well for our student population looking for service activities and practice before EWB-type projects or engineering jobs.

EFAC students from different engineering disciplines work alongside peers who have similar project interests. The EFAC teams have the opportunity to practice a user-centered design approach by interviewing customers and creating innovative products to meet client requirements. Products are designed with the self-imposed limitation to be extremely affordable (cost less than one day's pay at minimum wage to create or maintain), and the purpose of the innovative products is to improve customers' quality of life or enable a higher standard of living for targeted local communities. Teams develop an initial design for review and critique by the rest of the organization as well as the client, and work with the client to see the product through to completion and installation. Some of the professional skills EFAC members practice include: the ability to identify the needs of a community client, the ability to present ideas to a non-technical audience, and the ability to work with people who are not engineers.

EFAC's core team reflects its multidisciplinary objective and currently consists of twelve undergraduate and graduate students from Mechanical, Electrical, Civil, and Environmental Engineering. Our two EFAC Student Directors from Mechanical and Environmental Engineering have experience working with community partners. Our faculty advisors, both Instructors in the Department of Mechanical Engineering, have taught a wide array of project-based design courses, mentored student design projects, and led student groups. We are actively recruiting students from the other engineering disciplines offered at UCB to create an even more authentic and multidisciplinary setting.

Figure 1: Members of the EFAC Team working on the greenhouse project

Figure 2: Partnering with Local High School Students

Program goals

The program goals of EFAC were established prior to the initiation of the organization and include the development of a multidisciplinary engineering student group that engages in authentic design projects with local community clients. By providing the opportunity to practice the professional skills needed for post-graduation success, we hope to better prepare our engineering students to enter the engineering/technology workforce. Other program goals include: 1) building community between student EFAC teams and customers in urban City and throughout rural State settings; 2) enhancing awareness of the possibilities of engineering solutions and partnerships within local communities; and 3) modeling a replicable service-based organization for other engineering colleges.

The goals are broken down into specific performance criteria. Assessment methods target the specific performance criteria and are designed to ascertain if program goals and objectives were met. The results are used for a data-driven continuous improvement cycle, which will contribute to the success of the program.

Organizational structure

Within the first year, it became apparent that EFAC would require strong leadership and organization, including explicit roles and responsibilities for each member. The structure that is currently in place has evolved over the course of completing our first project. Table 1 outlines EFAC's organizational structure, highlighting the roles held by our members. The Student Directors and Project Managers meet with the Faculty Advisors, working together as a leadership team to provide support for the individual projects, Team Leaders, Financial Manager, Communications Director, and Website Director. Please see *Appendix A* for a summary of duties associated with these roles.

Table 1: EFAC Organizational Structure

Role	Responsibilities
Student Directors	Keep the activities of EFAC in line with the organization's mission and vision. Ensure that these activities reflect what is promised to clients and funding sources. Oversee and support Project Managers, Financial Manager, Communications Director, and Website Director. Work to ensure that EFAC activities and tasks are distributed among all members. Foster an inclusive environment where all students are welcome. Expand EFAC throughout the College of Engineering and Applied Science, and the University of Colorado Boulder.
Project Managers	Serve as the communication link between the SP teams and the Director and Faculty Advisor. Oversee the progress and management of the SP teams and provide SP teams with organizational and technical support. Work with Director to expand EFAC throughout the College of Engineering and Applied Science, and the University of Colorado Boulder.
Sub-Project Team Leaders (SP Team Leaders)	Serve as the communication link between the general members and the Project Managers by following reporting guidelines. Guide and oversee the design and manufacturing activities of the general members in each SP Team. Ensure that the SP Team stays on schedule. Nurture the emotional or people component of the SP Team.
Communications Director	Provides coordination for all internal and external interactions
Website Director	Develop and maintain content for website
Financial Manager	Organize budget and track expenses

Project acquisition

Project acquisition is an important factor in the success of the EFAC student organization. EFAC has a targeted desired client that narrows the pool of possible people and organizations. These clients must provide students with engineering design work that results in an improved quality of life or a higher standard of living for targeted local communities. Student Directors spent time during 2010 calling and visiting with more than a dozen organizations and schools in an effort to explain the goals and abilities of EFAC. Some of these visits were met with enthusiasm for participation while others wanted to see more finished products before they could commit. As a result, example projects that EFAC students had to choose from this year included development of equipment for local youth or teen non-profit organizations and assistive technology devices for special needs elementary or high school students.

