6-2017

A Survey of Women in Academia and the role of a Multidisciplinary Professional Society

Daniela Faas
Franklin W. Olin College of Engineering

Anne M. Lucietto
Purdue University, lucietto@purdue.edu

Gretchen L. Hein
Michigan Technological University

Lucy Lenhardt
Pennsylvania State University, Erie

Christi Patton Luks
Missouri University of Science and Technology

See next page for additional authors

A Survey of Women in Academia and the role of a Multidisciplinary Professional Society

Dr. Daniela Faas, Franklin W. Olin College of Engineering

Prior to joining Olin College, Dr. Faas was the senior preceptor in design instruction at the John A. Paulson School of Engineering and Applied Science at Harvard University. Dr. Faas was a Shapiro postdoctoral fellow in the Mechanical Engineering Department at MIT after receiving her Ph.D. in Mechanical Engineering and Human-Computer Interaction from Iowa State University. Dr. Faas graduated from Bucknell University with her M.S. in Mechanical Engineering and joint B.S./B.A. in Mechanical Engineering and International Relations. Dr. Faas is currently a research affiliate in the Department of Mechanical Engineering at MIT. Her research focuses on developing low cost immersive Virtual Reality applications for products and systems, early stage design process and methodology and engineering education.

Research interests: virtual reality (VR) applications in mechanical design, design methodology and engineering education.

Dr. Anne M Lucietto, Purdue University, West Lafayette (College of Engineering)

Dr. Lucietto has focused her research in engineering technology education and the understanding of engineering technology students. She teaches in an active learning style which engages and develops practical skills in the students. Currently she is exploring the performance and attributes of engineering technology students and using that knowledge to engage them in their studies. In addition to this work, she is interested in professional societies and how they support careers of their members.

Dr. Gretchen L. Hein, Michigan Technological University

Gretchen Hein is a senior lecturer in Engineering Fundamentals at Michigan Tech. She have been teaching ENG3200, Thermo-Fluids since 2005. She also teaches first-tear engineering classes. She has been active in incorporating innovative instructional methods into all course she teaches. Her research areas also include why students persist in STEM programs and underrepresented groups in engineering.

Ms. Lucy Lenhardt, Pennsylvania State University, Erie (Behrend College)

Gannon University, Erie PA. B.S. Mechanical Engineering Technology Penn State University, Erie PA. B.S. Plastics Engineering Technology 1986-1990: Johnson Controls, Incorporated, Plastics Components Division (Quality Engineering) 1990-1994: Penn State University, Plastics Technology Deployment Center. (Research and Development) 1994-present: Penn State University, Senior Research Associate. (Faculty, Plastics Engineering Technology)

Dr. Christi Patton Luks, Missouri University of Science & Technology

Dr. Patton earned a B.S. in Chemical Engineering from Texas A&M University, an M.S. in Applied Mathematics from The University of Tulsa, and a Ph.D. in Chemical Engineering from The University of Tulsa. She is currently an Associate Teaching Professor of Chemical Engineering at Missouri University of Science & Technology.

Dr. Beth A Myers, University of Colorado Boulder

Beth A. Myers is the Director of Assessment and Accreditation at the University of Colorado Boulder. She holds a BA in biochemistry, ME in engineering management and PhD in civil engineering. Her interests are in quantitative and qualitative research and data analysis as related to equity in education.

A Survey of Women in Academia and the Role of a Multidisciplinary Professional Society

Abstract

The Society of Women Engineers (SWE) is a global professional society of over 30,000 members with a mission to "Stimulate women to achieve full potential in careers as engineers and leaders, expand the image of the engineering profession as a positive force in improving the quality of life, and demonstrate the value of diversity"[1]. SWE is an organization that is deeply rooted in industry. The founding members were employed by firms that are a result of the industrial revolution, and thus the focus of its membership is on those that work for industry, consultants, and often themselves. This focus has unintentionally left a large population of its membership, the academic population, underrepresented and misunderstood.

