

6-2016

The Changing Role of Professional Societies for Academics

Gretchen L. Hein
Michigan Technological University

Daniela Faas
Harvard University

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

Jacquelyn Kay Nagel
James Madison University

Diane L. Peters
Kettering University

See next page for additional authors

Follow this and additional works at: <https://docs.lib.purdue.edu/enepubs>



Part of the [Engineering Education Commons](#)

Hein, Gretchen L.; Faas, Daniela; Lucietto, Anne M.; Nagel, Jacquelyn Kay; Peters, Diane L.; Reck, Rebecca M.; Vestraete, Mary C.; and O'Bannon, Deborah J., "The Changing Role of Professional Societies for Academics" (2016). *School of Engineering Education Faculty Publications*. Paper 44.
<http://dx.doi.org/10.18260/p.27356>

This document has been made available through Purdue e-Pubs, a service of the Purdue University Libraries.
Please contact epubs@purdue.edu for additional information.

Authors

Gretchen L. Hein, Daniela Faas, Anne M. Lucietto, Jacquelyn Kay Nagel, Diane L. Peters, Rebecca M. Reck, Mary C. Vestraete, and Deborah J. O'Bannon

The Changing Role of Professional Societies for Academics

Dr. Gretchen L. Hein, Michigan Technological University

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

Dr. Daniela Faas, Harvard University

Dr. Faas is currently the Senior Preceptor in Design Instruction at the School of Engineering and Applied Science at Harvard University. She is also a research affiliate in the Department of Mechanical Engineering at MIT. Dr. Faas was the Shapiro Postdoctoral Fellow in the Department of Mechanical Engineering at MIT from July 2010 to July 2012. She received her Ph.D. in Mechanical Engineering and Human Computer Interaction at Iowa State University under Prof. Judy M. Vance in 2010. Her research developed a methodology to support low clearance immersive, intuitive manual assembly while using low-cost desktop-based Virtual Reality systems with haptic force-feedback. Research interests: virtual reality (VR) applications in mechanical design, design methodology and engineering education.

Dr. Anne M Lucietto, Purdue University

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 of engineering technology students in the classroom and using that knowledge to engage them in their studies. Dr. Lucietto is a Fellow in the Society of Women Engineers, Senior Member of IEEE, and a member of other professional organizations.

Dr. Jacquelyn Kay Nagel, James Madison University

Dr. Jacquelyn K. Nagel is an Assistant Professor in the Department of Engineering at James Madison University. She has eight years of diversified engineering design experience, both in academia and industry, and has experienced engineering design in a range of contexts, including product design, bio-inspired design, electrical and control system design, manufacturing system design, and design for the factory floor. In 2012, Dr. Nagel was recognized by the National eWeek Foundation and IEEE-USA as one of the New Faces of Engineering for her pioneering work in bio-inspired design. In 2013, she attended the National Academy of Engineering's (NAE) fifth Frontiers of Engineering Education (FOEE) symposium where she was recognized as an innovative engineering educator. Dr. Nagel earned her Ph.D. in mechanical engineering from Oregon State University and her M.S. and B.S. in manufacturing engineering and electrical engineering, respectively, from the Missouri University of Science and Technology.

Dr. Diane L Peters P.E., Kettering University

Dr. Peters is an Assistant Professor of Mechanical Engineering at Kettering University.

Dr. Rebecca M. Reck, Kettering University

Rebecca M. Reck is a Visiting Assistant Professor of Mechanical Engineering at Kettering University. She completed her Ph.D. in systems and entrepreneurial engineering at the University of Illinois at Urbana-Champaign in 2016 and her master's degree in electrical engineering at Iowa State University in 2010. During her eight years at Rockwell Collins as a systems engineer, she contributed to the development of the new ProLine Fusion Flight Control System and served as the project lead for two aircraft. She earned a bachelor's degree in electrical engineering with a mathematics minor from Rose-Hulman Institute of Technology in 2005. Her research interests include control systems, mechatronics, instructional laboratories, and experiential learning.

