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# BRINGING WOMEN INTO SOFTWARE ENGINEERING

POURNAGHSHBAND, HASSAN

JOHNSON, LAURA

DEPARTMENT OF SOFTWARE ENGINEERING & GAME DEVELOPMENT

KENNESAW STATE UNIVERSITY

GEORGIA

Dr. Hassan Pournaghshband  
Ms. Laura Johnson  
Department of Software Engineering & Game Development  
Kennesaw State University  
Georgia.

## **Bringing Women into Software Engineering**

### **Synopsis**

Women are a minority in Software Engineering careers and studies. This paper serves to discover the reasons for the imbalance of genders in Software Engineering and other STEM related fields.

# **Bringing Women into Software Engineering**

Hassan Pournaghshband and Laura Johnson

Kennesaw State University

Kennesaw, Georgia USA

## **ABSTRACT**

The gap between male and female participation in STEM related fields within the United States continues to widen. More specifically, women are a minority in Software Engineering careers and studies. This paper serves to discover the reasons for the imbalance of genders in Software Engineering and STEM related field and the primary reasons that young girls avoid technical subjects. This paper will serve as an exploration of the organizations designed to bring more women into technical positions and the successful women of Software Engineering careers. This paper also provides answer for two vital questions: What programs and techniques have successfully brought more women into STEM fields such as software engineering? Who are some of the women who have benefited from careers in software engineering?

## **1. INTRODUCTION**

The importance of students mastering skills in critical problem solving has become evident, yet the interest in the crucial STEM field, a necessary “tool for success,” has been decreasing. Additionally, the gap between male and female participation in the United States in STEM fields grows larger. In 2011, 67.4% of adults aged 25 to 64 with STEM degrees at the university level were male [10]. The gender gap has led to the launch of numerous programs with the goal of generating female interest in STEM for women. Groups such as the National Girls Collaborative Project [13] and the Association of Women in Science [2] are designed to encourage young girls’ and women’s involvement in various technical fields including Software Engineering. New organizations with the goal of introducing and teaching women about technology. Other groups including Women in Technology [22] and the Society of Women Engineers [17] are active in supporting Women in STEM fields on college campuses. These research-based programs show evidence of success in engaging women and young girls in STEM fields.

Countless women have excelled with a career in Software Engineering such as Linda Cuerton, CIO of NASA and Jen Fitzpatrick, an employee of Google. Acknowledging these women and the many others demonstrate the fulfilment that a job in software engineering can offer.

## 2. NARRATED STATISTICS

Figures indicate an increase in women obtaining degrees in STEM related disciplines such as physics, engineering and computer science within the last decade. In 2010, Yale reported 30 to 40 percent of physics and physics related undergraduates were female [22.] Despite this growth, women only make up about 25 percent of computer and mathematical sciences [13.] One study revealed that the average tech company consists of only about 12 percent women engineers [3]. When researching the subject of female's in STEM fields, it is vital to note that statistics are "tricky because they don't typically differentiate between departments and roles within organizations: A woman in the HR department at Cisco will typically be counted as a 'woman in computing,' whereas a woman software engineer at an investment company won't" [3.]

When presented with identical applicants but different sexes, hirers more often chose the male or offered the woman significantly less salary [22]. Within the field, at the top-level point in their careers, women make up only seven percent of technology company founders. At the mid-level, fifty-six percent of women leave their technology based careers which is double the turnover rate for men in STEM fields [11.] Of those women who leave STEM careers, "24% take a non-technical job in a different company; 22% become self-employed in a technical field; 20% take time out of the workforce; 17% take a government or non-profit technical job; 10% go to a startup company; and 7% take a non-technical job within the same company" [11.] A study from the University of Texas showed that women, during the hiring process, "ask for \$7,000 less than their male counterparts in job interviews but when they were asked to negotiate on behalf of a friend or colleague, they asked for as much as men" [15.] Popular companies such as Levo League, Hackbright Academy, and Yellowsmith claim an unusual 67% female team. Google reports a 79% male team and Yahoo reports 37% women. Facebook's team contains 31% women and LinkedIn employs 39% women [7.]

