STEMMING THE TIDE: WHY WOMEN LEAVE ENGINEERING

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A study of this scope is not possible without the help and cooperation of many individuals. The study was conducted at the University of Wisconsin-Milwaukee and funded with a grant by the National Science Foundation.

We would first like to acknowledge and thank the many women engineers who so generously volunteered their time to participate in this study. They did so with enthusiasm and commitment, often contributing many suggestions, ideas, and comments to help us gain a better understanding of their decisions to stay in, or leave, an engineering career. We couldn’t have done it without them!

We thank the members of our team who were doctoral students in counseling psychology: Jane Liu, Michelle Parisot, Catia Figuereido, and Melissa Rico and, in particular, Mary Fitzpatrick, a former engineer who provided us with invaluable insights and assistance as we developed the study.

We thank all of the partner universities for their invaluable cooperation and support. We were remarkably fortunate to work with a number of Deans, Associate Deans, and WIE Program Directors from 30 partner universities who dedicated many staff hours and resources to provide us with mechanisms to reach out to their alumnae.

We thank the members of the UWM-ENTECH team who helped to create our website and the database, and continued to help problem solve the inevitable bugs and glitches.

We thank Gina Johnson, Communications Specialist at UWM, for her creative conceptualization and design of all media associated with this study.

We thank Alfonzo Thurman, Dean of Education at UWM, and Kanti Prasad, former Dean of Lubar School of Business at UWM, for their additional financial support of the project.

We thank Patricia Arredondo, Associate Vice Chancellor of Academic Affairs, and Sammis White, Associate Dean, School of Continuing Education, at the UWM Center for the Study of the Workplace, for their support and encouragement.

We thank the media relations team at UWM, particularly Tom Luljak, Vice-Chancellor, University Communications and Media Relations, Laura Glawe, Director, University Communications and Media Relations, and Laura Hunt, Senior University Relations Specialist, for their assistance with the project.

Finally, we thank our families who gave us advice, feedback, and support, especially Dr. A. A. Fouad, who is still disappointed his daughter chose psychology over engineering.

This project was funded by the National Science Foundation ("Women’s Persistence in Engineering Careers: Contextual Barriers/Supports"; NSF # 0827553). Any opinions, findings conclusions, and recommendations, are the authors’ and do not necessarily reflect the views of the National Science Foundation.
KEY FINDINGS: Some women left the field, some never entered and many are currently engineers.

Those who left:

- Nearly half said they left because of working conditions, too much travel, lack of advancement or low salary.
- One-in-three women left because they did not like the workplace climate, their boss or the culture.
- One-in-four left to spend time with family.
- Those who left were not different from current engineers in their interests, confidence in their abilities, or the positive outcomes they expected from performing engineering related tasks.

Those who didn’t enter engineering after graduation:

- A third said it was because of their perceptions of engineering as being inflexible or the engineering workplace culture as being non-supportive of women.
- Thirty percent said they did not pursue engineering after graduation because they were no longer interested in engineering or were interested in another field.
- Many said they are using the knowledge and skills gained in their education in a number of other fields.

Work decisions of women currently working in Engineering:

- Women’s decisions to stay in engineering are best predicted by a combination of psychological factors and factors related to the organizational climate.
- Women’s decisions to stay in engineering can be influenced by key supportive people in the organization, such as supervision and co-workers. Current women engineers who worked in companies that valued and recognized their contributions and invested substantially in their training and professional development, expressed greatest levels of satisfaction with their jobs and careers.
- Women engineers who were treated in a condescending, patronizing manner, and were belittled and undermined by their supervisors and co-workers were most likely to want to leave their organizations.
- Women who considered leaving their companies were also very likely to consider leaving the field of engineering altogether.

STUDY METHODS:

In November 2009, we launched a national longitudinal study, funded by the National Science Foundation (NSF), to investigate women engineers’ experiences in technical workplaces. To reach women who earned engineering undergraduate degrees, we partnered with 30 universities and recruited their female engineering alumnae through e-mail and postcards. Women recognized the importance of the study and responded enthusiastically to our survey. In fact, women from an additional 200 universities have participated after hearing of the study in the media and through colleagues. As of January 2011, over 3,700 women have completed the survey and more than three quarters have agreed to be re-contacted in future waves of the study.

