Exploring Motivations For Engineers Without Borders-USA

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ABSTRACT

With its rapid growth and near gender balance, Engineers Without Borders (EWB-USA) represents a model that the engineering field is striving towards. Understanding the motivations for members’ involvement and how it impacts their involvement with engineering can offer insight for how project-based organizations can influence recruitment and retention in the larger field. Using qualitative data, this research aimed to explore the motivations for EWB-USA involvement and for engineering involvement, and it compared how these motivations differed by organizational membership and gender. One hundred sixty-five engineers took part in the interviews and focus groups, representing a mix of males, females, professionals, and students from across the United States. Transcriptions were coded for motivations based on emergent themes and relative frequencies and patterns were reported. Trends showed that EWB-USA members were uniquely motivated by less-traditional engineering motivations than engineers not involved with the organization, and that the EWB-USA females, in particular, showed less traditional engineering motivations than the males. The findings also highlighted four ways in which EWB-USA impacts engineering motivations, which suggest that other project-based engineering organizations can leverage their unique position in the engineering field to help aid recruitment and retention of atypical engineers.

KEYWORDS: Motivations, qualitative methods, EWB-USA, gender

INTRODUCTION

Founded in 2002, the project-based engineering organization, Engineers Without Borders (EWB-USA) has quickly caught the enthusiasm of many engineers. In its eleven years, the organization has grown to over 12,000 members among over 250 chapters at both the student and professional level (EWB-USA 2012). In addition, its membership, with over 40% female involvement (Leslie 2010), contrasts the typical engineering setting averaging 11% and 20% females at the workplace and university settings respectively (Fouad and Singh 2011). These demographics model a more numerous and diverse engineering population that the larger field aims to achieve (National Science Board 2012).

Not only does EWB-USA witness growing and gender-balanced membership, but the organization also aids the creation of global, well-rounded engineers of the future (Amadei and Sandekian 2010). Specifically, EWB-USA member benefits have been shown to map onto the outcomes of the ASCE Body of Knowledge and ABET’s 11 criteria (Amadei and Sandekian 2010), which address the National Academy of Engineer’s calls for engineers of the future (National Academy of Engineering 2004). In addition, EWB-like university programs of humanitarian or community development engineering have grown in popularity over the last decade with large success (Moskal et al. 2008; Bielefeldt, Amadei, and Sandekian 2007). In reference to these programs, academics have found them to be “a major student recruiting and retention tool especially at the graduate level and among women” (Amadei and Sandekian 2010,}

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EWB-USA and its curricular counterparts seem to attract more passionate engineers and more female engineers than the typical engineering fields.

With all this excitement and growth around the organization, EWB-USA serves as a unique research setting that offers insight for both engineering project-based organizations and the wider engineering field. This study aims to understand the motivations for involvement with EWB-USA and whether or not those motivations relate to members’ motivations to pursue engineering. In addition, this research compares these motivations between genders in order to understand how such project-based organizations can aid engineering recruitment from this large pool of potential engineers.

MOTIVATIONS IN ENGINEERING

Motivational Theories

In order to understand the impact EWB-USA can have on engineering motivations, it is necessary to first review motivational theories. Two main theories dominate literature around motivations for the engineering field. The first, Social Cognitive Career Theory (SCCT) has been well-studied and applied to math and science fields. It unifies social cognitive theory and career development, to create theory around career interest, choice and performance (Lent, Brown, and Hackett 1994). At a simple level, the SCCT model has shown that self-efficacy expectations and outcome expectations influence interests and choice goals, which then influence choice actions and performance (Lent and Brown 2006). The model also assumes that these elements are dynamic and that actions will iteratively influence expectations, creating a cyclical pattern.

The second theory, expectancy-value theory (Eccles 2007), has also been well-studied, particularly in science, technology, math, and engineering (STEM) disciplines. Largely simplified, the expectancy-value model claims that expectations of success and subjective task values influence achievement-related choices and performance. The model lists four types of subjective task-values: interest (or enjoyment value), attainment value (the link between a task and one’s identity), utility value (the value to help achieve a goal), and relative cost. Even though all four values contribute to individuals’ motivations, Eccles and her colleagues have shown that these values provide particularly relevant understanding into gender differences in career-related choices (Eccles 2007; Eccles 2009).

Studying Engineering Motivations

Similar to SCCT, expectancy-value theory holds a dynamic view of choices, performance, and influencing factors. In both models, career-related choices are continuously influenced by new experiences that alter expectations, interests, and goals. Additionally, both models share similar influencing factors of expectations (either for success or self-efficacy and outcomes) and personal interests. While the two theories share similarities, Matusovich, Streveler and Miller (2010) argue that expectancy-value theory offers a more explicit framework to show how motivations impact persistence. Using expectancy-value theory in case-study research to understand engineering students’ persistence, the authors found the subjective task value of attainment, or the alignment with one’s sense of identity, was the most influential motivation for engineering persistence. Their research also found that women, in particular, struggled to find a fit between themselves and engineering.