## 3. ENTICING WOMEN TO SOFTWARE ENGINEERING FIELD

The software engineering field is a collaborative creative outlet. Creativity is displayed in developing new solutions utilizing small details and structural design. Software Engineering involves skill, but the heart of it is problem-solving. Software Engineers work in teams using *tools*, *techniques*, *procedures* and *paradigms* to enhance the quality of their software solutions. Despite this, software companies report trouble finding dependable developers, resulting in the high demand of good developers outpacing the supply. The high demand combined with the creative nature of the software engineering positions make for good pay. The average annual salary for an entry-level software engineer is \$62,670 [5.] The future growth of careers in software engineering is promising due to the forever increasing need for new technology and software. All these facts combined with women's talent in many aspects of life, if properly publicized, can be a starting point for luring them into the software engineering field.

A theory for the significant gender disproportion is schooling. Standardized tests reflect girls underperform boys in math and science subjects. Conversely, girls tend to maintain much higher course grades in math and science [1.] Girls start undervaluing their math abilities as they enter middle school. At this stage, girls tend to show less interest in math or science and pursue fewer

science or tech-related fields. Taking fewer science and math classes in high school can leave young girls unprepared for the higher level of material in college courses. The courses feel harder and requires more effort to stay afloat potentially causing a loss of interest. The decrease in interest of STEM topics correlates to fewer tech-related jobs later in life. This possibly means that bringing “women into the developer field has more to do with early exposure far before attending university” [8.] A survey conducted by google of about 1,600 men and women showed that young women “aren't really taught what computer science actually means, and are half as likely to be encouraged to study it” [7.] Girls described technology and science related fields as "boring" and "difficult". The competitiveness of math and science fields can discourage some women. A study by Wellcome Trust states that “many (women) felt that the competitiveness of science (e.g., to secure a grant and post,) and especially at the early career stages, results in less weight being given to integrity and meritocracy, making academia an unattractive long-term career option for those who are less naturally competitive” [21.] Stereotypes seem to follow women into STEM fields. In popular modern comedies, female scientists and mathematicians are portrayed as odd and eccentric. On the opposite side of the spectrum, some stereotypes suggest women have an inborn technical incompetency. For example, in 2010, Mattel published “Barbie: I can Be a Computer Engineer.” The book received backlash for representing Barbie as a computer engineer who could not program without the help of her male friends. In the book, Barbie is only capable of contributing to the design aspects [23.] Such stereotypes can discourage young girls from STEM fields. In an attempt to bring more women into STEM fields, several organizations give young girls a chance to excel in technology, science and engineering.

The National Girls Collaborative Project program “seeks to broaden the participation of girls and women in all fields of science, technology, engineering, and mathematics education by supporting research, dissemination of research, and extension services in education that will lead to a larger and more diverse domestic science and engineering workforce” [13.] The NGCP is an organization with the goal of “informing and encouraging girls to pursue careers in science, technology, engineering, and mathematics (STEM).” The NGCP supports increased access to resources for any institutions interested in “expanding girls’ participation in STEM.”

The Association for Women in Science is the largest multi-disciplinary organization for women involved in science, technology, engineering, and mathematics fields [2.] The AWIS aspires to help women working in STEM fields obtain fair compensation in the work place and expose young girls to successful role models. AWIS focuses on women already in STEM jobs by offering mentoring and recognizing their achievements.

The organization, Women in Technology (WIT), strive to “progress the role of women in the tech industry and to better STEM education opportunities for girls” [22.] In addition to helping women already in STEM careers, WIT offers a program called Girls in Technology (GIT). GIT offers “educational and hands-on STEM programs that promote creativity and innovation, and inspire girls to pursue STEM-related careers. GIT is based on seven core beliefs including: critical reflection, empowerment, self-efficacy, passion, innovation, collaboration, and leadership [22.] The seven core belief system assists girls in developing and maintaining an interest for achieving professional goals in STEM related fields. Our school, Kennesaw State University, like many other schools, has its own divisions of WIT for students to join.