THE PARTICIPANTS

The engineering alumnae who participated in the study consisted of 4 groups: those with an engineering undergraduate degree who never entered the engineering field, those who left the field more than 5 years ago, those who left the engineering field less than 5 years ago, and those who are currently working as engineers. We first report on what we learned from the first two groups of women who are no longer working in engineering. Then, to help understand potential reasons why women left the field, we compare current engineers with engineers who left less than 5 years ago on their perceptions of the supports and barriers in the workplace and their perceptions of managing multiple roles. We only contrasted the current engineers with those who left less than five years ago to provide similar time frames for comparison as well as to ensure that recollections were recent enough to be accurate.
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Women Who Left Engineering

Some alumnae never entered the engineering profession:

Fifteen percent (N=560) of our participants had completed the rigorous training required to earn a baccalaureate degree in engineering but chose not to enter the field of engineering:

- What did they major in? The three most frequently cited majors were: Industrial Engineering, Chemical Engineering and Mechanical Engineering. Nearly half of this group of engineers earned an additional degree, primarily master's degrees, although 11% had earned an additional BS degree.
- Are they working? YES. Although they did not enter engineering, 4 out of 5 of them are working in another industry. Two thirds of the women are working in a managerial or executive position. The most frequently cited industries in which they work are: Information Technology, Education, and Government/Non-profit. A quarter of the women who did not enter the field reported that they were earning less than $50,000, while another quarter reported earning between $51,000 and $100,000. Most of this group had a spouse who was also employed full time, reflected in the third of them reporting a family income greater than $150,000.
- Why did the women not enter an engineering career? The top five reasons women reported for deciding not to enter engineering were: They were not interested in engineering, didn’t like the engineering culture, had always planned to go into another field, did not find the career flexible enough, or wanted to start their own business. These reasons did not differ significantly across different age groups or years of graduation.

Some women left an engineering career more than five years ago:

- One in five of the participants (N=795) started in an engineering career but left the field more than five years ago.
- What did they major in? Similar to the women engineers who never entered the engineering field, the top three majors earned by this group of women engineers were: Industrial Engineering, Mechanical Engineering, and Chemical Engineering. Almost half had earned an additional degree, most often an MS or MBA.
- Are they working? YES. Two thirds are currently working, a third of them are earning over $100,000, and 70% of these women are in management or executive level positions. More than two thirds reported a family income of over $100,000. The top three industries in which these women are working in are: Education, Healthcare, and Consulting.
- Why did they leave an engineering career? A quarter of the women reported that they left the field to spend more time with their family. Other women reported that they lost interest in engineering or developed interest in another field, they did not like the engineering culture, they did not like engineering tasks, or they were not offered any opportunities for advancement.

Profile of Women Currently Working in Engineering and Those Who Left Less Than Five Years Ago

POTENTIAL REASONS FOR LEAVING:

The women who left engineering less than five years ago were compared to those who are still in an engineering career. Current engineers were the largest group in our study (N=2,079) while those who left less than five years ago were the smallest group (N=298). We first compared the groups on various demographic and career-related variables.

- Are current engineers less likely to be married or to be parents? NO. The groups were not significantly different in race, marital status, or parental status. Both groups were about 80% White, with two thirds married, and 40% had children living at home with them. Both groups of women were relatively evenly distributed across the different age groups.
- Are current engineers more likely to have majored in a particular field? NO. The two groups of engineers, for the most part, did not differ by disciplinary area. The top three majors for both groups were Chemical, Mechanical, and Civil Engineering.
- Did women leave engineering to stay home with children? A third appear to have done so, but two thirds of the women who left are working full time in another field, and 78% of those are working in management or executive level positions. For those who are currently working, there were no significant differences between those who left and those who stayed in the average range of salary.

We next compared women currently working in engineering with those who left the field key psychological factors. It is possible that current engineers differed from women who left engineering with regard to their levels of self-confidence, expected outcomes from performing certain tasks, or underlying interests. We specifically examined confidence and expected outcomes in three critical areas that comprise a successful engineering career for women: performing engineering tasks, managing multiple work-life roles, and navigating the political landscape at work.

Are current engineers more likely than women who left engineering less than five years ago to:

- be confident of their abilities as an engineer or what they expect from performing engineering tasks? NO.
- be confident of their abilities to navigate the political climate or what they expect from managing these dynamics? NO.
- have interests in engineering related activities? NO.

CURRENT ENGINEERS: MANAGING MULTIPLE ROLES

Are women’s perceptions of managing multiple roles influenced by psychological variables, such as self-confidence, or by their supervisor or other workplace factors?

- The answer was both. The three most important contributors to a current engineer’s experience of conflict between work and family roles was their lack of self-confidence in their ability to manage multiple roles, being overloaded by their current work role (including the fact that they were given too many tasks and had too much responsibility without commensurate resources), and working in an uncivil work environment that treated women in a condescending and patronizing manner.
- The use of a company’s work-life benefit policies exacerbated the conflict that engineers experienced between their work-life roles.
- The greater the conflict experienced between work and non-work roles, the greater is the intention to leave the organization as well as the profession.
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• The greater the conflict experienced between work and non-work roles, the greater is the intention to leave the organization as well as the profession.
1: INTRODUCTION

Why Study Women Engineers?