Others have assessed engineering motivations using surveys. In their well-known APPLES study, Sheppard et al. (2010) found six main motivations for students to study
engineering. In order from most to least frequent, these motivations were intrinsic behavioral, intrinsic psychological, social good, financial, mentor influence, and parental influence (p.40). The top two motivations, intrinsic behavioral and intrinsic psychological, showed that students were most often motivated by a natural interest in or enjoyment from engineering, or a natural interest or aptitude for doing engineering activities. These findings agree with the motivational theories that stress the importance of engineering interests (SCCT and expectancy-value theory) or identity alignment (expectancy-value theory). Our research draws on these findings to interpret our results.

**Engineering Motivations & Organizations**

Because an individual’s motivations influence persistence-related decisions, motivations are an important topic of research. Furthermore, because SCCT and expectancy-value theory provide a way to access and interpret research on engineering motivations, we believe they are beneficial frameworks for interpreting our results. Specifically, we use the framework—the importance of engineering interests and identity—to show the distinctions in motivations between men and women and between EWB-USA members and engineers not involved with the organization. As we will show, our findings agree with Eccles who writes,

> “If we want to increase the number of females who aspire and then actually go into [physical science and engineering] fields, we need to provide them with better information about the nature of these occupations so that they can make better informed decisions regarding the full range of occupations they might consider as they try to pick a career that fits well with their personal values and identity as well and their short- and long-term goals.” (2007, p. 209)

She writes that in order to aid interest and persistence in engineering, particularly for females, the field must provide means for students to make more informed decisions. Although Eccles does not offer suggestions for ways to provide such means, exposure to engineering through organizations is one channel that we propose can aid this need.

In research of students involved with organizations including ASCE, ASME, IEEE, and SWE, Hartman and Hartman (2005), found that, among other gains, these students were “more strongly committed to a future in engineering” (p. 134). Although other studies have found activities outside of the classroom are particularly helpful for women in engineering (Sheppard et al. 2010; Dean and Fleckenstein 2007), the need for more studies about the importance of involvement in engineering organizations continues (Sheppard et al. 2010; Chachra et al. 2008). Because organizations offer engineering exposure to young engineers, it is important to identify the motivations for both involvement in these organizations and in the larger engineering field in order to better understand how these organizations can aid the need for more numerous and diverse engineers. This study aims to fill this gap and provide an initial understanding of how one such project-based organization is aiding the needs of the larger field.

**RESEARCH PURPOSE**

This research focuses on the project-based engineering organization, EWB-USA. Engineers involved with this voluntary organization make up a mix of student and professional members working on local university or professional chapters to provide design solutions to engineering-related problems in developing communities. The goals of EWB include providing
“sustainable engineering projects, while creating transformative experiences and responsible leaders” (EWB-USA 2012). As the introduction shared, in its ten years of existence, EWB-USA has created a 12,000 plus membership exhibiting a nearly balanced gender ratio. This unusual growth and balance has begun to draw the attention of researchers who thus far have only provided anecdotal or small-scale evidence of its benefits (Jaeger and LaRochelle 2009; Zornes and Kaminsky 2009; Amadei and Sandekian 2010).

This study aims to understand why EWB-USA was able to rapidly grow and attract volunteers, including a roughly gender-balanced membership. The research goals seek to understand the motivations for involvement in EWB-USA, whether these motivations align with motivations for engineering, and whether these motivations vary based on gender. Ultimately, these goals will help us better understand how such organizations can impact the engineering profession. More specifically, we ask the following research questions:

1. What are the motivations for joining and remaining involved in EWB-USA?
2. How do these responses vary by gender?
3. What are the motivations for joining and remaining in engineering among EWB-USA members?
4. How do these responses vary with engineers not involved in the organization and by gender?
5. How does EWB-USA impact the engineering motivations of its members?

METHODS

Data was collected through focus groups and interviews and subsequently analyzed using qualitative coding procedures and analysis.

Data Collection

As an exploratory study, this research used qualitative research methods in order to gain a rich understanding of participants’ motivations. A combination of focus groups and interviews were used to collect data. Focus groups were conducted in person either at EWB-USA conferences or at participants’ university or workplace settings. They were conducted where possible with two researchers, where female research assistants conducted female focus groups and male research assistants conducted male focus groups. Interviews were conducted in similar settings; however, one researcher conducted these interviews, and phone interviews were sometimes necessary.