Established in 1950, the Society of Women Engineers focuses on inspiring women to pursue engineering careers [17.] SWE is nonprofit and offers scholarships to bachelor and graduate level engineering students. With over 35,000 members, the Society of Women Engineers organizes events for young girls in elementary school to promote interest in engineering. The five fundamental core values of SWE are integrity, inclusive environment, mutual support, professional excellence, and trust. Globalization is a current goal of SWE, with hopes of partnering with global employers to increase the number of women in engineering.

At Twitter, a group called Women in Engineering is committed to supporting the advancement of women in the Engineering. The group aims to inspire “girls and women to pursue education and careers in engineering” [18.]

At the Georgia Institute of Technology, a group likewise called Women in Engineering assists female students in engineering majors. The group works on recruiting top female students into engineering discipline. The group makes every effort to ensure the highest level of retention once students are enrolled by providing an environment that encourages curiosity, creativity and intellectual and personal growth of the students [6.] Georgia Tech’s Women in Engineering program sponsors a yearly conference with the goal of inspiring high school girls with information about engineering disciplines.

Women in Engineering, Women in Technology and The National Girls Collaborative Program are just a few examples of organizations trying to make a significant difference for young girls. These groups work hard to present young girls with role models and opportunities to find an interest in math, science, engineering, and technology related fields. With the help of groups such as The Society of Women Engineers and the Association for Women in Science, more women will gain interest in STEM related subjects translating into further participation in the professional world.

#### **4. PROMINENT FEMALE FIGURES IN SOFTWARE ENGINEERING**

STEM women feel overlooked in public studies. While statistics show men vastly outnumber women in Software Engineering careers, researching women in STEM provides a myriad of field shifting heroines who have prospered with careers in software engineering. Women such as Helen Augusta Blanchard and Edith Clarke are examples of successful women in engineering careers.

Helen Augusta Blanchard, also known as Lady Edison, was one of the greatest inventors of the 1800s. She held 28 patents. Blanchard’s first patent was a zigzag sewing machine in 1873 when industrial garment production was evolving. Blanchard is well known for the invention of a surgical needle, pencil sharpeners and self-taking needles. Later in her life, Blanchard founded a machine company in Philadelphia [5.]

Edith Clarke worked as an engineer for General Electric. Clarke received a patent for the graphical calculator. Clarke was the first women to teach electrical engineering at the University of Texas. Clarke acquired a bachelor’s degree in mathematics, astronomy, and electrical engineering [5.] In September of 2009, Linda Cuerton was appointed as NASA’s CIO to ensure “the development of integrated IRM strategies, including standards, policies, NASA Enterprise Architecture, IT

security, management, and operations” [12.] Cuerton has won Leadership awards and recognition for her hard work from Women in Technology.

The Vice President of Engineering and Product Management at Google is Jen Fitzpatrick. Fitzpatrick works on products such as Google’s local search, Google Places and, Place pages. Fitzpatrick led the software development process for products such as AdWords, Google News and Product Search. Fitzpatrick was one of Google’s first female engineers, starting her career in 1999 [4.]

The most renowned woman software engineer is Margaret Hamilton. In 1958, Hamilton earned an undergraduate degree in mathematics. In 1960, Hamilton was a 24-year-old programmer at MIT. Hamilton helped pioneer the Apollo 11 landing on July 20, 1969. Hamilton also played a major role in developing the flight software for the space vessel [16.]

The presence of successful women in software engineering is still in its infancy. Young Girls need role models for inspiration. When presented with successful women in technology, young girls may find more interest in related fields. Women already in STEM fields can relate to the struggles of these prominent figures. It is important to bring further recognition to more women in Software Engineering for future generations of women.

## **5. CONCLUSION**

Gathering data regarding women in Software Engineering and STEM fields proved difficult. Despite the lack of available information, it is obvious that women within software engineering fields are underrepresented. Women avoid technical careers for a wide variety of reasons including prejudice, a lack of understanding, negative stereotypes and a lack of role models.

The stereotypes of female software engineers can be abolished as more women enter into STEM fields. Additionally, numerous organizations inspire women to join STEM fields by providing role models and programs for young girls. Women in Technology, the National Girls Collaborative Program, the Association for Women in Science and many more organizations maintain the same central goal of creating interest in STEM for girls at a young age. Without active immersion into technology math and engineering, young girls start to avoid math, science, and technical courses. Exposure to computers at an early age can help bring more women into the software engineering field. The organizations offer courses on STEM topics and mentorships. This should not stop in school, but rather they should strive to find mentors and supporters in the workplace that value their impact on the job. Providing information of successful STEM women throughout history can inspire young girls. Highlighting the success of women in STEM with celebrations such as International Women’s Day publicizes underappreciated role models.