Dr. Mary C. Verstraete, The University of Akron

Mary Verstraete is an Associate Professor of Biomedical Engineering and the Associate Chair for the Undergraduate Program in Biomedical Engineering at The University of Akron. She is also the faculty advisor for the student chapter of the Society of Women Engineers and the BME faculty advisor for Tau Beta Pi. Dr. Verstraete received her BS, MS and PhD in Engineering Mechanics, with a focus in Biomechanics, from Michigan State University and started working as an Assistant Professor at The University of Akron in 1988. During her 27 years at the university, she has received tenure and promotion to Associate Professor (only the second woman to do so in the College of Engineering), served as the first Director of the Women in Engineering Program, and served four years as Department Chair of Biomedical Engineering. Dr. Verstraete has been awarded numerous teaching honors, both within The University of Akron (university and College wide) and nationally from the Society of Women Engineers (Distinguished Engineering Educator Award) and the American Society of Engineering Education Biomedical Engineering Division (Theo C. Pilkington Outstanding Educator Award and North Central Section Outstanding Teaching Award).

Dr. Deborah J. O'Bannon P.E., University of Missouri, Kansas City

Deborah O'Bannon is a Professor of Civil Engineering at the University of Missouri-Kansas City, PE, a Fellow in ASCE and SWE, and has been directing the civil engineering capstone class since 2003. The class received one of the inaugural NCEES Awards for Connecting Professional Practice and Education in 2009.

The Changing Role of Professional Societies for Academics

Abstract

This research paper describes how professional societies provide services to their members with a focus on the Society of Women Engineers (SWE). Professional societies fulfill many roles for their members. For underrepresented groups, the different roles become more important. Despite increasing numbers of women and other underrepresented groups in engineering academia, retention rates of women are still below the national average. Professional societies such as the Society of Women Engineers (SWE) may close the retention gap through community building. Not only do professional societies provide opportunities for networking and career building, but they also provide affirmation that there are others in similar roles. Although there are financial and time constraints to becoming active within a professional society not affiliated with one's technical area, when academics feel that their involvement is valuable to their career development they will invest necessary time and money into the professional society. Similarities exist between how professional societies retain/attract faculty from underrepresented groups and how universities accomplish the same goal.

This research paper focuses on how one professional organization, SWE, is providing opportunities to women in academia that include professional development, recognition/awards, networking, leadership development, and career advancement. In the past, SWE has been viewed as a non-technical professional society. However, SWE is uniquely positioned to provide a community that transcends the organizational boundaries by encompassing technical, service, and professional development areas for women in academia that is inclusive, collaborative, and supportive as well as connected to industry, government and academia on multiple levels.

Introduction/Motivation

Many women enter careers in engineering and other STEM fields and find that they lack a community where they feel they belong. Professional societies can help fill that need and provide a variety of networking and career building resources. There are many professional societies, some with a disciplinary focus and others focused on cross-disciplinary commonalities such as professional engineering registration status (e.g., the National Society of Professional Engineers), interests in an area such as education (e.g., the American Society for Engineering Education), or affinity-based organizations. The Society of Women Engineers (SWE) is one such affinity based organization, without a venue for publishing technical papers or standards, but focused on generating a sense of community and giving tools to succeed. Since SWE formed in 1950, it has shown how female engineers are an asset to the engineering profession and community. While SWE's initial focus was on women pursuing careers in industry, the society has recognized and broadened its membership base to include other career paths, including those involving entrepreneurship, government service, and academic careers. SWE's constituents are no longer just undergraduate students enrolled in a college or university, but has expanded to include

graduate students and professionals of all levels. This population often includes non-traditional students, professionals who have returned to academia for additional training, degrees, or to enact a career change.

Within SWE there are committees and ad hoc focus groups. The Women in Academia (WIA) Committee and community within SWE has been an advocacy group for promoting careers in academia and providing a supportive link between the professional and academic members. The WIA committee consists of approximately 20 members who are active in planning and carrying out activities relevant to the larger academic community within SWE. To strengthen the advocacy efforts of SWE, the committee developed an advocacy statement of what the WIA Committee supports. This statement was subsequently adopted by the SWE Board of Directors. The full advocacy statement is in Appendix A. The key points, which are important to this discussion of what SWE and WIA offer its membership, include the following:

- tools and resources to support the interests of these members,
- advocating with the institutions and universities where these members work and volunteer,
- educating others about this unique career track,
- support networking of these and other members,
- development of a STEM pipeline of female STEM academics.