In total, 165 engineers participated in the study and as a group took part in twenty-seven interviews and thirty-two focus groups. Participants were primarily recruited at conferences or through email solicitations affiliated with their membership in engineering organizations such as EWB-USA, ASCE, ASME, etc. The research team took care to sample a combination of male, female, student and professional engineers, who were both involved and not involved with EWB-USA. Table 1 displays the breakdown of research participants. At least two focus groups and three interviews were held for each of the eight demographic categories listed in the table (including some mixed gendered focus groups). We purposely recruited more EWB-USA members for the study than engineers not involved with the organization to better understand the organization. However, the research team experienced difficulties recruiting EWB-USA professional females.

| Table 1: Summary of research participants |
While the parameters in Table 1 (EWB-USA membership, gender, and professional or student status) were the primary attributes of focus for participant selection, care was also taken to arrange a variety of geographical locations, engineering majors, and EWB-USA experience. In total, 24 states and 13 engineering majors were represented among participants, and roughly two thirds of the sampled EWB-USA members had travelled with the organization while the other third had not.

In the interviews and focus groups, semi-structured, ethnographic-style questions were asked to start an open-ended discussion about motivations, educational experience, and extra-curricular activities. These types of questions allowed for unrestricted responses (Spradley 1979). For example, motivation-based questions included: Why did you become an engineer? Do you see yourself staying in engineering? What will motivate you to stay in the field? Similar questions were asked about EWB-USA motivations. The interviews lasted approximately 40 minutes and the focus groups were generally one hour. Participants were either provided a gift certificate of $5 for their participation in the study or provided with snacks and refreshments during a focus group. For each interview or focus group, an audio recording device was used for accuracy. In total, 37 hours of audio recording were captured for this study.

Data Analysis

Qualitative Coding

Once the transcriptions were checked for accuracy, the files were uploaded into the qualitative coding software program, QSR NVivo 10. NVivo allows users to code qualitative data into nodes, and consider patterns in the data (Bazeley and Richards 2000). First, a node was created for each research participant and attributes, such as gender, engineering major, etc. were assigned to each node. Each participant’s responses were then assigned to their corresponding node, which allowed for the attribute-based comparisons.

In addition to coding responses to their participant nodes and attributes, responses were also coded for content. Coding began at the macro level based on the interview question. One macro node collected motivations for both entering and remaining in engineering while a separate macro mode collected these motivations for EWB-USA. Transcriptions were primarily coded directly based upon the question; for example, anytime someone answered the prompt, “Tell us why you are motivated to study/practice engineering,” their response was coded into the ‘engineering motivations’ node. However, while the direct responses to this question were the primary way in which participants shared their motivations, unsolicited motivations were also coded to this category. For example, a participant may have shared their classroom experience and said, “...that’s why I got into engineering in the first place,” or “... that’s what will motivate me to stay in this career.” These types of comments, in addition to direct responses to the question, would be coded to the macro ‘engineering motivations’ node.

Once the initial coding had taken place, the ‘engineering motivations’ and ‘EWB motivations’ nodes were explored further for emergent themes. For each of these macro nodes, initial themes were created based on reoccurring patterns rather than from the literature. For
example, several participants mentioned an aptitude for or enjoyment of math and science as a motivation for pursuing engineering. This pattern generated a node named ‘math and science’. Following the recommendation of Saldaña (2009), we created and maintained a coding dictionary in order to aid accuracy between multiple coding sessions and researchers.

Once the initial nodes were created, the themes and dictionary were shared with the research team for review and discussion. From the discussion, some themes were combined or split apart until agreement was made that each node represented a unique theme with multiple participant responses. For example, an initial node was created for participants who showed an interest in technology or computers; however, after the first round of thematic coding was completed, this theme held only five responses, and overlapped with the theme of ‘interest in subjects’, which had captured respondents’ interest in specific engineering-related subjects such as cars, construction, or environmental science. Therefore, these two nodes were combined. The coding was then iteratively adjusted to match the final list of nodes and definitions. Any unique responses that did not fit into one of the main themes were coded into a catch-all ‘other’ node in order to capture responses based upon relative frequencies.

Once the thematic coding was completed, another member of the research team recoded three files using the dictionary (two focus groups and one interview). The coding was then compared using a coding comparison query in the software, and 98.7% agreement was found across all motivational nodes with an average kappa value of 0.75 (using equivalent weights for all sources). This agreement was considered sufficient for moving forward with analysis as recommended by Miles and Huberman (1994). After finalizing the coding, there were fifteen distinct themes for engineering motivations and seventeen themes for EWB-USA motivations.