The National Academy of Engineering has clearly shown that the US needs technological expertise to be competitive in the global market, and it is critical to train engineers to provide that expertise. However, research shows that women are much more likely to leave an engineering career, thus losing many of the engineers US colleges are training. Women are, in fact, underrepresented in the field of engineering at every level. Most of the research on effective interventions has successfully focused on increasing women’s choice of engineering major. The result is that women are now nearly 20% of engineering graduates. However, only 11% of professional engineers are women (National Science Foundation, 2011), a statistic that has been stable for nearly 20 years. In fact, the proportion of women engineers has declined slightly in the past decade, suggesting that, while the pool of qualified women engineering graduates has increased, they are not staying in the field of engineering. Clearly, while our educational system is having some success at attracting and graduating women from engineering programs, women who earn engineering degrees are disproportionately choosing not to persist in engineering careers, and research has not systematically investigated what factors may contribute to their decisions.

Women’s decisions not to persist may be due to their own concerns about managing the organizational climate, performing engineering tasks, or balancing work and family roles. Women also may encounter organizational barriers when they reach a juncture to move into management from engineering roles. It is therefore, critical to understand the diversity of factors that lead some women to persist in engineering and others to leave it, as our educational system may have a role in better preparing women engineers for workforce challenges. In addition, the organizations that employ women engineers have a vital role in creating work environments that both attract and retain women engineers.

There are personal costs to choosing to leave a career for which one has trained long and hard for. There is also a societal cost to losing the potential of, or the investment in, a trained workforce, particularly at a time when there is a shortage of technological employees in the United States. In short, it is important to understand the factors that lead to women’s choices to leave engineering so that educational and organizational institutions can intervene to shift those choices.

Background on Engineering Labor Force

U.S. leadership in technical innovation has been a vigorous force behind economic prosperity for at least the last 50 years. Recent concern about declining numbers of U.S. citizens choosing to enter technical careers and the increase in technological talent and jobs overseas led Congress to ask the National Academy of Sciences to analyze the U.S. technical talent pool and make policy recommendations to advance U.S. competitiveness in global research and development markets (Committee on Science, Engineering, and Public Policy, 2007). The report effectively argues for the increased importance of technology to the U.S. economy, demonstrates global trends in research and development that favor other countries, and highlights the need for concrete action to enhance U.S. competitiveness. However, while the report briefly notes that U.S. women and minorities are underrepresented in science and technology, it does not address the additional loss of women from technology careers, post-graduation, which represents a substantial loss of talent from the technical workforce.

As we note above, women are the most underrepresented in the engineering disciplines. The loss of women from the profession after they complete their undergraduate degree is particularly disheartening as well as costly to the educational system, society, and to women themselves. Furthermore, it is at this point in time that women begin to enter the workforce, during which they are more likely to face the barriers to advancement and satisfaction that lead them to leave.

The goal of this study is to examine the factors that influence these decisions and to compare them to those impacting men’s decisions. We seek to better understand the barriers that different women face in the workplace and to identify strategies that can help mitigate their effects to reduce women’s attrition from the workforce.

CURRENT ENGINEERS: PREDICTING SATISFACTION AND TURNOVER

We also examined women’s perceptions of the work environment and whether those perceptions influenced satisfaction or retention. Women who left engineering differed significantly from current engineers on perceptions of the workplace climate, both in terms of supports and barriers they encountered. We examined workplace support at two levels: first, the extent to which their organizations supported their training and development, provided avenues for advancement, valued their contributions at work, and created a supportive climate for fulfilling multiple life role obligations. Second, support was assessed in terms of the extent to which the women engineers reported having a mentor, and received support from their supervisors and co-workers. We also examined two types of workplace related barriers that could impact their levels of satisfaction as well as thoughts of leaving: workplace climate factors were captured by the extent to which supervisors, senior managers, and co-workers undermined them and/or treated them in a condescending, patronizing, or discourteous manner. A second set of workplace barriers focused on the extent to which women engineers lacked clarity in their roles, experienced contradictory and conflicting work requests and requirements, and were overburdened with excessive work responsibilities without commensurate resources.