Our pilot project

EFAC's first project, initiated in January 2010, was to design and build the interior of a greenhouse for the *Troy Chavez Foundation*, a non-profit urban farming organization in Denver, Colroado[9]. The Foundation engages close to 300 community youth in urban farming activities to

foster responsible decision-making, self-reliance, and a commitment to "giving back" to the community. During the winter months, the garden is closed, and many youth lose touch with the program. The Foundation's goal is to have youth stay involved year-round by working and learning in the greenhouse during the winter.

Figure 3: Greenhouse at the *Troy Chavez* Memorial Peace Garden

Figure 4: Interior of unfinished greenhouse

Another organization had previously donated the empty greenhouse to the Foundation, and the Foundation had been looking for the resources necessary to transform the bare greenhouse interior into a space for students to grow vegetables and participate in various curricular activities and community ceremonies.

On our first site visit, EFAC worked with the client to identify three major design/build areas that needed to be addressed: 1) Floor installation: create aesthetic, functional floor space for gardening and attending lessons and ceremonies; 2) Planting space: design & install 3' x 2.5' adobe planter beds along interior perimeter; maximize available growing area via give extra hanging vegetable beds; 3) Water conservation: design and install simple rain/snow catchment and distribution system.

We began the project in March 2010 and had planned to finish the project in August 2010. However, our new target time for completion is March 2011. Although later than initially planned, this will still allow the Foundation's staff to begin teaching in the greenhouse this winter, and the students will be able to raise seedlings for spring planting.

Additional projects

For the spring 2011 semester, student teams have made the decision to move forward with three additional community projects. The first product intends to help a local, low-income 12th grade student with Cerebral Palsy feed himself more independently. The second product partners with a local elementary school that serves a low-income, gang-activity area to develop robust outdoor equipment for locking bikes during school hours. The third project intends to address playground equipment that currently is not accessible by the special needs students at a local low-income elementary school with a high special-needs student population. The client representatives for

these projects are open to all types of engineered solutions and enthusiastic about learning from our EFAC students.

Program assessment

Throughout the EFAC organization, an emphasis is placed on a continuous evaluation cycle, with quantitative and qualitative assessment methods employed to assess the program's success in meeting its goals. Both EFAC student and clients feedback is used to inform the program direction prior, during, and at the completion of each project. Quantitative methods include pre- and post- student attitude surveys in which students rate their motivation for studying engineering and attitudes towards community service on a Likert-type scale. Clients rate their satisfaction with the project and students teams in a similar manner. Qualitative methods include open-ended survey questions that provide a richer data set than quantitative questions alone and are useful for supplementing and explaining numerical results. EFAC students and clients will report on the strengths, challenges, and suggestions for improving the program and are prompted to provide anecdotal feedback. While attitudes were not gathered initially for the inaugural project, the following examples of assessment results from fall 2010, shown in Figures 5-6, illustrate this evaluation cycle. It should be noted that there are limitations regarding the EFAC data. Currently, this data is strictly being used for program improvements. With a student group size of 12, statistical analysis will not be performed until several years of data is collected from EFAC student participants, or the organization is piloted at additional campuses.

Results from the current project

EFAC students this past fall were queried on their satisfaction of the initial project after its completion. Students were asked to rate their satisfaction of the project on a scale of 1-10, with 1 equivalent to 0% satisfaction and 10 equivalent to 100% satisfaction. Figure 5 illustrates the mean response rate on the student satisfaction questions thus far (n=6). Overall, students wanted more complexity in the project (mean = 6.33) and discovered the difficulties of working on multidisciplinary teams (mean = 8.17). They were satisfied with the flexibility (mean = 10.0), resources associated with their projects (mean = 10.0), and the scheduled time to complete the project (mean = 10.0).