Early discussion at the board level in the mid 2000's indicated a willingness for a paradigm shift. However, the representation of academics on the board and other leadership roles has been lacking. This can be attributed to the lower numbers of this group relative to the whole, as well as the requirements of tenure that do not support the time and dedication to such an endeavor. A small but influential group of members, including a former board member, and a few involved at various levels of the society have been working toward increasing opportunities for women in academia (WIA). Some of the initiatives have been the societal support of the WIA committee, the addition of professional development opportunities targeting women in academic careers, providing recognition and awards, and aiding in networking opportunities. These all lead toward career advancement, making SWE more attractive to women engineers in the academe.

To further our understanding of available opportunities and those opportunities that will make membership and active participation more attractive to members in academia, a survey was developed. Information gathered by the survey include demographics, perceived needs, and potential contributions the individual could make in furthering the creation of professional development opportunities for this population. This work is intended to share the results of this survey, using descriptive statistics, further developing our understanding of this underserved population within SWE.

Introduction

SWE has served as a professional organization with a focus on women engineers since its inception in 1950. The original founders "... wanted the opportunity to develop their abilities, to give expression to their potential, to contribute to society"[2]. Historically, the society has focused on the professional development of their members in industry. Over the past several years, SWE has recognized that their members come from a wide range of organizations, including industry, government and academia. To serve members from government and academia, committees were

formed. This work will focus on the Women in Academia (WIA) committee and the needs of this group.

There are 606 SWE members that affiliate as WIA, although there are clear indications that more of the general SWE membership (approximately 30,000) would qualify as WIA members. The WIA Committee has about 20 active members who advocate for the needs of women pursuing careers in academia. These include university/college faculty (tenure and non-tenure), researchers and administrators. The role of SWE and its activities to include people from academia involves many areas: tools and resources for this population, advocating within the academic arena, and educating engineers from other career paths about the academic path. Another area of significant effort is in providing networking opportunities and ensuring there is a pipeline for women in Science, Technology, Engineering and Mathematics (STEM) academic careers[3].

Literature Review

Women engineers are challenged to participate in many organizations. In addition to our roles within our careers, we volunteer at the university, community, schools and professional organizations. Much of the value of the service we perform is based on the commitment we feel towards those organizations. In this paper, we will explore how and why women participate in professional organizations through a survey.

An interesting aspect of being a woman engineer is that 89% of the other engineers are not. This is true whether the woman is an engineer in academia or industry. In 2014, interviews with 52 women engineers were studied. The interview focused on their career history, and the engineer's view of how well she fit into her work environment and what their workplace interactions were. The participants came from a wide range of engineering fields and organizations (representatives from industry, academia, government, etc.) Four categories of interactions occurred that marginalized their professional identity: "amplifying, imposing gendered expectations, tuning out, and doubting technical abilities". One interesting finding is that regardless of where the women worked, there were comments and attitudes of co-workers, and within the organization's structure itself, that resulted in marginalization[4].

In 2014, 458 men and women completed a survey investigating whether or not "incivility" occurred at academic conferences and, if so, identifying the impact of that incivility. "Incivility" being defined as "rude and discourteous behavior". The researchers wanted to determine when and if incivility occurred and if the occurrences differed based on gender and what the impact of those experiences were. Regardless of gender, incivility was reported more frequently when the climate was viewed as sexist. This perception resulted in a lower conference satisfaction. When this was studied in greater detail, it was found that when the environment was perceived as sexist, women reported instances of incivility. Conversely, when men reported that the conference climate was sexist, they reported a higher conference satisfaction[5].

Also in 2014, a different survey was completed that involved three engineering professional organizations (American Society of Civil Engineers, the Institute of Electrical and Electronics Engineers, and the American Production and Inventory Control Society) and what motivated members to become engaged in that society. The results showed that members regarded the leadership opportunities within the society to be valuable. Lobbying was not seen as a motivator for engaging the membership, nor did it have an impact on the commitment of the members to that organization. Within these engineering societies, the more education a member had, the more likely they were to volunteer within the organization[6].

These sources found that women engineers realized their gender affects their career satisfaction within their organization and within professional organizations. Other researchers found that involvement in leadership within a society greatly enhances members' commitment to the organization. Since the SWE membership has historically been from industry, this has led to the interest in determining what members from academia value in their SWE membership and what could be done to encourage others from academia to join.