Are current engineers more likely than women who left engineering less than five years ago to:

• experience different types of support? YES. Current engineers were significantly more likely to perceive opportunities for training and development. Interestingly, the current engineers reported fewer work-life benefits available to them, but were significantly more likely to have used those benefits
• have a mentoring relationship? NO. Only about a quarter of each group reported having a mentor and there were no differences in satisfaction with mentoring.
• encounter supportive supervisors and co-workers? YES.
• encounter role related barriers in the work environment? NO.
• encounter organizational level barriers in the work environment? YES. Current engineers were significantly less likely to perceive organizational barriers. Specifically, they were less likely to perceive either co-workers or supervisors as undermining them, perceived less sexism in the environment, and were less likely to view organizational time demands as a barrier.

Finally, we looked at what predicts current engineers’ job and career satisfaction and their intention to leave their companies as well as the field of engineering.

• Do workplace barriers affect current women engineers’ satisfaction? YES. The two barriers that most negatively influenced women’s satisfaction levels were work-role uncertainty and a work environment that consistently undermined them.
• Do workplace supports affect current women engineers’ satisfaction? YES. Different forms of support, such as training and development opportunities, supportive co-workers and supervisors, and companies that allowed employees time to balance their multiple life roles, were positively related to satisfaction.
• Do climate factors influence intention to leave their job? YES. Both workplace climate and personal factors influenced intention to leave. Being undermined by their supervisors, perceiving that the organization was not supportive of them, and that their managers were unwilling to accommodate their desire to balance multiple life roles, predicted their intention to leave their current organizations.
• What predicts intention to leave engineering as a career? Feeling a lack of confidence in their ability to perform engineering tasks and manage multiple roles combined with not being positive about the outcomes they expected from performing engineering tasks leads women engineers to consider quitting the engineering field altogether. The other two most significant contributors to women’s intentions to quit engineering were excessive work responsibilities without commensurate resources and a lack of clarity regarding their work roles.
• What predicts job and career satisfaction? Perceiving that the organization is supportive and provides opportunities for advancement. Personal factors also were related to job and career satisfaction: women who reported high levels of self-confidence in navigating their organization’s political landscape and juggling multiple life roles and who expected positive outcomes to result from their efforts to navigate the organizational climate at work, were most likely to express both job and career satisfaction.
• Do psychological factors predict intention to stay better than work environment factors? NO. Women’s intention to stay in engineering as a field and in their current organization is best predicted by a combination of psychological variables related to confidence, expected outcomes, and interests, as well as supports and barriers encountered at work.

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THE AUTHORS

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Nadya A. Fouad, Ph.D. is a Distinguished Professor and Chair of the Department of Educational Psychology at the University of Wisconsin-Milwaukee and faculty member in the Counseling Psychology program. She is editor of The Counseling Psychologist. She served as Associate Dean of the School of Education from 1995-1998, and as Chair of the Task Force on the Climate for Women at UWM. She was recipient in 2003 of the John Holland Award for Outstanding Achievement in Career and Personality Research, the 2009 APA Distinguished Contributions to Education and Training Award, the 2009 Janet Helms Award for Mentoring and Scholarship, and 2010 Paul Nelson Award by the Council of Chairs of Training Councils. She was President of Division 17 (Counseling Psychology) from 2000-2001. She is a past chair of the Council of Counseling Psychology Training Programs (2003-2007). She was a member and chair of the Board of Educational Affairs (2004-2006). She is currently chair of the Competencies Workgroup (2006-present) and vice chair of the APA Ethics Committee. She serves on the editorial boards of the Journal of Vocational Behavior and the Journal of Career Assessment. She has published articles and chapters on cross-cultural vocational assessment, career development of women and racial/ethnic minorities, interest measurement, cross-cultural counseling and race and ethnicity. She is currently working on studies to examine the persistence of women in engineering careers. She served as co-chair (with Patricia Arredondo) of the writing team for the Multicultural Guidelines on Education, Training, Practice, Research and Organizational Change, which were approved by the American Psychological Association in August, 2002 and published in the American Psychologist in May, 2003.

Dr. Romila Singh, Ph.D
Associate Professor, Lubar School of Business and Associate Director of the Center for the Study of the Workplace, UW-Milwaukee

Romila Singh, Ph.D., received her doctorate from Drexel University in Organizational Sciences. She is an Associate Professor in the UW-Milwaukee Lubar School of Business. Her research focuses on understanding career management issues related to career choices, work-life relationships, mentoring and retention, and turnover decisions of women and people of color. Romila’s research has appeared in leading journals in management and vocational behavior. She has also authored and co-authored several book chapters. Romila teaches courses in human resources management and has been awarded the School of Business teaching award every semester since Spring 2002. She is currently serving as the Faculty Advisor for the student chapter of Society for Human Resource Management (SHRM).

Romila and Nadya are co-principal investigators on a NSF-funded national study on understanding women engineers’ decisions to leave engineering.