



Service-Motivated Students' Transitions To Industry

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Service-Motivated Students' Transitions to Practice

Abstract

With a growing emphasis on developing holistic engineers, many engineering educators are turning to service-based pedagogies to help students gain broader perspectives of their roles as engineers in society. The explosive growth of Engineers Without Borders (EWB) and the rise of programs such as Purdue's Engineering Projects in Community Service (EPICS) and Michigan Tech's D80 program exemplify how both students and institutions highly value such activities. Research into the effects of activities such as these has shown that students gain a greater understanding of their civic and social responsibility, awareness of the world, and increased academic, personal and professional advancement. There remains, however, significant uncertainty about what happens when these students leave school and enter the engineering profession, and to what degree they are able and willing to continue participating in engineering service.

Engineering service opportunities and value in the workplace were explored through interviews with twelve engineering company employees. The employees were engaged in engineering service and described varying degrees of support from their companies. The engineering firms ranged from environmental engineering consultants to large construction to the aerospace industry. Also, eight alumni of Learning Through Service (LTS) activities in college (similar to EWB) were interviewed about their pathways since graduating from college. All of the interviews lasted thirty to sixty minutes using a semi-structured approach.

The engineering employees had a wide range of experiences in the ways and means to which their service aspirations were supported. Some firms offered an extra week of paid time off for engineering service-related travel while at other companies employees received informal accolades and invitations to give lunchtime presentations. Employees described the ways they were able to present the value of engineering service activities to decision makers in their firms (high-level engineers to marketing managers) in order to be supported. The twelve employee interviews and eight alumni interviews painted a complex and encouraging picture of the status of engineering service in the workplace.

Background

The Engineer of 2020 describes that engineers need to be able to address the increasingly complex and global problems of the future, and feel responsible to society in the projects they work on¹. From natural disasters to cybersecurity, competent and compassionate engineers have never been in higher demand. Unfortunately, the U.S. has too few engineers at present to meet the demands of the future².

As the NAE's *Changing the Conversation* describes, engineering needs to change its image in order to attract more and diverse engineers in the US². Not only are engineers innovators and problem-solvers, but they are change-makers that can benefit society in positive ways - a strong message that could be useful in shifting public perceptions of engineering and attracting a more diverse population into the profession. Corporate participation in *pro bono* work could further

support this view of engineering as benefitting society^{3,4}. The proliferation of EWB at the professional level is encouraging, but the ways that engineering companies support these efforts is important to understand.

Learning Through Service (LTS) - including service learning, graduate degree programs focused on engineering in developing communities, and extracurricular activities such as Engineers Without Borders (EWB) and outreach, are becoming more popular as a way for students to learn the social context of their engineering discipline⁵. A growing number of engineering students are involved in these LTS activities every year. EWB has over 14,000 individuals involved and new chapters are constantly being founded⁶. Curricular programs like EPICS at Purdue that allow students to engage with local communities for beneficial engineering projects are also expanding to more universities and even high schools⁷. Research has shown that students who have taken service learning courses tend to have higher levels of social responsibility⁸. Additionally, those in project-based service learning courses have improved learning outcomes and ability to practice design⁹. These positive effects associated LTS are juxtaposed with a growing “culture of disengagement” that has been found in engineering programs such that students overall tend to lose concern for the ways their engineering impacts society over the course of their degree¹⁰.

LTS activities and courses such as those described above may also help with the recruitment of more women into engineering¹¹, where currently less than 20% of engineering degrees are earned by women¹². Studies have shown that girls in middle and high school discount engineering as a potential major as they perceive the profession as uncaring¹³. Further, less than half of female engineering graduates actually persist into an engineering career¹⁴ – if only 25% of those who left decided to stay instead, 220,000 engineers would be added to the profession in the U.S.¹⁵ Their reasons for leaving engineering have been studied to a certain extent, but possibly a lack of support for service efforts, which women find more important than men, could contribute to the ‘chilly climate’ described in other publications¹⁶⁻¹⁸. More broadly, though, research has shown that if engineering aligns with one’s sense of self, one is more likely to persist in the field¹⁹, and women tend to identify less with the engineering profession^{20,21}. In a study of EWB-USA members, women tended to identify more than men with their characterization of an EWB-USA member, which included descriptions such as “humanitarian” and “passionate”²². If one sees that the engineering profession values service and benefitting others, they may be more likely to persist in engineering and participate in service throughout their career.

This study aims to (i) understand the support mechanisms and structures available to engineering professionals involved with engineering service practices and (ii) find how engineers develop and sustain this support in their workplaces. As engineering service grows at the professional level, through EWB chapters and outreach activities, understanding the ways companies are engaging with the process is of great interest.

Methods

In the Fall of 2013, engineers who were known to be involved with professional EWB-USA chapters were emailed to request a 30-minute interview over the phone. All materials including emails, consent forms, and interview questions were approved by the University of Colorado

Human Subjects Research Institutional Review Board (IRB). Some interviewees also recommended colleagues to contact to learn about their experience at a different company, so the sampling method became snowball sampling. In general, the employee who knew the most about the engineering service program at the company was interviewed. Companies varied in size and discipline: small to large, environmental to aerospace. Also, employees were interviewed from both the industry (those that make or build something) and consulting (those who design, calculate, or specialize on projects run by another company).