Research Question

Membership in any professional organization is based on the perceived benefits that organization provides to its members. In this study, we developed a survey to answer the following questions:

- *Why do women in academic careers elect to join SWE?*
- *Why do women in academic careers maintain a membership in SWE?*

Methods

In order to answer these research questions and provide further understanding of this subpopulation in SWE, the authors developed a survey. The survey uses accepted survey development methods such as those provided by Fink[7], focusing on how to conduct survey's, Blair, Czaja, and Blair[8] on how to design surveys, and finally Van Selm and Jankowski[9] on how to conduct survey's online. These references were chosen because of their applicability to the online survey needed to answer the research questions. Further, the authors did not find a validated tool that related closely to the questions and breadth of answers desired by the authors.

The survey was web-based and was distributed to the SWE WIA e-mail list. The WIA e-mail list consists of over 600 contacts. Members within the committee were able to forward the survey to other professional organizations. The survey was anonymous, therefore, there was no way to track what organizations received the survey other than what was reported in the survey results. Additionally, there was no method to track how many people received the survey such that a response rate could be calculated. The survey was completed by 58 respondents. The survey included demographic data in addition to SWE specific questions. Participants were not paid and the data was anonymized. The details of this survey are presented and discussed in subsequent sections.

The survey was grounded in accepted survey development methodologies[7-9] and focused on the characterization of the engineering/engineering technology academic. Responses to the questions are referenced in the results section of this paper. Areas of concern can be classified into the following categories: Demographics – Personal and SWE, Work Responsibilities, Recognition, Satisfaction, and Participation in Other Societies.

The data was cleaned and sorted to facilitate its review. For example, some respondents did not answer questions, and the data was extracted and number of responses tallied. This accounts for the variance in the number of responses as seen in the figures throughout the results section. The responses reviewed for this paper required qualitative analysis, where content analysis[10-12] was used to summarize the data and find issues of significance for inclusion in this paper.

Content Analysis.
Content analysis was the preferred method as one reviews the qualitative data, and focused review of the remaining data were put into context with all of the other qualitative responses. Content analysis[11] was used to evaluate the data from the respondents, when applicable.[11] This methodology provides a means to examine data in order to determine if there are patterns in responses to open ended questions. This method of analysis is frequently used when flexibility and ability to be used in a variety of situations is important to the authors for complete data interpretation and dissemination.

The results of the survey were evaluated and are discussed below.

Results

The survey distribution included a variety of sources and the timeframe allotted by the authors was short, nearly three weeks. The number of respondents is 58; the total response rate is unknown as is the click through rate[7,8,14]. However, for the time given to respond at the end of the calendar year, this appears to be a good result. Respondents did not always respond to every question, therefore, the total responses on each question vary.

All but two respondents had received at least some graduate level degree with doctoral degrees leading (n=42) and a master degree second (n=10). Two respondents were male or transgender. Three quarters (75%) of the respondents are professional members in SWE with 22% of the total respondents being life members. The respondents were also asked how long and when they became involved in SWE. Figure 1 shows the distribution amongst the respondents in terms of membership length. Most of them, 67%, have been a member of SWE over the last 10 or more years. Both 6-9 year and 3-5 year membership were at 12%. Only one person was a new member with less than a year of membership to SWE. From Figure 1, it is evident that many of the people completing the survey have a long-term commitment to SWE.