SWE, like other professional societies, recognizes the significance of mentoring, relationships, and retention of like-minded engineers. In the case of this discussion, it has been recognized for decades that female STEM faculty benefit from mentoring due to their unique position in academia.¹ Not only are there issues based on gender, but female STEM faculty are often part of a non-traditional group, which may include older, minority, and disabled women. Due to the nature of this paper, we will consider these topics as appropriate, but will focus on retention of women in academia, support from other professional societies, networking, and SWE's unique role of supporting women in all areas of engineering. Within the context of WIA, we will discuss the roles professional societies fulfil in academic settings, retention of women in academia, SWE's ability to build community in this population, and where SWE can benefit from its involvement in academia.

Roles of Professional Societies in Academic Settings

Women have been historically and continue to be underrepresented in STEM fields. American Society for Engineering Education (ASEE) tracks the degrees earned by different groups. In 2011, 22.6% of the doctoral degrees earned were by women, but women comprise only 13.8% of engineering tenured and tenure track faculty. For underrepresented groups within engineering, the numbers are even lower where 2.5% and 3.7% of faculty are African American and Hispanic, respectively.² While women and underrepresented groups comprise such a low percentage of

academic positions, many universities are actively recruiting faculty from them. In fact, in national hiring experiments, it was shown that there is a 2:1 preference to hire women for STEM tenure track positions.³

Professional societies play a large role in networking for professionals and faculty. The impact of these organizations on career development differs for the two groups. In engineering, professional organizations play a large role in licensing and certification. Members of these organizations are active in service and commitment to their societies. Overall, in engineering professional organizations, there is a higher percentage of members with advanced degrees than those with a bachelor's. This study also showed that there was a higher percentage of women volunteering than men.⁴

The American Society of Mechanical Engineers (ASME) Design Engineering Division (DED) have developed and instituted workshops that focus on professional skills for their members, along with “building awareness of the inequalities that still exist in our community and beyond”.² From 2009 onward, the ASME DED developed workshops that were held annually at the ASME International Design Engineering Technical Conferences (IDETC). Each year, there were workshops that covered a different topic. The goal of the program was to increase the diversity of the DED. Therefore, the organizers contacted chairs of Mechanical Engineering Departments and sent out information to various lists. The overall goal was for 70% of the workshop attendees to be from underrepresented groups with the attendee composition ranging from graduate students through senior faculty and administrators. The result of the program is that the attendees over time became more involved in DED activities and had a positive effect on their careers.²

Another study was completed where faculty in “biological sciences, chemistry, computer science, earth and atmospheric sciences, electrical engineering and physics” were surveyed to determine their involvement in STEM leadership which was defined as someone who had a “position in a professional science or regulatory organizations.”⁵ The researchers found that women were more likely than men to have these types of positions. It was not clear in the research if these positions were volunteer or compensated. The study also showed that individuals who had a larger network were more likely to hold STEM leadership positions. As expected, obtaining research grants, submitting research proposals and journal publications were all associated with STEM leadership. The study showed that being a woman increases the probability of being a STEM leader but they tend to be in that position if they are connected to a man in the field. This could be due to the lack of women in STEM, the goal of increasing diversity in STEM or the high quality of women who remain in STEM fields.⁵

Retention of Women in Academia

Issues surrounding the retention of women in engineering careers are not unique to academia.² Throughout all types of engineering career paths, women have a greater tendency to leave the

field than do men.⁶ There is no one single cause for the retention issues; some of the factors involved are work-life balance, maternal benefits, equal pay, implicit bias, and the overall work environment.^{6,7} These concerns are common to both industry and academia, although they may manifest themselves differently. In academia, for example, implicit bias may affect students' evaluations of an instructor. It has been shown that women experience bias in students' ratings of professors^{8,9}, and that women may receive less credit than male collaborators for their joint work in some fields.¹⁰ It has also been found that women receive fewer citations, despite publishing in more prestigious journals than men do,¹¹ and that women are less likely than men to self-cite.¹² All of these factors affect how women are perceived by their colleagues, which is important in the promotion and tenure process and therefore has a strong effect on retention.

One of the important things that increases retention of women and minorities is effective mentoring.⁶ It has been found that, if someone is a minority in their field, at least one of their mentors should be a member of the same minority population. One particular work on mentoring, focused on African-American faculty members, found that mentors were able to provide resources, listen, and in particular relate to their protégés, and that this was of value in encouraging persistence.¹³

There are a number of different efforts to promote retention of engineering faculty, initiated through a variety of different organizations. Some of these organizations are Institute of Electrical and Electronics Engineers (IEEE) and Women in Engineering Programs & Advocates Network (WEPAN), both of which hold webinars for new faculty members. IEEE has hosted five virtual events of varying in length from a few hours to multi-day conferences for early career faculty.¹⁴ Topics of these events have ranged from broad topics like launching a successful academic career to specific topics like standards education and student assessment. WEPAN has a variety of resources for all faculty to create a more inclusive classroom.¹⁵ The WEPAN resources are part of a project called Engineering Inclusive Teaching sponsored by the National Science Foundation (NSF).