**Qualitative Analysis**

To analyze the data, the research first assessed relative frequencies of responses based upon the unit of analysis of the individual. Using queries in the software, the response themes were listed as rows in a table, with attributes listed as the columns. The cells of these tables were filled in with counts of individual participants who had indicated a motivation within that particular coding theme. Because the unit of analysis was the individual, the number of responses to each theme by an individual was not analyzed. In other words, it did not matter if a respondent only indicated a theme once or several times, in either of these cases, it only mattered that the participant indicated a motivation within that theme, and it only counted once.

Relative frequencies were then calculated for each theme based upon the percentage of participants who had indicated motivations. For example, 63 male participants shared motivations for studying or practicing engineering; of these, 27 indicated that aptitude in math and science was a motivator; therefore, the frequency of this response was 42.9% (27 over 63). Note that some participants did not share an engineering motivation because each focus group or interview was slightly adapted to the participants, as is common in ethnographic-style work (Spradley 1979). Some EWB-USA member focus groups, for example, discussed motivations for joining and remaining involved in EWB-USA so much that general engineering motivations were sparsely discussed in the allotted time.

Relative frequencies were produced to compare the engineering motivations based upon two attributes—EWB-USA membership and gender—and motivations for being a member of EWB-USA were compared between genders. Tables 2 and 3 share these results. Because participants were given freedom to share all of their motivations for engineering and EWB-USA, many respondents shared motivations that fit into multiple themes. For instance, the average
participant’s engineering motivations were coded into 3.4 themes; therefore the relative frequencies in the tables do not sum to 100%.

While relative frequencies illustrate which themes were more or less common among different demographics, the strength of qualitative data comes from participants’ rich descriptions, which help to answer ‘how’ questions (Miles and Huberman 1994). This led to further qualitative analysis which focused on explaining patterns in participant’s responses. During the coding process, the researcher’s thoughts, data trends, and connections to literature were kept in a coding memo with links to specific data points. Notes were added throughout coding for each file in order to keep track of patterns and themes, as recommended by Miles and Huberman (1994). Once all data sources were coded, this memo was later coded by hand for emergent themes and shared with the research team. These notes and discussion generated claims that were later confirmed or disconfirmed by qualitative evidence. This method of analysis helped to find representative quotes demonstrating the findings and to explore disconfirming evidence in the trends.

RESULTS

The following results are shared in order of the research questions, starting with a focus on EWB-USA motivations, followed by engineering motivations, and finally by the impact of EWB-USA on engineering motivations. These results focus on the comparisons of relative frequencies while the later discussion supports the findings from the frequencies with participant quotes in order to address the research questions.

EWB-USA Motivations

Table 2 presents the relative frequencies for EWB-USA motivations ranked by most to least frequent themes among all participants; two columns separate results by gender. The top three motivations among all participants were the desire to ‘help others’, the opportunity for ‘engineering application and experience’, and a ‘natural fit’ with the organization (as some participants shared that they align with the values or mission of the organization, or they desire to do EWB-type work as a career). Other noteworthy motivational themes include ‘worthwhile activity’ where respondents shared that they were interested in EWB-USA because it was rewarding, fulfilling, or made them feel good; and ‘EWB as a combiner of interests’ captured the many respondents who said they joined EWB-USA because it allowed them to pursue engineering alongside another one of their interests.

<table>
<thead>
<tr>
<th>Motivation</th>
<th>EWB-USA Members</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
</tr>
<tr>
<td>Help others</td>
<td>56.6</td>
</tr>
<tr>
<td>Eng. application and experience</td>
<td>41.5</td>
</tr>
<tr>
<td>Natural fit</td>
<td>28.3</td>
</tr>
<tr>
<td>Culture or travel or global interests</td>
<td>26.4</td>
</tr>
<tr>
<td>Worthwhile activity</td>
<td>26.4</td>
</tr>
<tr>
<td>EWB as combiner of interests</td>
<td>24.5</td>
</tr>
<tr>
<td>Recruited</td>
<td>24.5</td>
</tr>
<tr>
<td>Another similar experience</td>
<td>22.6</td>
</tr>
<tr>
<td>Like social aspect</td>
<td>18.9</td>
</tr>
<tr>
<td>EWB community members</td>
<td>11.3</td>
</tr>
</tbody>
</table>
When comparing the relative frequency of responses between genders, both males and females listed ‘helping others’ as their top motivation; however, females mentioned a motivation to help other much more frequently than the men. Females also mentioned motivations of ‘natural fit’ with the organization, a desire to pursue ‘culture or travel or global interests’, EWB-USA as a ‘worthwhile activity’ and ‘EWB as a combiner of interests’ more frequently than males. Males were more frequently motivated by ‘another similar experience’, an interest in ‘learning more than technical’ subjects, and ‘patriotism’, which some males had specifically indicated as their reason for wanting to represent USA abroad.