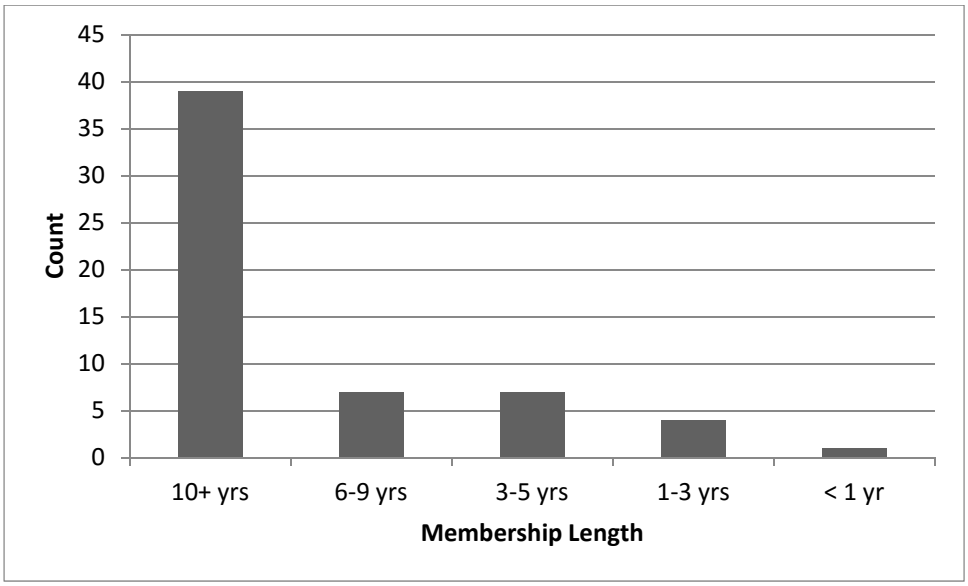

Figure 1. SWE Involvement by Number of Years (n = 58).

Many of those responding to the survey transitioned to professional members after completing their university studies. About 50% were members while they were undergraduates, and a third were members during graduate work (See Table 1).

Table 1. Membership During Undergraduate and Graduate Studies (n = 58)

SWE Membership while in College	Undergraduate	Graduate
No	29	37
Yes	29	21

Because some SWE members join as an undergraduate and remain members throughout their careers, there were survey questions regarding this involvement. The respondents stating they were members of SWE during their years as an undergraduate student included those that served as the founding president, president (3), secretary (4), treasurer, and various committee members in their student section. Those that were members of SWE during their tenure as a graduate student indicated that there were limited opportunities to serve and the reasons cited included no graduate student sections, lack of time, and no opportunity to do so. Once a student graduates, some elect not to continue their membership in SWE or other professional organizations where they were student members.

Figure 2 summarizes the responses to the question regarding their primary reason for becoming a professional member of SWE. Some respondents chose more than one response. Most joined SWE as a professional member mainly for the networking opportunities (n=34), with outreach as the second highest (n=13). Because SWE emphasizes industry, research opportunities had a

lower response rate. Many respondents answered "Other" to this question, but did not have the option of adding text to describe the "Other".

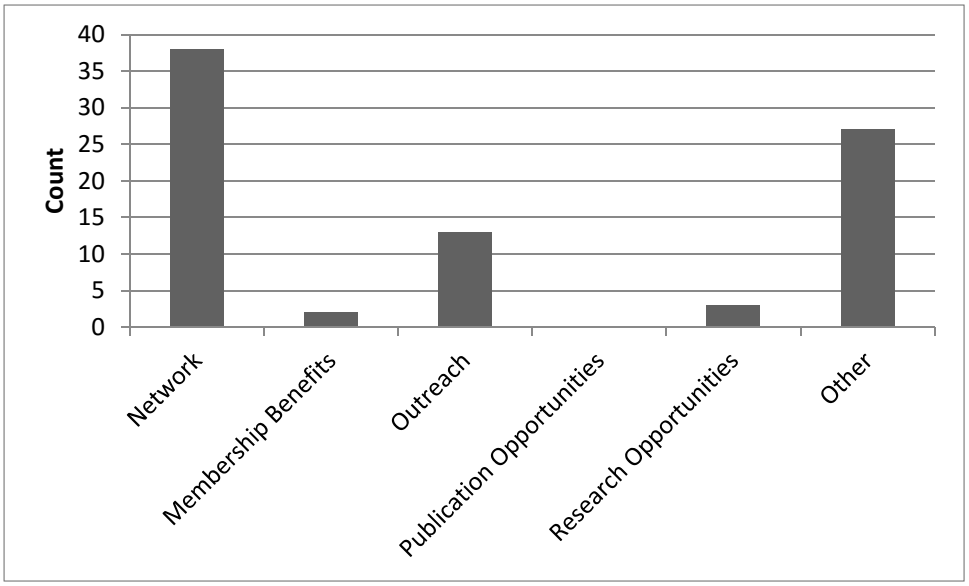

Figure 2. Primary Reason for Joining SWE as a Professional (n = 58)