Organizations that include advocating for women in their mission, such as Association for Women in Science (AWIS), WEPAN, and American Association of University Women (AAUW), have resources for women academics, while others are carried out by technical or disciplinary societies, such as IEEE and ASEE. In the latter case, advocating for women is the mission of a smaller division of the larger organization. Some examples of such divisions are IEEE's Women in Engineering (WIE) and the Women in Control group within IEEE's Control Systems Society (CSS); the ASME board on Minorities and Women in Engineering; and ASEE's Women in Engineering Division.⁷

These organizations are seen very differently in the promotion and tenure process. Typically, organizations such as IEEE, ASME, etc. are seen as being a "technical home", in which members can present their research and interact with a technical community. In contrast, organizations such as SWE, AWIS, WEPAN, and AAUW are seen as being less important, and involvement with them is not weighted as heavily. However, these organizations can serve an important purpose, as they are one avenue that can connect women with a larger network, and

with potential mentors. As it has been found that inter-institutional networking and mentoring is particularly useful to women,¹⁶ involvement with these societies is also beneficial to female faculty's home institutions.

SWE and Retention of Women in Academia

SWE has long been concerned with issues surrounding the retention of women in engineering careers, particularly since close to 40 percent of women with engineering degrees choose to pursue other fields.^{17,18} One of the Society's strategic goals is to advocate for the success of women in engineering and technology. SWE's advocacy includes an annual trip to Washington D.C. for congressional visits. Some of the topics of discussion for the trip in 2015 included equal access to research funding from the Federal Government and providing opportunities for women to lead in STEM fields.¹⁹ In the past topics have included equal pay and resources for working mothers. While SWE advocates for all women in STEM fields, some of the topics promoted in these annual trips are also of importance to women in academia.

While SWE's membership is primarily composed of undergraduate students in engineering and professionals working in industry, there is a growing contingent of the membership who are pursuing academic careers, and there is an active WIA committee within SWE. Because of its longstanding interest in retention of female engineers, and this growing academic contingent, SWE is working to address issues of retention among women pursuing academic careers.

SWE has several activities, initiated by the WIA Committee, which promote the retention of women in engineering faculty positions. These activities include a mentoring program that connects female faculty members with more senior female faculty, a dedicated academic track at the Society's Annual Conference, and a series of webinars on topics of interest to female academics, such as the tenure process.

SWE began offering webinars on various professional development topics about five years ago. A further discussion of these webinars is given later in the paper. These webinars are free to members and have a nominal cost to non-members. In the past three years, the WIA Committee has developed and held webinars with topics focusing on the promotion and tenure process, how to establish a research program at a predominantly undergraduate university, two-body problem strategies, and paths through graduate school and beyond. These webinars are typically well attended, with a few recent topics and the number of registrants listed below. While not all registrants attend the webinar at the time of broadcast, others may view the replay later, when their schedule permits. They provide women pursuing careers in academia with career development and networking opportunities. But sometimes, this contact is insufficient to provide all the needed communication that new faculty need:

- Managing dual careers in academia: 96 registrants
- Choosing and delivering a high quality online program: 40 registrants
- Access Engineering, Part 1: 39 registrants
- Access Engineering, Part 2: 36 registrants

Mentoring is another way to enable women in academia to succeed. Mentoring serves many purposes. It was once thought to be different for men and women, however Levesque, O'Neil, Nelson and Dumas²⁰ do not agree. They found that both genders have the same perception of mentoring behaviors, with women reporting that they expect mentors to champion them, as well as approve of their behaviors.²⁰ Others performing generalized research on mentoring support the use of mentoring to increase retention, increase faculty success, and provide social networking of like-minded professionals.²¹