Engineering Motivations

Among all participants, the top three most frequently mentioned engineering motivations included an interest in or aptitude for ‘math and science’, a ‘natural fit or satisfaction’ with the field, and an ‘interest in subjects’ referring to specific, engineering-related subjects such as rockets. Other emergent themes requiring further explanation include ‘work environment’ which included responses referring to liking the diversity of project work or being able to work both inside and outside of the office; ‘opens doors’ collected responses referring to the opportunities an engineering degree gives such as being “a career to fall back on;” ‘EWB or EWB-like’ included responses in which participants were motivated for engineering through their EWB-USA or similar organizational experience; and ‘just happened’ collected responses where participants said that they are unsure how they ended up in engineering, but “it kind of just happened” or they “stumbled in.”

Table 3: Percentage of respondents indicating motivations for studying or practicing engineering

<table>
<thead>
<tr>
<th>Motivations</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EWB-USA</td>
<td>Non EWB-USA</td>
</tr>
<tr>
<td>Math and Science</td>
<td>39.4</td>
<td>40.0</td>
</tr>
<tr>
<td>Natural fit or satisfaction</td>
<td>33.3</td>
<td>46.7</td>
</tr>
<tr>
<td>Interest in subjects</td>
<td>36.4</td>
<td>43.3</td>
</tr>
<tr>
<td>Help others</td>
<td>27.3</td>
<td>20.0</td>
</tr>
<tr>
<td>Work Environment</td>
<td>18.2</td>
<td>36.7</td>
</tr>
<tr>
<td>Family member</td>
<td>15.2</td>
<td>23.3</td>
</tr>
<tr>
<td>Teacher or mentor</td>
<td>15.2</td>
<td>13.3</td>
</tr>
<tr>
<td>Opens doors</td>
<td>21.2</td>
<td>23.3</td>
</tr>
<tr>
<td>Like to tinker</td>
<td>21.2</td>
<td>30.0</td>
</tr>
<tr>
<td>Problem solving</td>
<td>15.2</td>
<td>23.3</td>
</tr>
<tr>
<td>Salary or job security</td>
<td>15.2</td>
<td>26.7</td>
</tr>
<tr>
<td>Camps or experiences</td>
<td>12.1</td>
<td>16.7</td>
</tr>
</tbody>
</table>
We observed distinct differences when responses were compared between engineers involved and not involved with the organization (before gender distinction). While the top response of ‘math and science’ remained high, many of the subsequent motivations varied. In general, EWB-USA engineers were more frequently motivated by a desire to ‘help others’ and an interest in or involvement with ‘EWB or EWB-like’ experiences. Engineers not involved in the organization were much more frequently motivated by more traditional motivations from literature such as engineering being a ‘natural fit or satisfaction’; being encouraged by a ‘family member’ or ‘teacher or mentor’; having an interest in ‘subjects’, ‘tinkering’, or ‘problem solving’; and being drawn to the ‘work environment’ and salary or job security.’

When we compared the responses by gender (without organizational distinction), again, the top response of ‘math and science’ remained the most frequently mentioned motivator; however, differences emerged here as well. Females mentioned motivations for studying or practicing engineering based upon ‘EWB or EWB-like experiences’, the encouragement of a ‘family member’ or a ‘teacher or mentor’, and the desire to ‘help others’ more often than males. Males more frequently mentioned being motivated for engineering by a ‘natural fit or satisfaction’, an interest in ‘subjects’ or ‘tinkering’, and the appeal of ‘salary or job security’.

While these themes displayed gender differences, some themes appeared with approximately equivalent frequency between the genders (such as ‘work environment’ or ‘problem solving’). Themes with roughly equivalent frequencies were more common for the gender comparison than for the comparison between those involved with EWB-USA and those not involved.

Table 3 presents the results for engineering motivations separated by both organizational involvement and gender and are ranked by the most frequent response themes among all participants. As mentioned, the results showed more differences between the organizational attributes than the gender attributes. Females and males not involved with EWB-USA mentioned many of the same themes with higher relative frequency than their gendered counterparts within the organization. For example, about 25% of both men and women not involved with the organization reported being motivated by ‘salary or job security’, while about 15% of men and about 5% of women involved with EWB-USA reported this motivation. Similar patterns emerged for the more traditional engineering motivations such as encouragement from a ‘family member’, an interest in ‘problem solving’ and an appeal for the engineering ‘work environment’. These results suggest two trends: (1) that women and men in EWB-USA have unique engineering motivations from those engineers not involved with the organization, and (2) that the women in EWB-USA are even more atypical (or on the periphery), with a higher percentage of unique motivations than men in the organization. These trends are explored further in the discussion as they pertain to the research questions.