When asked what discipline the respondents practiced, the result was overwhelmingly Mechanical Engineering, followed by Civil Engineering. Figure 3 shows respondents representing many different engineering disciplines with Mechanical (n=20) being the highest. This correlates to historical graduation rates by engineering discipline overall. Even though women are a much higher percentage of the 2014-2015 Environmental (49% of 1124) and Biomedical (40% of 5683) engineering graduates, there are more ME graduates (13% of 25,436) and Civil graduates (22% of 11,900) overall due to the sheer volume[15].

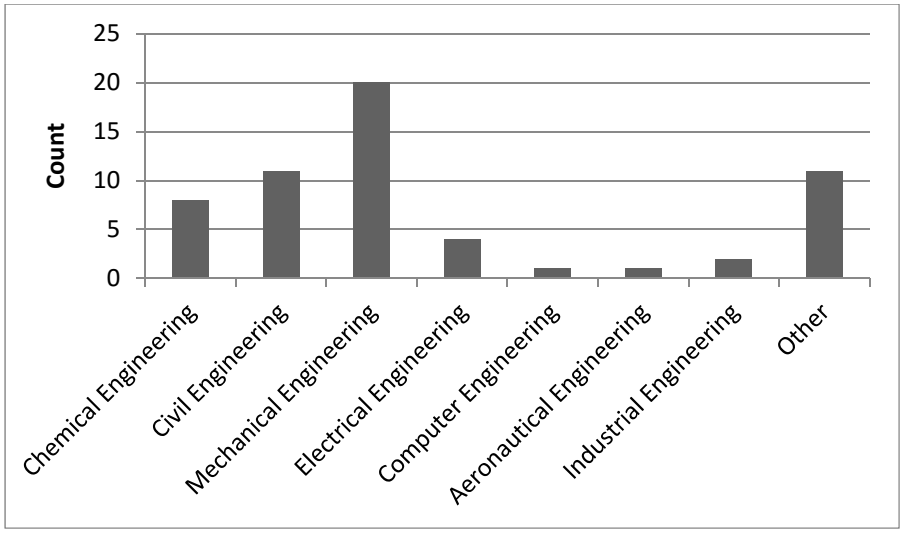

Figure 3. Engineering Disciplines (n = 58)

The evidence of the perceived value of SWE membership to universities is shown in Figure 4. Overwhelmingly, those surveyed perceive that there is little credit given to them for their membership. This is probably related to the fact that SWE is known as an industry-based professional organization.

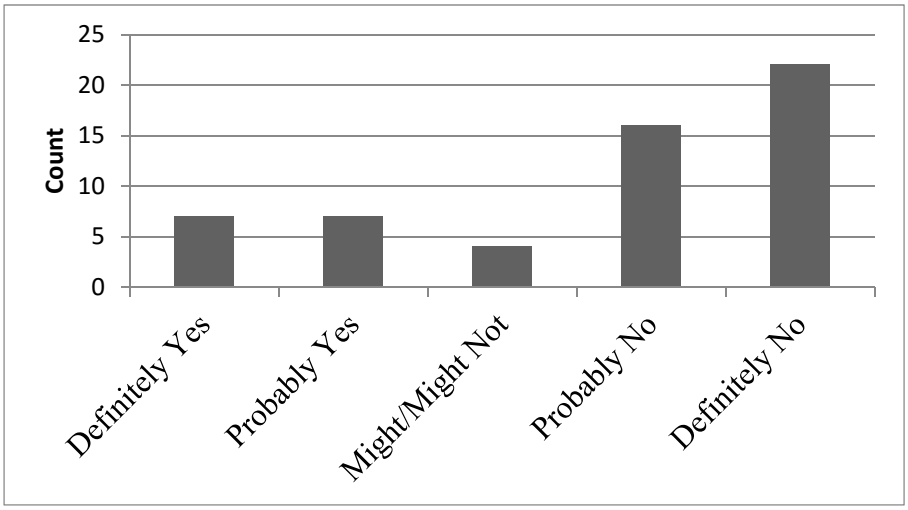

Figure 4. Departmental Credit for SWE Involvement (n = 56)