Some of the interviewees were interviewed with the goal of understanding how employees are supported in the workplace for their engineering service endeavors (Protocol 1, given in Table 2). The rest of the individuals were alumni of LTS programs who were interviewed with the goal of understanding their pathway following their involvement with engineering service in college (Protocol 2, given in Table 3).

Table 1: Engineering Alumni Interviewed

<u>Interviewee</u>	<u>Position</u>	<u>Engineering Discipline</u>	<u>Company Sector</u>
Interview Protocol 1 – Engineering Employees			
Tamara	Communications Specialist	Construction	Industry
Daniel	Senior Project Manager	Civil/Construction/ Environmental	Both
Kristen	Project Engineer	Water	Consulting
Cole	Project Engineer	Civil	Consulting
Paul	Wastewater Process Specialist	Water	Consulting
Garrett	Technical Bid Specialist	Mechanical	Industry
Cynthia	Senior Engineer	Mechanical	Industry
Rodney	Senior Project Engineer	Structural	Industry
Elise	Hydrogeologist	Environmental	Industry
Don	Test Engineer	Aerospace	Industry
Max	Senior Mechanical Engineer	Mechanical	Industry
Ethan	Senior Mechanical Engineer	Aerospace	Industry
Interview Protocol 2 – LTS Alumni			
Hank*	Project Engineer	Environmental	Consulting → Family Therapy
Victoria	Project Engineer	Environmental	Consulting
Amy	Project Manager	Water	NGO

Derek	Sanitation Program Manager	Water	NGO
Jeff*	4 th Grade Teacher	Education	Public
Kim*	Project Engineer	Water Resources	Consulting
Phillip	Project Engineer	Geotech/Environmental	Consulting
Vanessa	Project Manager	Structural	Consulting

*left the engineering profession after graduation

Table 2: Protocol 1 Interview Questions

What pro-bono or community service opportunities are available for employees?
How do employees find out about these?
Do you notice that there is a “type” of employee that gets involved in these?
Similarities in background or prior experiences? Personality? Role in the company? Age?
To what degree are these supported? Paid time off? Extra unpaid vacation allowance? Organizational?
How active are these programs? What percentage of your company participate? How did they begin?
Do you believe that these programs are part of what attracts engineers to apply here? Are they used in the marketing/advertising/branding of the company?
Do you have any other comments about the company culture towards community service and pro-bono work that you would like to share? Any questions I should have asked?

Table 3: Protocol 2 Interview Questions

Describe experiences in your undergraduate or graduate education that influenced your view of the engineering profession.
Describe post-collegiate experiences that have influenced your view.
What has been your career path after graduation?

Interviews followed a semi-structured format where interviewers were allowed to ask follow-up questions to allow for more elaborate responses. Interviews lasted from 30 to 60 minutes and were performed by one of two researchers over the phone, on Skype, or in person depending on the preference of the interviewee. Interviews were transcribed verbatim using voice recognition software, then edited to match the conversation exactly in Microsoft Word. All interviewees were given a pseudonym using typical methods²³. As the first round of interviews was exploratory, inductive coding methods were used to allow themes to emerge from the interviews themselves²⁴.

Analysis and Results

Employees described a variety of support mechanisms for their engineering service work. At one end of the spectrum, employees received verbal praise and made lunchtime presentations to share their experiences with their co-workers. Some employees were pleased with the fact that the company was flexible in allowing them to take time off (using personal vacation time) for their engineering service endeavors. At the other end of the spectrum of support, some companies provided up to one week of paid vacation and funds for travel related to engineering service. The following stories from individuals serve to illustrate the diversity of support by employers and respective levels of satisfaction by employees.

Garrett and Cynthia, both mechanical engineers, received very little official support for their service work. Garrett worked at a firm based in Denmark, and perceived that “there’s no PR to be gained from supporting anything (volunteering).” Additionally, the company had been struggling financially, and they were not in any position to start financially supporting volunteer efforts, or at least that was how Garrett felt, so he did not ask. Cynthia spent a tremendous amount of time working for EWB and another organization in Haiti. She described the situation in her company, “They will match \$10 an hour up to \$1000. So I get \$1000 grant so that’s nice for my organization, but that’s not nearly as nice as if they gave me some support to have more time to do my work.” She went on to describe her dissatisfaction with the support that contributed to her leaving her senior engineering job to work full-time in Haiti. There was not enough time to manage both without support.

Ethan described that he did not have much financial support for his engineering service activities from his large aerospace employer, however there was a lot of interest from his co-workers to hear what he was involved with and to get involved themselves. Despite the low level of formal support from Ethan’s company, he remained satisfied, saying, “...the managers themselves have been fantastic. When I have a trip coming up, and I say here’s what I’m doing, I’m planning this trip, and I want to be a part of this and then they are happy to let me take the time off, and I take vacation time.” Part of the reason that Ethan’s company may not have officially supported his EWB work is that he was being careful not to force the relationship: “I haven’t been pushing it to the company to like recognize our chapter and I think that that should happen kind of organically.”