**DISCUSSION**

As introduced, the aim of this research is to better understand the motivations for the involvement in EWB-USA and their interaction with motivations for engineering, particularly
when gender is considered. The following sections discuss the results in light of the research questions: EWB-USA motivations, engineering motivations, and their intersection.

**EWB-USA Motivations**

As Table 2 shows, EWB-USA members identified at least seventeen unique motivational themes in their qualitative responses. While all the themes listed in the table emerged for at least five distinct participants, the top two most frequent themes stood out as top motivators—the desire to ‘help others’ and the interest in ‘engineering application and experience’. The high frequency of these themes suggests their importance. First, EWB-USA members desired to join or stay involved with the organization because of one of its core missions—helping others. These engineers wanted to give back, as one male said,

“I just wanted to find an organization that we were able to give back. I mean there [are] a lot of organizations at campus that do a lot of little engineering competitions and stuff, you know like build bridges and different canoes and things like that, but we were just looking for an opportunity to use our skills in a way that we could really help people.”

EWB-USA members also enjoyed the unique hands-on experience that their involvement offered as this female shared, “I think it’s a great way to have professional experience while you’re still learning in school... it’s different to see it in action and actually be able to make it happen.” These motivations, among the others listed in Table 2, were key motivators for EWB-USA.

The gender differences among these response frequencies were most noticeable in females’ repeated desire to ‘help others’ and their view of EWB-USA as a ‘natural fit.’ When asked about this natural fit, both males and females shared that EWB-USA seemed to align with more feminine interests of helping others, being social, and being well-rounded (e.g. with strong interpersonal skills). These comments align with research that suggests natural differences in male and female personalities and interests (e.g. Eccles 2009), and they align with the public mission and vision of EWB-USA that includes serving and making a difference (EWB-USA 2012).

In addition, females more frequently shared that EWB-USA was a ‘combiner of interests’. This female student expressed that, “I was always into nonprofits and humanitarian stuff, but I was good at math so I went into engineering....” She continued to share that when she was exploring organizations to join she thought that, “[EWB] matched both worlds together for me and it made engineering seem like it had more of a purpose than just making money which is what I initially thought.” Here we see that this young woman’s motivation for EWB-USA came from the organization’s ability to match her engineering and humanitarian interests. As expectancy-value theory shows (Eccles 2007), people are often motivated to pursue an action when it aligns with their personal interests (among other things). This theory would suggest that, because the organization has greater alignment with traditionally feminine interests, more women than men are motivated to join the organization. While some EWB-USA males shared similar motivations, fewer men than women mentioned these overlapping and intrinsic interests.

**Engineering Motivations**

As shown in Table 3, the engineers in this study listed at least fifteen unique motivations for entering or staying in engineering. Although this study allowed themes to emerge rather than coding for pre-defined themes, such as those offered by Sheppard et al. (2010), we found similar results. Five of the APPLES study’s six themes aligned with our top results. The only major
difference was in their fourth-most frequent ‘financial’ motivation, which was our 11th most frequent theme. This difference likely came from the uniqueness of the EWB-USA population as the ‘salary or job security’ theme was not a common motivator for them. Our top emergent responses of ‘natural fit’ or interest in ‘subjects’ and ‘math and science’ aligned with the top intrinsic motivations in the previous research. As in the APPLES study, the engineers in our study were primarily motivated by their natural interests in and natural fit with the engineering field. These top motivators proved to be important themes as the analysis progressed between the groups.

Gender differences in the results also agreed well with past research. First, the most frequent response, ‘math and science’, between genders aligned with research that has shown that varying levels of ability are no longer the cause of the STEM gender gap (Seymour and Hewitt 1997). Others have shown that men typically have more natural interest in technical engineering subjects (Faulkner 2007) while women are drawn to the social side of the field (Faulkner 2007), the influence of positive role models (Fouad and Singh 2011), and a desire to help others (Hewlett et al. 2008). The men in this study reported more frequent technical interests, which literature confirms we could expect.