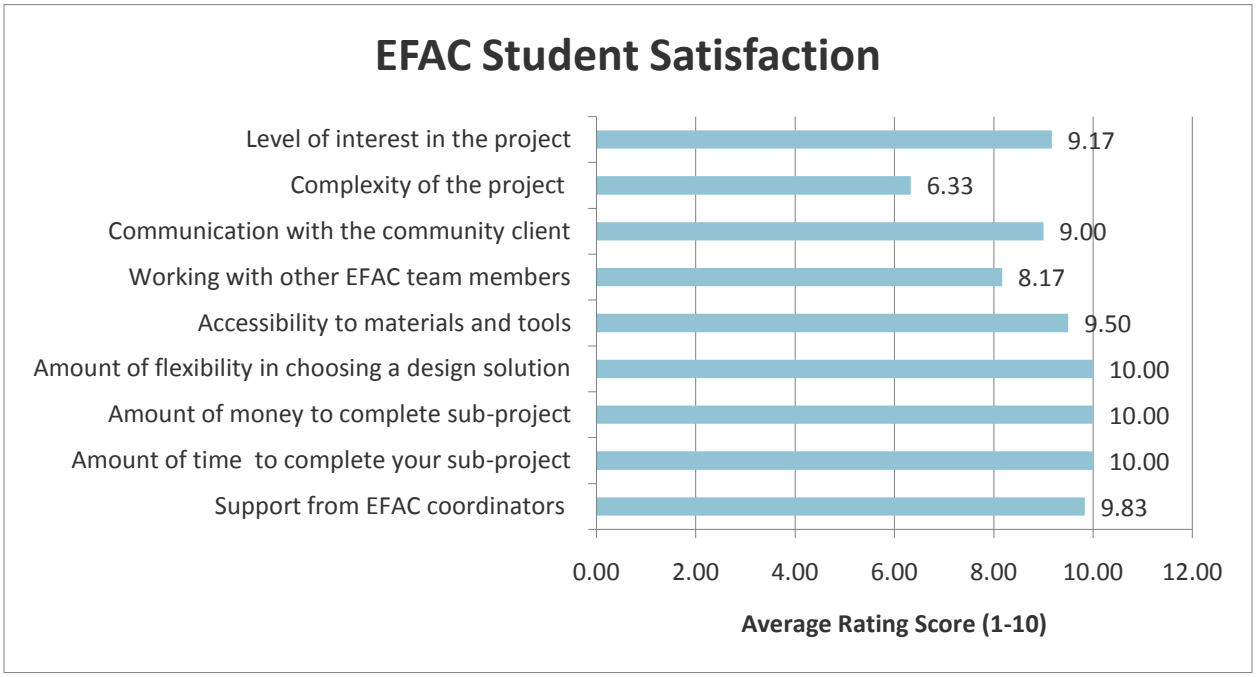

Figure 5. EFAC Student Satisfaction (n=6)**.** Graph shows mean scores of student satisfaction on a scale of 1-10, with 10 equivalent to 100% satisfaction.

During the fall post-survey, EFAC students were also asked to offer their top suggestions for improving the program. The responses varied, ranging from stricter deadlines to facilitating communication among team members. One student commented:

> *I know it was more or less the difficultly that resulted from trying to balance the schedules of multiple people, but I think the project took too long to complete.*

Another EFAC member stated:

> *(Include) a few more meetings for motivational purposes since it is sometimes difficult to keep your mind on the task when it is not being forced on you.*

Overall, the students indicated that they were satisfied with the project and would continue to engage in and recruit for the EFAC organization.

Also, this fall we administered a short "client-satisfaction" survey to our first client. The client was asked to rate her satisfaction of the project on a scale of 1-10, with 1 equivalent to 0% satisfaction and 10 equivalent to 100% satisfaction. One of the questions asked our client to rate her level of satisfaction with the project and her experience interacting with our team. As seen in Figure 6, our first client was most satisfied with: communication between her organization and the EFAC Directors (mean = 10.0), professionalism of EFAC student members (mean = 10.0), quality of the completed project (mean = 10.0), and the creativity of the final project (mean = 10.0). Our client was not entirely satisfied with: communication between her organization and EFAC student members (mean = 6.0), how well the project met her organization's needs (mean = 9.0), and the completion of the project in a timely manner (mean = 8.0).

Figure 6. EFAC Client Satisfaction (n=1)**.** Graph shows mean scores of client satisfaction on a scale of 1-10, with 10 equivalent to 100% satisfaction.

Our client did report that she would recommend EFAC to another organization. Lastly, when asked to "provide any suggestions or feedback to help improve EFAC's future work with organizations," our client responded:

> *Our organization is very grateful for the willingness of these young students to participate and help. We always say 'never look a gift horse in the mouth.' With that said, we appreciate all the participation and effort made to complete the project. Any time that has been given we are grateful for.*

Overall, our team is pleased with the level of satisfaction of our first client. Her feedback has helped us to more specifically identify aspects of our organization that need to be improved as we transition into our second project.

Lessons learned

Our first year has been a humbling experience, especially for those of us who held Student Director or Project Manager roles. One major challenge we faced was the time commitment. As much as they wanted to, it was difficult for many EFAC members to devote the amount of time that would have been required to finish the project in a timelier manner. Our initial planned completion date was August 2010; however, this date was moved to February 2011. In the future, we may be able to award independent study credit to interested students who commit a certain number of hours per semester to EFAC. This would require that we implement more academically rigorous activities to fulfill the CEAS independent study criteria.