Elise worked at a small environmental engineering company which was seeing a growth in the number of employees who were asking for financial support in order to do engineering service work. At the time of the interview, the company principals in her branch had decided to develop a “charitable contribution fund” in order to help employees do service. Prior to the development of this fund there were no official ways to request funding. Elise described the process to “[write] up a kind of a proposal on my own, like this is the kind of volunteer work I have been doing over the past year for this project and this upcoming trip like the [] trip, for example, is going to include all of these components and my expertise would be useful because of X, Y and Z and I think that this opportunity is good for me for the following reasons.” This shift in Elise’s companies’ approach, by setting up formal systems to fund engineering service based upon a call for support from their employees, seems to be a key step for companies to officially support engineering service.

Max worked in the mechanical engineering industry and had a mid-level position in the company. Max became involved with EWB and realized that not only was this a great way to volunteer and use his skills, but he was able to gain leadership experience on these projects that would not have been possible until years later in his engineering career. He said that "...it's seen as an opportunity to develop those leadership skills in an engineering organization before you have do that..." As he came to realize this, he shared with his superiors and eventually had a meeting with the vice president of the company to explain the value of EWB involvement, and to ask for support from the company, "He saw what I was talking about and he was immediately on board." Max continued, "...it's seen as an opportunity to develop those leadership skills in an engineering organization before you have do that (on the job)..." He efforts to develop a support system for EWB worked to some extent, but the company was hesitant to make it a policy due to the fear that it would be taken advantage of to just get paid time off. At the point of the interview, the company allowed individual managers to make decisions about extra paid leave based on the performance of the individual.

Cole was the leader of a company-supported EWB group. This international consulting company had EWB groups at many of their offices, so they supported both financial and technical expertise networks for their employees to tap into. Cole was paid for a couple hours per week to manage the company-wide EWB group. This group was publicized prominently and used in recruitment efforts by the company. Cole described that the company recognized the benefits of employees' involvement with EWB, similar to Max's experience. The difference, though, was that Cole's company is happy to publicly and systematically support EWB efforts.

Tamara, Kristen, Victoria, and Paul worked at firms whose support was at the highest end of the spectrum. Each received an extra week of paid vacation as well as travel expenses paid while they were on their engineering service projects. This was a significant commitment by the company. Kristen described that this was a fairly new phenomenon: "Up until last year, nobody else, nobody else's company did anything to support their involvement. People had to use their own vacation time, they had to pay for the travel expenses all on their own." These employees seemed quite content with this system of support. For some, this even played a factor in their choosing their company when searching for jobs.

Discussion

The diverse examples given above show that the engineering field is not unified in its ways and means of supporting engineering service. It seems, however, that more and more firms are formally supporting their employees in doing engineering service, either through financial contributions, extra paid time off, or both. As a profession, perhaps engineering could learn some from law or medicine that are able to publicly report how many hours of *pro bono* work their profession performs²⁵.

First, in terms of "changing the conversation," engineering needs to improve its public image. The message around why someone should get into engineering should be as much (if not more) "because I want to help people" as "I am good at math and science and I enjoy tinkering." While talking about the potential benefits of engineering can be important, showing the efforts of those involved with engineering service can be far more impactful. This may be a particularly powerful message for populations who seek to help others through their profession and would

tend toward medicine. Perhaps engineering could be framed to show that it is also a professional pathway that can achieve similar goals of helping others. Companies such as Ethan's in the aerospace industry might be fertile ground for engineering service to grow since employees may be searching for a way to balance their paid work and the company may be trying to improve their public image. Further, Ethan's company is large and can afford to financially support its employees in this type of work. Hopefully more companies like his will be institutionalizing this type of service in the near future.

From the recruitment, retention, and persistence perspectives, support of engineering service in professional practice seems to be a good idea for multiple reasons. Besides the public relations benefits, it is more expensive to train a new engineer to replace the one that left than it would be to pay for an extra week of vacation. Further, as Max described, engineering service projects give employees a chance to develop their leadership skills before they have such a high position in the company. These employees who are supported can possibly go to middle schools, high schools, and universities to show how valuable engineering has been in assisting underserved communities which can help to improve the image of the engineering profession and diversify the workforce. With more of these efforts, engineering may be perceived as a more caring profession.

Certainly, it is up to any engineering company how they want to support service by their employees, and each employee is going to perceive this support at varying levels of satisfaction. It stands to reason, though, that some support is better than none and that companies who are competing with others in the same space for quality employees would want to have comparable support structures. This support can start with the employees by presenting the value to decision makers; it can start with the decision makers who recognize the PR and professional development benefits; it can start with the students who may demand these structures in order to be hired at a particular firm; or it can even start with the public who have allowed the engineering profession to get by working quietly and diligently, but not putting all their skills to the best use of humanity.

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