As mentioned in the results, differences in engineering motivations were more prevalent between organizational attributes than gender attributes. Because motivational theories proposes that alignment between engineering and personal interests or engineering and identity are some of the strongest motivations (Eccles 2007), these organizational differences in engineering motivations highlight the first trend: EWB-USA members have unique interests and identities than engineers not involved with the organization. For example, one male not involved in EWB-USA stated that, “It’s in my nature. I’m an engineer and the practicality of it appealed to me a lot more than [other options].” Similarly a female not involved with the organization stated that,

“I knew I wanted to do engineering probably from the time I was in middle school. I am an engineer mind, you know I love math; I love science; I love building things; I love putting things together. I was not the arts and crafts kind of kid, so I just knew I wanted to go into that kind of thing for a long time, so really it was kind of a no brainer.”

These two students showed a strong intrinsic interest in engineering. While some EWB-USA members shared similar identity-based or interest-based motivations, fewer EWB-USA members expressed these more traditional motivations.

When the results were further analyzed for gender and organizational differences, the results supported a second trend: women in EWB-USA have even more unique engineering motivations than men in the organization. In addition to less frequent intrinsic interest in or identity alignment with engineering, these women indicated less frequent encouragement from ‘family members’ or ‘teachers or mentors’. This difference was especially striking because as a whole, women in this study were more frequently motivated than men by such encouragement, which meant that the EWB-USA women were especially lacking such access and guidance. This was exemplified by one female student not involved with the organization who said she got into engineering, “Because I really like problem solving and I’m really good at math and science and when I was in high school a teacher was like, ‘Those skills are for an engineer,’ and I was like, ‘Okay.’” This student showed that her interests and abilities were recognized by a teacher who guided her into engineering. Such a response was more frequent among these women not
involved with the organization than those involved. These results align with literature which shows that a lack of familiarity with the engineering field prevents many women from entering (Intel 2011; Girl Scouts 2012). With less guidance from or examples of family members, teachers, or mentors, EWB-USA women have less access to the field resulting in less natural pathways into the field.

While the women in EWB-USA showed less frequent traditional motivations, they also showed more frequent motivations for ‘helping others’ and ‘EWB or EWB-like experiences’. Our results align with previous studies that have shown that women are drawn to activities with altruistic goals (Hewlett et al. 2008). These women, however, also showed a unique motivation for engineering through EWB-USA itself or EWB-type work, such as Peace Corps or development work. One female shared:

“This ended up switching from aero [aerospace engineering] to civil [engineering] because of EWB. ... I felt way more engaged in my engineering when I was working with EWB and had that cultural aspect because I felt like aero was very machine-oriented and there wasn’t a lot of human interaction to the learning that I was doing, and I couldn’t really think of how I could apply to a setting with people. Civil was a good fit for me because I was able to see myself working with people in the future.”

This student shared that she was motivated to switch engineering majors to one that fit her social interests because of EWB-USA. While several females shared similar motivations, others shared a more general motivation for EWB-like work in development: “I had a career as a social worker... and got burnt out, and I was looking for an alternative career path. [I] decided to go into engineering and had this idea that I wanted to do some sort of development work.” Some women, such as this professional engineer, showed that an interest in development work motivated them to go into engineering.

While males involved with EWB-USA also showed this specific motivation, nearly one third of the EWB-USA female members expressed a motivation for this theme versus one fifth of the men. Of the engineers not involved with EWB-USA, zero participants mentioned this motivational theme. Once again, these results align with motivational theories as these EWB-USA members, and these women in particular, showed less motivation for engineering from traditional reasons and more motivation from these altruistic and development-like interests. The results indicate that EWB-USA members, and, more specifically, its female members, have unique engineering motivations.

**EWB-USA’s Impact on Engineering Motivations**

A final topic of interest for this research involves the intersection of these two motivations. While the iterative nature of motivational theories would assume that EWB-USA involvement impacts the engineering motivations of its members, qualitative evidence for how this occurs offers novel suggestions to other project-based organizations. First, as shown in the previous section, EWB-USA or similar type work emerged as its own motivational theme for entering or staying in engineering. This unique interest demonstrated an initial way that EWB-USA has impacted engineering motivations; it provided a direct motivation. As one male professional aptly said, “I thought I had to make a choice between designing systems and relating to people in my major and EWB proved to me that it’s a false dichotomy... it’s true to say that I’m an engineer because of EWB.” This statement exemplified this direct way that EWB-USA impacted engineering motivations. By providing an alternative to the assumed role
of what engineering is, one that matches these members’ unique interests, the organization illustrated the fit between individual identities or interests and engineering.

Further evidence for this impact was observed in the motivations for EWB-USA where members credit joining the organization because it was a ‘natural fit’ or a ‘combiner of interests’. For example, one female student stated that,

“I could have gone into law school, instead of engineering. It was something I was interested in, but I mean what it came down to is that I really want to do engineering, but not like smartphone engineering, I wanted to do a different kind of engineering like world politics engineering ... I don’t want to work in a process plant; that is not why I’m studying engineering. It doesn’t have to be limited to that, and I get comfort from being in EWB because I have kind of stopped doubting that engineering was the right thing.”