Given the chance, women can obtain a great deal of success in Software Engineering. With the right resources and encouragement, women can shine brightly in technical careers. Schools and businesses need to continue to encourage and provide resources for younger generations of women in order to resolve the imbalance of genders in STEM fields.

## **6. REFERENCES**

1. American Psychological Association. *Girls make higher grades than boys in all school subjects, analysis finds*. <http://www.apa.org>, 2016. Web. 19 July 2016.
2. Association for Women in Science. *AWIS*. n.d. Web. 19 July 2016.
3. Bacon, Lauren. "The Tech Industry's Woman Problem: Statistics Show It's Worse Than You Think." *Quartz*, 7 Nov. 2013. Web. 19 July 2016.
4. Bort, Julie. "BEYOND MARISSA MAYER: 25 powerful women engineers in tech." *Business Insider*. Business Insider, 24 Aug. 2012. Web. 19 July 2016.
5. EngineerGirl. *EngineerGirl*. n.d. Web. 19 July 2016.
6. Georgia Institute of Technology. *Women in Engineering*. 2016. Georgia Institute of Technology Women in Engineering. 19 July 2016.
7. Gilpin, Lyndsey. "The state of women in technology: 15 data points you should know." *Tech Republic*. TechRepublic, 30 July 2015. Web. 19 July 2016.
8. Kozlowski, Lori. "Women in Tech: Female Developers by the Numbers." *Forbes*. Forbes, 22 Mar. 2012. Web. 19 July 2016.
9. Kunda, Elaine. "Why women avoid STEM careers." *Huffington Post*. 20 June 2013, Web.
10. Milgram, D. (2011). How to recruit women and girls to the science, technology, engineering, and math (STEM) classroom. *Technology & Engineering Teacher* 71(3)
11. National Center for Women. "Did you know: Demographics on technical women." National Center for Women Information Technology. *National Center for Women & Information Technology*, 30 June 2013. Web. 19 July 2016.
12. NASA. Linda Cureton. *NASA*, 7 June 2013. Web. 19 July 2016.
13. National Girls Collaborative Project. "Engaging girls in STEM." *National Girls Collaborative Project*. 2016. Web. 19 July 2016.
14. Pittman, Olivia. "7 organizations working to promote women in STEM - college raptor Blog." *College Raptor*. College Raptor Blog, 2012. Web. 19 July 2016.
15. Rajani, Ricky. "Women in tech panel interview." *GenHeration*. GenHERation, 31 Jan. 2015. Web. 19 July 2016.
16. Rothman, Lily. *Remembering the Apollo 11 moon landing with the woman who made it happen*. TIME.com, 20 July 2015. Web. 19 July 2016.
17. Society of Women Engineers. *Society of Women Engineers*. n.d. Web. 19 July 2016.
18. Twitter. "Women in engineering | Twitter engineering." *Twitter*. Twitter, 2016. Web. 19 July 2016.
19. Vasquez, Marina Garcia. "Alaina Percival: 10 Reasons Why More Women Should Work in Software Engineering." *The Wall Street Journal*. wsj.com, 11 Aug. 2014. Web. 19 July 2016.
20. Warne, Henrik. "5 reasons why software developer is a great career choice." *Henrik Warne's blog*. Henrik Warne, 8 Dec. 2014. Web. 19 July 2016.
21. Welsh, Jennifer. "These are the 7 things keeping women out of science careers." *Business Insider*. Business Insider, 16 Oct. 2013. Web. 19 July 2016.
22. Pollack, Eileen. "Why are There still so Few Women in Science?" *The New York Times*. The New York Times, 03 Oct. 2014. Web. 11 March 2016.
23. NPR Staff. "After Backlash, Computer Engineer Barbie Gets New Set of Skills." *NPR*. NPR, 22 Nov. 2014. Web. 14 Mar. 2017.