Hall, et al¹ and Thomas²² as well as others researching this area affirm that mentoring systems are generally designed to support male faculty as opposed to female faculty. Discussion of this issue has been going on for decades, and others continue that discussion today. Due to the lower numbers of female engineering faculty on campus, there is a shortage of female faculty. Men hesitate to mentor women, making the mentoring relations difficult to establish with a small pool of potential mentors. This situation has been recognized and organizations such as the NSF have sponsored Women in Engineering Leadership Conferences that include female professors since 2000.²³ Other programs and activities undertaken to support female engineers, including STEM faculty, have not focused entirely on female STEM faculty in academia. Thus supporting the boundaries that develop and deter the flow of new faculty into this space.²⁴

Recently, the WIA Committee began a mentoring program for new female faculty in order to answer these unmet needs. The purpose is to provide new faculty with a person with whom they can discuss their research, teaching, committee challenges and receive advice and support. Since the program began in 2014, over 20 mentor-protégé relationships have developed, with a total of 93 applications received for the program since its inception. Since the program is a membership benefit, those who are not yet SWE members are not eligible; however, several applicants have joined SWE specifically in order to be able to participate in the program. One challenge in running the program is the smaller number of senior faculty who are available to serve as mentors, as there is more demand for mentors than can easily be answered.

SWE as Community building within Academia

Community building, within any type of organization, is the creation or enhancement of a community of individuals with a common interest. The outcomes of community building include fostering a sense of place, a sense of coherence and identity through joint action, a sense of inclusion through relationship building, and a sense of diversity through social complexity among a group of individuals that might not otherwise engage with each other.²⁵

Community building within academia is often segmented by type of institution, as the requirements for tenure and promotion are very different across research intensive, master's granting, and predominately undergraduate institutions. Meaning the faculty at research intensive institutions typically connect or collaborate with faculty at other research intensive institutions as those relationships might result in research collaborations, funding opportunities, a pipeline for graduate students, or publications. However, often within the same institution, departmental and college focus on teaching and research is so different that the basis for tenure can be rather different. Faculty at master's granting institutions, or predominately undergraduate institutions where teaching is the focus often find tenure requirements vary, as related to the primary objectives of those respective institutions. Although academics at all types of institutions are evaluated on their performance in the areas of teaching, service, and research, the three areas carry different weights at the different types of institutions. This identifies a gap in academic community building across institution types.

Participation in a technical (e.g., IEEE, ASME) or educational society (e.g., ASEE) is often a means for meeting promotion and tenure requirements and does not necessarily offer community building as described by MacQueen.²⁵ The Women in Academia community within SWE offers something that technical (e.g., IEEE, ASME) and educational societies (e.g., ASEE) cannot—a community that transcends the organizational boundaries (beyond professional development and networking) by encompassing technical, service, and professional development areas for women in academia that is inclusive, collaborative, and supportive as well as connected to industry, government, and academia on multiple levels. SWE WIA addresses the identified gap in academic community building by bringing together academics from a variety of institution types interested in topics broader than (but indirectly related to) promotion and tenure requirements such as support and technical networks, fostering women interested in academia, and best practice sharing.

With respect to network building the SWE Women in Academia community facilitates mentorship, collaboration (industry, academic), and consultant opportunities. As discussed previously, a formal mentoring program was started to connect junior and senior faculty from a variety of institutions with the goal of supporting and advocating for each other. Other activities include annual socials at different conferences to help members expand their network and to find collaborators. The SWE WIA community also facilitates fostering women interested in academia through sharing student advising/mentoring practices, advertising and recruiting for REUs (Research Experiences of Undergraduates), and sharing employment opportunities. With respect to best practice sharing the SWE WIA community provides an open forum for members to share best practices related to advising SWE collegiate sections, SWE involvement, recruitment/retention, balancing the three areas of promotion and tenure requirements, pedagogy, outreach activities, etcetera. These opportunities are provided through multiple means, such as conferences, webinars, websites, emails, and meetings. The SWE WIA community meets the outcomes of community building as described by MacQueen.²⁵

Benefits for SWE in Academia?

Within SWE, WIA serves two interconnected roles. One is the WIA community serves a participatory role within the organization and has an informal structure. The other is the WIA Committee. The mission of the SWE WIA Committee is to support female engineers who work for academic institutions, including those in tenured, tenure-track, and non-tenure-track positions, as well as those in staff positions. In addition, the WIA Committee has an interest in supporting women who are considering academia as a future career path, thus also often consider the needs of graduate students. This group of women represents a diverse set of employment, promotion, and professional development requirements and needs:

- Careers in academia typically require an advanced degree (Ph.D.)
- Promotion in academia does not take into account 2/3 of typical job responsibilities, thus individuals are unaware of other ways to advance in academia
- Professional development and networking needs of women in academia vary from others in industry
- Academia is an environment that differs greatly from industry and the challenges of a typical work week may be significantly different from industry
- Female faculty are often caught between their own needs and the needs of their students
- Non-tenure track faculty often have their own set of unique development requirements that are often non-research driven.