Another major obstacle we faced was accountability. In the beginning stages of the project, we relied too much on the intrinsic motivation of our EFAC student members. In other words, we did not set clear expectations, rules, and consequences for certain scenarios – especially the common situation of students committing to projects, using EFAC funds to purchase supplies, and then abandoning the project due to a lack of time or interest. We approached this problem by instigating more specific guidelines, roles, and responsibilities for each EFAC member, and a general rule that EFAC membership would be sustained only if that member continuously demonstrated the maturity, professionalism, and follow-through necessary to successfully complete engineering projects after graduation.

At the same time, the loss of interest and participation by some EFAC members represents a more fundamental challenge faced by our organization – one that has caused us to more critically assess how well our first project aligned with students' interests, whether the time commitment was too much for students, and how much the students value the experience they gain from participating in EFAC. As a team, we are in the process of reflecting on these questions. Fortunately, we do have plenty of interested and committed members to begin our two new projects this spring.

EFAC will continue to expand throughout the College of Engineering and Applied Science, and the University of Colorado Boulder. One of our goals for this coming year is to identify a source of funding that we can use to sustain EFAC as a program. A well-defined evaluation cycle can help secure external funding. EFAC reviewed its evaluation methods and, similar to other service-learning initiatives such as the University of California, San Diego's *Global Teams in Engineering Service* (TIES) program, developed new assessments grounded in social science and education research[10]. We have revised our assessment instruments to study the impact of service-learning on our participants multiple times throughout the course of each project and will collaborate with other programs on gathering data around the impacts of service-learning on engineering students and the community. We hope to also address the shortcomings of low response rate within our current members.

From our lessons learned, we have generated recommendations (outlined in *Appendix B*) to help other student organizations.

Conclusion

As an engaging part of students' education, the EFAC organization creates an opportunity for students from all engineering disciplines to participate in altruistic engineering design projects while exploring the social impact of technology that improves the happiness, health, and safety of local impoverished communities. EFAC is an outlet for multidisciplinary students who want to apply their educational investment to make a real difference in their community.

Our first project has been a success, with multiple enthusiastic clients and projects ready for the spring and subsequent semesters. Assessment cycles are in place to rigorously evaluate the programs impact on student motivation, intent to complete and engineering major, and attitudes towards teamwork and community service. We will also continue to assess student and client

satisfaction with the program. We envision the innovative EFAC model to spread to other universities, and we are committed to blazing the trail.

References

1. Accreditation Board for Engineering and Technology (ABET). "2011-2012 Criteria for Accrediting Engineering Programs," retrieved from http://www.abet.org/forms.shtml (accessed March 2011).
2. National Academy of Engineering. (2004).*The Engineer of 2020: Visions of Engineering in the New Century.* Washington, D.C.: The National Academies Press.
3. National Academy of Engineering. (2007). *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. Washington, D.C.: The National Academies Press.
4. Shuman, L., Besterfield-Sacre, M., McGourty, J., "The ABET 'Professional Skills' – Can They Be Taught? Can They Be Assessed?," *Journal of Engineering Education*, Vol, No 94, January 2005, pp. 41.
5. Engineers Without Borders-USA, "About Us," http://www.ewb-usa.org/about.php, accessed January 10, 2011.
6. Immekus, Jason C., Maller, Susan J., Tracy, Sara and Oakes, William C. "Evaluating the Outcomes of a Service-Learning Based Course in an Engineering Education Program: Preliminary Results of the Assessment of the Engineering Projects in Community Service - EPICS," *Proceedings*, 2005 American Society for Engineering Education Annual Conference & Exposition, Portland, OR, June 2005.
7. Matusovich, Holly, Follman, Deborah and Oakes, William. "Work in Progress: A Student Perspective - Why Women Choose Service-Learning," *Proceedings*, 2006 Frontiers in Education Conference, San Diego, CA, session S2G, October 2006.
8. Coyle, E. J., Jamieson, L. H., & Oakes, W. C. (2005). EPICS: Engineering projects in community service. *International Journal of Engineering Education*, *21*(1), 139–150.
9. The Troy Chavez Foundation, "Home," http://thetroychavezfoundation.weebly.com/index.html, accessed January 15, 2011
10. Bratton, Mandy. "Work in Progress: Capturing the Learning in Service-Learning," *Proceedings*, 2010 Frontiers in Education Conference, Washington, D.C., session F4D, October 2010.