There might be a correlation between getting credit for being involved with SWE and the type of institutions the respondents worked for. Slightly more than half of the respondents (58%) worked for a public university with doctoral programs, whereas only 12% work for an undergraduate only university or college. This is reflected when asked in the survey how important research, teaching, administrative duties or personnel management was. Roughly half (48%) of the respondents indicated that teaching was extremely important, followed by research at 38%. When asked in the survey if they would consider leaving academia, most of the respondents stated "no" (Figure 5). This implies that the women surveyed find value in working in an academic setting. This is an encouraging statistic because many women in engineering elect to leave and find opportunities outside of engineering.

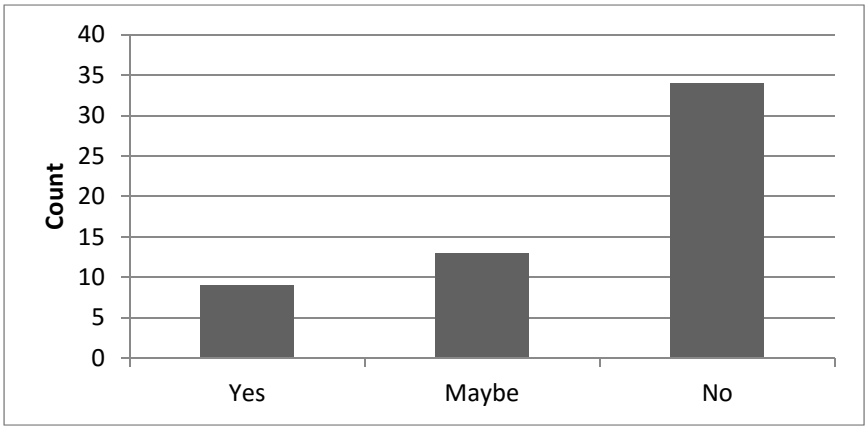

Figure 5. Considering Leaving Academia (n = 56)

Using content analysis to summarize data from the question asking if respondents were considering or may be considering a change to their current career path, the majority indicated that they would either retire (n=6), go to industry (n=8), train for a new field (n=2), or go to a non-profit organization (n=2). When asked what their largest obstacle or problem facing them today is the respondents indicated the following:

- Obtaining Grants/Funding and Supporting Graduate Students (n=13)
- Lack of Time/Work Life Balance (n=9)
- Unreasonable Senior Colleagues/Political Situations (n=8)
- Implicit Bias (n=3)
- Lack of Support for Engineering Technology (n=2)
- No Ph.D. (n=2)
- Financial Health of Institution (n=2)
- Geographic/Personal Attachments
- Finishing Terminal Degree
- Teaching Large Classes

Based on the survey results the authors found that women in academic careers joined SWE as an undergraduate and maintained their membership into a career as an academic. Some of the respondents were traditional students as they progressed through degree attainment in close succession. Others were non-traditional students that worked for a number of years in industry and then moved into an academic career. Regardless of their career path most of the respondents joined SWE as undergraduates.

This leads to the second question of why the women in academic careers maintain membership in SWE. The answers to this question vary with some respondents stating they were a member of the Board of Directors or held another leadership position within the organization, had outreach opportunities, and valued the networking opportunities.

Discussion

The mission of the WIA Committee of the Society of Women Engineers is to support female engineers who work for academic institutions. For this paper, the value of SWE membership was examined through the lenses of members in academia and how it relates to more traditional professional society memberships. Overall, members in academia join for long periods, often because they were involved as undergraduates or because they are faculty advisors to local chapters. However, there are few perceived benefits in terms of career advancement in academia for being involved in SWE at the local or national level. The results suggest the following

answers to the question proposed.

For most academics, there are three areas that contribute toward career progress: research, teaching, and service. Each university has its own defined emphasis on each of those areas. Involvement in SWE is very likely not considered as part of the tenure process. WIA members join for networking and not for professional advancement. Better visibility within the SWE community could provide opportunities that match the three traditional areas of research, teaching, and service. Because SWE is an industry facing organization, hence a large undergraduate membership, increasing connections to possible research funding may be symbiotic.