Many female faculty associate SWE with students. They were a member as an undergraduate or graduate student, or perhaps are currently acting as their institutions' Faculty Advisor. However, SWE has much to offer to all professionals in engineering, including those employed in the academic sector. SWE's 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"²⁶ applies directly to women in academia as they advance their careers, work toward leadership roles in their colleges and universities, and face the same challenges to increase the number of women in their fields. The Society of Women Engineers provides copious resources to assist women in all of these areas.

Regional and Society conferences offer workshops directed at career development for female faculty and for those aspiring towards a faculty position including the following topics from the most recent Society conference in 2015:

- How to Choose your Academic Service Obligations Wisely
- Reviewing Academic Papers: How to Give Useful, Effective Feedback as a Peer Reviewer
- Pedagogy 101 - Introduction to Teaching
- Tips on Grant Proposal Writing for NSF CAREER Grants and Other Programs
- Alternative Pathways to an Engineering Education: Academic Careers in Community College Instruction and Leadership
- Views From the Search Committee

- Pursuing an Academic Career after Industry Experience
- Strategies for Obtaining Your First Academic Position

Webinars, mentioned previously, are available to SWE members covering a similar variety of topics. Furthermore, these conferences could be a unique opportunity to be used as a recruitment tool for universities to increase their diversity portfolio. Currently, universities participate in the Career Fair at SWE conferences in order to recruit female graduate students; while many of these graduate students go into industry, others do intend to follow academic careers, and this both builds the academic pipeline and assists future academics in building their networks. Building a large network is a key component to a successful faculty application.

Involvement in local section activities also provides members in academia a variety of networking and career development possibilities. “SWE will be a prime facilitator for creating personal relationships, support systems, and networking between women in engineering and technology.”²⁶ Meeting with female engineers from area industries and organizations allows academics to better understand the needs of women outside the academic community, as well as making important connections related to research activities, outreach plans and requirements, and other professional development opportunities. It also provides a personal support network for members.

Another facet of SWE, as stated in its description, is to be recognized for building leadership skills and providing leadership experience. Leadership development is not typically a focus of other technical societies and skills are difficult to develop without practical experience. Involvement in a professional society such as SWE opens opportunities for leadership development in part due to a rich pool of mentors and advisors. SWE, as a national organization, allows these mentors to come from different organizations and universities and backgrounds to provide unique practical leadership experience. This is critical to the success of underrepresented groups. SWE also promotes women through the recognition of their accomplishments through the numerous awards presented to members each and every year. Active participation exposes potential nominees to the process and to experienced nominators to help them.

Although SWE is not recognized by many as a “professional” technical organization, and it does not directly influence a faculty member’s ability to generate research sufficient to be considered for tenure and promotion, SWE members recognize that the organization provides many intangible benefits such as those discussed above. Ultimately, deep and positive connections within the SWE community can improve professional goals, leadership skills, and skill sets unique to academic careers.

Conclusions

Professional societies have a role in promoting women in academia. They provide many aspects that are valuable for career development and advancement. They are supportive of the unique concerns of underrepresented groups. In some societies (e.g. ASEE, IEEE, ASME), this is done through divisions whose focus is on a subset of their membership. The structure of SWE is

different because its focus is a specific engineering group, women, with communities and committees addressing the professional concerns needs of their members. We have provided examples of how SWE is providing disciplinary, affinity-based and academic communities for its members. The examples provided can be used as a model for other organizations.

Women continue to be underrepresented in STEM fields, which means that there are fewer women that serve as faculty members compared to their male counterparts. While faculty recruitment has shifted to seek out applications from women, there are still hurdles that are unique to women and other underrepresented groups in academic settings. SWE is a unique professional society that can provide a community that transcends the organizational boundaries by encompassing technical, service, and professional development areas for women in academia that is inclusive, collaborative, and supportive as well as connected to industry, government and academia on multiple levels.