Appendix A: EFAC Organizational Structure

Role	Responsibilities	Duties
Student Directors	Keep the activities of EFAC in line with the organization's mission and vision. Also ensure that these activities reflect what is promised to clients and funding sources. Oversee and support Project Managers, Financial Manager, Communications Director, and Website Director. Work to ensure that EFAC activities and tasks are distributed among all members. Nurture the emotional or people component of the team by creating an inclusive environment where all students are welcome. Work to expand EFAC throughout the College of Engineering, and the University.	• Serve as the primary feedback loop: monitor EFAC's activities, evaluate these activities to the EFAC's set goals and responsibilities, and provide feedback to various groups • Provide direct support to Project Managers • Synthesize information from Project Managers, EFAC faculty advisor, and SP weekly reports to create agendas for general (monthly) meetings • Oversee general meetings • Check-in with Financial Manager, Communications Director, and Website Manager on a biweekly basis, or as needed • Create agendas for biweekly meetings with Faculty Advisor and Project Managers • Work with Project Managers on student recruitment, campus presence, student training, and project acquisition
Project Managers	Serve as the communication link between the SP teams and the Director and Faculty Advisor. Oversee the progress and management of the SP teams and provide SP teams with organizational and technical support. Work with Director to expand EFAC throughout the College of Engineering, and the University.	• Provide direct support to SP teams • Oversee SP team design and manufacturing activities • Oversee progress of SP teams to help SP teams stay on schedule • Collect SP teams' weekly reports • Provide SP teams with feedback and bring questions to Director • Contribute to meeting agenda for biweekly meetings with Director and Faculty Advisor • Run a portion of the general (monthly) meetings • Work with Director on student recruitment, campus presence, student training, and project acquisition

Sub-Project (SP) Team Leaders	Serve as the communication link between the general members and the Project Managers by following reporting guidelines. Guide and oversee the design and manufacturing activities of the general members in each SP Team. Ensure that the SP Team stays on schedule.	• Create and maintain a project schedule (Gantt chart) • Arrange weekly meetings with members in SP team • Submit weekly reports to Project Managers • Bring any questions (design and manufacturing, team dynamics, etc.) to Project Managers • Attend general (monthly) meetings and deliver short presentation about SP team's progress • Keep track of building materials • Foster on maintaining a non-competitive and non-exclusive environment for new members • Mentor new members
Communications Director	Provides coordination for all internal and external interactions	• Send agenda (prepared by Director) and meeting time/location for general (monthly) meetings at least one business day in advance to team members • Compile contact information of all members • Record minutes during the general meetings • Email meeting minutes within 24 hours to all members • Respond to emails from students interested in joining EFAC • Communicate with organizations outside of the team (i.e. community partners/clients)
Website Director	Develop and maintain content for website	• Work with Student Directors to modify and publish existing website • Maintain Blog page • Maintain Member page • Update webpage with activity info (calendar of events, weekly meetings, etc.) • Publish meeting minutes on website
Financial Manager	Organize budget and track expenses	• Maintain budget spreadsheet • Make copies of all receipts • Submit receipts • Send budget spreadsheet to Director on the first of each month • Contact people who have committed funding to EFAC

Appendix B: Summary of Lessons Learned

From our lessons learned, we have generated the following recommendations to help other student organizations.

Clear and Common Focus	EFAC directors, project managers, student members, and community partners must share and commit to clearly articulated and common goals. Meeting frequently – both formally and informally – helps to ensure that the team's activities stay aligned with the organization's mission and vision.
Mentorship	Sometimes, undergraduate students may not yet posses the skills necessary to manage real projects and can greatly benefit from graduate student mentorship. In turn, this offers graduate students the opportunity to strengthen their own knowledge and skills through the process of teaching others.
Accountability	Implementing clear and consistent rules and consequences help ensure that all members regularly attend meetings, follow through with project responsibilities, and meet project deadlines. EFAC directors must work to ensure that rules and consequences are enforced fairly and consistently in each situation.
Leverage Resources	Select projects for which the necessary resources are most available. The acquisition of project equipment can be expensive; hence, it is helpful to select projects that can be completed using existing resources (i.e. students' machine shop and support staff). Also, local businesses often provide donations and discounts for student projects.
Realistic Expectations	For some students, participation in EFAC represents their first authentic, hands-on engineering experience. EFAC directors should set realistic expectations in regards to the complexity and craftsmanship of project deliverables.