Many female faculty associate with SWE through their students as they continue to be members. A surprising outcome of this survey was that most women have been SWE members for multiple years despite their perception of SWE being getting no credit towards tenure for service to SWE. This survey made it clear that involvement in leadership within SWE enhanced members' commitment to the overall organization. Most respondents were a member as an undergraduate or graduate student, which means that the retention rate is very high for members. This could be because SWE provides members a variety of networking and leadership possibilities. However, factors for faculty retention and promotion are still largely driven by research. This survey has shown that women find satisfaction in working in academia, but often find professional societies unsupportive.

Conclusions

Women working in academia face unique challenges, especially in engineering. Historically, SWE has provided a networking and support structure for women engineers, but has not emphasized research or academia. The WIA committee in SWE provides a path for women with academic careers to have a place and a voice in SWE.

The survey responses share things that are known to be true throughout the organization such as the desire to do outreach is attractive to prospective SWE members. The results of this survey support that knowledge. The respondents to the survey are generally long term (>10 years) members of the society and have participated in volunteer activities throughout the organization. Academics are unique in that their promotion system requires peer evaluated publications in a variety of sources, presentations, dissemination of well-crafted research, and various levels of recognition for their work. SWE supports some of the needs of this group, and not others. It is the authors' plan to share the survey data with the intent to further develop the understanding of this group of members within SWE. It is believed that SWE will enhance their offerings and support based upon the findings of this research, while other professional societies review their programs and increase their support for a group that has not experienced a great deal of support in the past. The authors recommend that the WIA Committee of SWE begin to offer networking

opportunities that emphasize research such as networking events at conferences, disseminating information on research opportunities, and facilitating connections between academic members with related research interests. In several years, this survey should be re-administered to see whether these activities have been successful in meeting the needs of current SWE members and attracting new SWE members.

References

1 Society of Women Engineers. *About SWE*, <http://societyofwomenengineers.swe.org/about-swe> (2017).

2 Society of Women Engineers. *The SWE Story*, <http://societyofwomenengineers.swe.org/membership/history/2454-the-swe-story> (2015).

3 Hein, G. L., Faas. D., Lucietto, A.M., Nagel, J., Peters, D., Verstraete, M, & O'Bannon, D. The chaging Role of Professional Societies for academics. Paper presented in *2016 ASEE Annual Conference* (ed ASEE) (New Orleans, LA, 2016).

4 Hatmaker, D. M. Engineering identity: Gender and professional identity negotiation among women engineers. *Gender, Work & Organization* **20**, 382-396 (2013).

5 Settles, I. H. & O'Connor, R. C. Incivility at academic conferences: gender differences and the mediating role of climate. *Sex Roles* **71**, 71-82 (2014).

6 Gazley, B., Tschirhart, M. & Hager, M. A. Engagement motivations in professional associations. *Nonprofit and Voluntary Sector Quarterly* **43**, 39S-60S (2014).

7 Fink, A. *How to conduct surveys: A step-by-step guide*. (Sage Publications, 2012).

8 Blair, J., Czaja, R. F. & Blair, E. A. *Designing surveys: A guide to decisions and procedures*. (Sage Publications, 2013).

9 Van Selm, M. & Jankowski, N. Conducting Online Surveys. *Qual Quant* **40**, 435-456, doi:10.1007/s11135-005-8081-8 (2006).

10 de Sola Pool, I. *Trends in Content Analysis. Eidted by Ithiel de Sola Pool*. (University of Illinois Press, 1959).

11 Krippendorff, K. *Content analysis: An introduction to its methodology*. (Sage, 2012).

12 Neuendorf, K. A. *The content analysis guidebook*. (Sage, 2002).

13 Baruch, Y. & Holtom, B. C. Survey response rate levels and trends in organizational research. *Human Relations* **61**, 1139-1160 (2008).

14 Johnson, T. & Owens, L. Survey response rate re porting in the professional literature. Paper presented in *58th Annual Meeting of the American Association for Public Opinion Research, Nashville.(2003).*

15 Yoder, B. L. in *American Society for Engineering Education.*