References

1. Hall, R. M. & Sandler, B. R. Academic Mentoring for Women Students and Faculty: A New Look at an Old Way to Get Ahead. (1983).
2. Fu, Katherine; Reid, Tahira N.; Terpenney, Janis P.; Thurston, Deborah; Vance, Judy M.; Finger, Susan; Wiens, Gloria J.; Kazerounian, Kazem; Allen, Janet Katherine; and Jacobson, Kathy. Broadening Participation: A Report on a Series of Workshops Aimed at Building Community and Increasing the Number of Women and Minorities in Engineering Design, *Mechanical Engineering Conference Presentations, Papers, and Proceedings 2013, Paper 11*.
3. Williams, W. M. & Ceci, S. J. National hiring experiments reveal 2:1 faculty preference for women on STEM tenure track. *Proceedings of the National Academy of Sciences* **112**, 5360-5365, doi:10.1073/pnas.1418878112 (2015).
4. Hager, M. A., Engagement Motivations in Professional Associations. *Non-Profit and Voluntary Sector Quarterly*, Vol 43 (2S), Pg. 39S-60S (2013).
5. Parker, M., Welch, E.W., Professional networks, science ability, and gender determinants of three types of leadership in academic science and engineering, *The Leadership Quarterly*, Vol. 24, Pg. 332-348 <www.elsevier.com/locate/leaqua> (2013).
6. Stewart, A. J., La Vaque-Manty, D., & Malley, J. E. Recruiting female faculty members in science and engineering: preliminary evaluation of one intervention model. *Journal of Women and Minorities in Science and Engineering*, 10(4) (2004).
7. Rockquomore, K. A. For a Diverse Faculty, Start with Retention. *Inside Higher Ed*. <https://www.insidehighered.com/advice/2016/01/06/how-retain-diverse-faculty-essay> (2016).
8. Flaherty, C. Bias against female instructors. *Inside Higher Ed*. <https://www.insidehighered.com/news/2016/01/11/new-analysis-offers-more-evidence-against-student-evaluations-teaching> (2016).
9. Powell, A. Rate My Professors data shows students' gender bias against professors. *USA Today*. <http://college.usatoday.com/2015/02/16/rate-my-professors-data-shows-students-gender-bias-against-professors/> (2015).
10. Guo, J. Why men get all the credit when they work with women. *The Washington Post*. <https://www.washingtonpost.com/news/wonk/wp/2015/11/13/why-men-get-all-the-credit-when-they-work-with-women/> (2015).

11. Reynolds, E. Female engineers publish in better journals but get fewer citations. *Science*. <http://www.sciencemag.org/scientific-community/2016/01/female-engineers-publish-better-journals-receive-fewer-citations> (2016).
12. Benderly, B. L. Men have a greater tendency to cite themselves, study says. *Science*. <http://www.sciencemag.org/careers/2015/09/men-have-greater-tendency-cite-themselves-study-says> (2015).
13. Mondisa, J.-L. Increasing diversity in higher education by examining African-American STEM mentors' mentoring approaches. In *Interactive Collaborative Learning (ICL), 2015 International Conference on* (pp. 321-326). IEEE. (2015).
14. IEEE Virtual Workshop Series on Early Career Faculty Development (ECFD). https://www.ieee.org/education_careers/education/university_programs/early_career_faculty_conference.html (2016).
15. WEPAN Engineering Inclusive Teaching: Faculty Development Program. <http://www.wskc.org/eit> (2015).
16. Niemeier, D. A., & Smith, V. Building careers, transforming institutions: underrepresented women and minorities, leadership opportunities, and interinstitutional networking. *Journal of Women and Minorities in Science and Engineering*, *11*(2). (2005).
17. St. Fleur, N. Many women leave engineering, blame the work culture. NPR : All Tech Considered <http://www.npr.org/sections/alltechconsidered/2014/08/12/339638726/many-women-leave-engineering-blame-the-work-culture?sc=17&f=1001> (2014).
18. Frehill, Lisa M.. The Society of Women Engineers National Survey about Engineering. SWE CPC Exclusive. <http://www.nxtbook.com/nxtbooks/swe/nationalsurveyengineering/index.php?startid=20&q=retention+study> (2014).
19. Society of Women Engineers. Legislative Action Center. <http://societyofwomenengineers.swe.org/legislative-action-center#/1/background> (2016).
20. Levesque, L. L., O'Neill, R. M., Nelson, T. & Dumas, C. Sex differences in the perceived importance of mentoring functions. *Career Development International* **10**, 429-443, doi:doi:10.1108/13620430510620539 (2005).
21. Ugrin, J. C., Odom, M. D. & Pearson, J. M. Exploring the importance of mentoring for new scholars: A social exchange perspective. *Journal of Information Systems Education* **19**, 343 (2008).
22. Thomas, S. in *Alliances for Advancing Academic Women Bold Visions in Educational Research* (eds PennyJ Gilmer, Berrin Tansel, & MichelleHughes Miller) Ch. 7, 147-164 (SensePublishers, 2014).
23. Niemeier, D. A. & Smith, V. BUILDING CAREERS, TRANSFORMING INSTITUTIONS: UNDERREPRESENTED WOMEN AND MINORITIES, LEADERSHIP OPPORTUNITIES, AND INTERINSTITUTIONAL NETWORKING. **11**, 181-196, doi:10.1615/JWomenMinorScienEng.v11.i2.40 (2005).
24. Pawley, A. L. in *Frontiers In Education Conference-Global Engineering: Knowledge Without Borders, Opportunities Without Passports, 2007. FIE'07. 37th Annual*. S2H-16-S12H-21 (IEEE).
25. MacQueen, Kathleen M., Eleanor McLellan, David S. Metzger, Susan Kegeles, Ronald P. Strauss, Roseanne Scotti, Lynn Blanchard, and Robert T. Trotter. "What is Community? An Evidence-based Definition for Participatory Public Health." *American Journal of Public Health* *91*:1929-1938. (2001).
26. Society of Women Engineers. SWE Vivid Descriptions. <http://societyofwomenengineers.swe.org/about-swe/3943-vivid-descriptions> (2016).