Similarly, a professional male engineer expressed that,

“I love making engines go faster, I like that type of stuff, but I don’t see the greater purpose of making a vehicle go 300 miles an hour, and I needed something else. So I looked at transferring, I looked at switching majors, I looked at all these different things, and then EWB was starting at [my school] and I decided to check it out and I said, ‘Wow, here is an opportunity to have engineering and this human touch to it,’ and then I stayed as a mechanical [engineer] and I got involved with EWB.”

These statements illustrated a common trend: EWB-USA offered a way to combine unique interests with engineering. Many of the members saw this unique alignment as a “perfect fit” such as one female professional, who, upon learning about EWB-USA as a student, thought, “Oh my god, that’s my group; that’s all the other kids that are like me.” This woman, like many others expressed finding fulfillment between themselves and engineering through EWB-USA: “I think it’s definitely fulfilling the other part of me that isn’t an engineer.”

As Eccles (2007) suggests, this pairing of unique, traditionally non-engineering interests and engineering would typically be at odds and cause such individuals to avoid or leave the field. However, this qualitative research showed that EWB-USA can act as a bridge between these atypical engineers and the field. By offering the opportunity to align their interests or identities with engineering, EWB-USA members showed a desire to enter engineering, change to a more suitable engineering major, be encouraged that engineering is the “right thing” for them, or find fulfillment in engineering.

While not all EWB-USA members mentioned such larger motivational impacts from their involvement, individuals without this impact were often found to have more intrinsic interests in engineering. For example, one male student in the organization expressed that he did not have “a really strong desire to give back to the community through volunteering for engineering projects,” but he saw EWB-USA as “a great hobby because it gives you something different to do.” In cases like this, such EWB-USA members showed more natural fit with typical engineering interests. As this male shared earlier in his interview, “I wanted to get a technical degree because of the job prospects and because I felt like that was the best use of my skills...environmental engineering is obviously the coolest major in engineering; it aligns to my interest the best.” Here this student expressed his natural draw to engineering because it aligned with his interests and he was attracted to the job opportunities, both of which were more
traditional engineering motivations. This student exemplified those EWB-USA members who did not find the organization to have significant impact on their engineering motivations, because they often were found to have more traditional engineering motivations. These findings help to confirm the results that EWB-USA has a strong impact on engineering motivations for those with atypical engineering interests or access because it offers a bridge for personal interest and identity alignment.

CONCLUSION

This study explored the project-based engineering organization EWB-USA to highlight what motivates its members for both organizational and engineering involvement. Because of the organization’s atypical engineering demographics and relatively youthful age, the organization provided a unique context for understanding how organizations can play a role in aiding the need for more numerous and diverse engineers. Qualitative data from 165 engineers showed two major trends in the data: (1) EWB-USA members have unique engineering motivations from engineers not involved in the organization, and (2) females involved with EWB-USA show even more unique engineering motivations than men in the organization. These motivational differences largely surfaced as differences in traditional engineering interests and differences in access to the engineering field. EWB-USA members showed a larger diversity of interests than engineers not involved with the organization, and female EWB-USA members, in particular, showed additional barriers to accessing the engineering profession coupled with a strong passion to help others and pursue EWB-type work long term.

These results largely align with previous literature on motivational theory for engineering and the gender gap in STEM fields. The women and men involved with EWB-USA—those with these atypical motivations—also demonstrated that their engineering motivations were often influenced by their organizational involvement. Based on these findings, we conclude that EWB-USA helps to recruit a unique subset of engineers to the field—engineers with strong interests in the social side of engineering, with strong desires to help others and benefit society, with limited access to the field, and with more diversity of gender, interests, and identity. Consentino de Cohen and Deterding (2009) suggested that, in order to recruit more engineers, a wider net should be cast; EWB-USA appears to be casting that wider net.

These results have implications for both project-based organizations and the larger engineering field. First, this research shows that project-based organizations can make an impact in recruiting engineers to the field. Many EWB-USA members joined the organization because of the ability to bring together their engineering interests and their unique, non-technical interests. This connection showed members a new side of the field—a side where their uniqueness fits. Other organizations can leverage their unique positioning in the field to do the same. Although this research was limited to one project-based organization, motivational theories suggests that these results could be replicated in studies of other organizations. In addition, despite the limitations of a qualitative, exploratory study, these results will help to inform future work testing these qualitative trends on a larger scale. Understanding these motivations for atypical engineers can help to draw them into the profession as it looks to increase its numbers and diversity.
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