Appendix A - SWE WIA Advocacy Statement

SWE Advocacy for Women in Academia (WIA): What Does it Mean?

The Society of Women Engineers continues to **actively support the advancement of women** in engineering and technology, specifically those who have chosen an **academic career** pathway, through the following means:

1. Providing SWE members who are women in academia (WIA) with tools and resources to enhance their position within their own academic institutions and advocate/make wise choices for themselves. In particular, SWE can promote many existing resources, such as conferences, webinars, mentoring programs, and the awards program, to a new audience, WIA members who may not be taking advantage of these programs. Further, SWE can enhance and develop content and programming, such as the academic track at the annual conference and academic webinars, specifically for academics on topics such as negotiating for startup package, tenure track paths, lecturers vs. research faculty, how options for advancement in academia vary from person to person, grant proposal writing, balancing family obligations during the tenure process, increasing self-citations, etc.

2. Advocating with academic institutions to ensure that women have access to resources to advance within their career, that work/life balance awareness is increased, and that a better work environment for female employees is created. Specifically, SWE can partner with other organizations, such as ASEE, WEPAN, the NSF ADVANCE program, and IEEE, to develop and share best practices for hiring (database for hiring, outside reviewers, etc.). SWE can also engage academic leadership (deans, university presidents) in pointed discussions on, e.g., service obligations, gender bias in student evaluations, involvement in SWE (i.e., is it service or outreach?), implicit bias, and/or policies and procedures (e.g., extension of tenure clock for family leave). This could be achieved by holding a SWE conference specifically for WIA.

3. Educating SWE members, industry partners, and the public about careers in academia and how they differ from careers in industry or government. SWE can create an ‘Academia 101’ presentation to explain what a career in academia entails and how it is different from a career in industry/government as well as host networking and other sessions at SWE conferences to allow industry and government partners to have frank and open conversations about academia.

4. Facilitating personal and professional connections within and between career pathways (academia, industry, and government) and at all levels (research, education, pipeline) to create mutually beneficial partnerships that advance the field of engineering. In particular, SWE can hold events, such as at networking meetups at (regional) SWE events, where people from academia, industry, and government are brought together to promote interaction that can lead to improved education/research. Specific outcomes may include collaborations leading to new curriculum projects, internships, research funding for undergraduates or capstone projects, and government funding for research.

5. Creating a pipeline of female engineering academics by increasing awareness and understanding of the academic career path. For example, SWE can increase understanding of what an academic career path entails, resolve misconceptions, and/or conduct an awareness campaign. Examples include conference sessions and/or webinars targeting a broad engineering audience.