Why Gender Diversity Is Both a Challenge and an Impending Financial Growth Opportunity for the Global Technology Industry

Kristin Holmberg-Wright, Distinguished Lecturer, University of Wisconsin-Parkside USA
David J. Wright, Professor of Finance, University of Wisconsin-Parkside USA

ABSTRACT

Although technology ranks among the lowest industries in terms of gender diversity, recent research indicates that those companies within the tech industry that are more highly gender-diverse yield greater financial value. The paper describes the reasons why women perceive technology degrees to be less attractive than other fields. Finally, the paper presents solutions that universities and employers are using to improve gender diversity and thus, add substantially more value to the global technology industry.

Keywords: gender diversity, tech industry, computer science degrees

INTRODUCTION

The lack of women choosing a computer science degree in college and working in technology companies is well documented and has persisted for a long time. Demands for greater female participation in the global technology industry have historically been based upon political or cultural arguments founded on fairness and equality. However, there is now growing evidence that greater gender diversity contributes significant economic benefits to companies in all sectors, but in particular, adds substantially more value to highly gender-diverse tech companies. In other words, gender diversity is more than a highly laudable goal for the global technology industry. The management teams of tech companies that, first, recognize the reasons why women perceive technology degrees to be less attractive than other fields, and second, use employer incentives to improve gender diversity, will be rewarded with greater financial value compared to their less gender-diverse competitors.

Sangeeta Badal (2014) conducted a research study at Gallup that examined over 800 companies in the retail industry and the hospitality industry. For both industries, the study concluded that those businesses with greater gender diversity generated both higher revenue and greater profits than their less-diverse competitors. More recently, Morgan Stanley's Sustainability and Global Quantitative Research teams conducted a research study of 108 tech companies "based on a common gender diversity investment framework" (Morgan Stanley, 2017). They found "that a better balance of men and women in the workplace can deliver returns with less volatility". Specifically, for the five year period of 2012 through 2016, "highly gender-diverse tech companies returned on average 5.4% more on an annual basis than the average yearly returns of their peers with less gender diversity." The study provides comprehensive quantitative evidence of the value added to tech companies who are able to increase their gender diversity.

"Technology will not stay in the lead in the US unless the gender diversity gets materially better. It's just not. It's just not going to happen" This is a quote from Apple CEO Tim Cook on June 9, 2017 when he spoke a meeting sponsored by the MIT Technology Review (2017). He explained that the lack of women in tech is an enormous issue, one that must be addressed in total from societal as well as educational and work perspectives. To address the enormous issue now facing tech in the US, Cook suggests the focus must be on the totality of the issue. It is not just about gender parity; the lack of women in computer science is a significant issue for the tech industry and a serious economic challenge for the US workforce. For example, 1.4 million jobs will open in computer science by 2020, yet there will be only enough qualified graduates to fill just 29% of the available jobs and less than 3% will be filled by women (Mylavarapu, 2016).

Recently, the US has seen an increase in women entering more STEM (science, technology, engineering, and mathematics) fields, spurred by a multitude of efforts. However, women are still choosing other fields than technology. In an interview, Melinda Gates recalled how in 1980 when she graduated with a computer science degree, 37% of the computer science degrees were awarded to women. Today it is less than 18%. At the same time, the law and medical degrees awarded were about the same and today the numbers of women graduating in those

fields has risen. She further pointed out that if the numbers of women and minorities graduating in computer science continues to be so low, the US will lack a diverse team at the table developing the technology that we all are using. (Murphy, 2017).

Cheryan (2015) suggests the reason for the continued decreasing number of female computer science graduates is due in part to social barriers – both real and perceived. The researchers argue that women don't choose to pursue computer science degrees due to the stereotypes about the kind of people who work in the field. Women don't see themselves fitting in with the stereotypes. The research concluded that such perceptions – real or imagined – have shaped females' career paths.

According to Maria Klawe, President of Harvey Mudd College, women once were about a third of computer science majors. Females chose to study computer science because women had better typing skills and were thought to be more careful. Women majored in computer science, because it was an area they were expected to be successful in. But the reality changed with the introduction of personal computers (PC's). Users could either use PC's for word processing or to play games like Pong and Space Invaders (Pickett, 2018). Games became male centric and women began dropping out of computer science. With the advent of the PC's, tech was no longer an industry dominated by women; it was an industry for men (Williams, 2017).

WHY WOMEN PERCEIVE TECHNOLOGY TO BE LESS ATTRACTIVE THAN OTHER FIELDS

Research on why women are not pursuing computer science degrees have identified problematic perceptions and ideas such as the negative impact of stereotypes, women's view of math, fear of failure, confidence with computers, tech career knowledge, and the lack of role models. To address the issues arising from gender disparity which currently exists, these issues and more must be confronted.

Stereotypes

One of the earlier stereotypes of computer science workers was played by the current host of the Tonight Show, Jimmy Fallon, when he was a regular on Saturday Night Live almost 20 years ago. Jimmy Fallon played the lead character in a popular recurring sketch entitled "Nick Burns Your Company Computer Guy" from 1999 to 2001. Nick Burns was socially awkward, obsessed with machines and computer jargon in a rude know it all manner, and always with unkempt hair with several pocket pagers strapped on his belt. (Kendall, 2009). There was even an episode with a female equivalent of Nick Burns played by Calista Flockhart. This view continues to dominate the image of computer science college majors and workers. Likewise, the field of technology is often defined in masculine terms, leaving women to question their entrance into an area where they expect to meet stereotypical bias and discrimination.

The impact of stereotypes is one of the most widely studied topics in social psychology. Claude Steele (2010) explained the term in his classic Whistling Vivaldi. He argued that certain situational factors can lead people to confirm negative stereotypes about the social group they belong to. Once the negative stereotype is accepted, an increase in overall anxiety and a decrement in performance occur. Likewise, today there have been numerous high profile cases of sexual harassment in Silicon Valley at Google, Uber, Microsoft, and more. Such accounts only add to the extremes of how toxic the field can be for women and leaves open ended questions of how and why women would want to endure such treatment.

Mathematics

Women are perceived not to be as mathematically inclined as men. By second grade, girls already believe boys are better at math (Cheryan, 2015). Stereotype threat continues with the (false) perception that girls are intellectually inferior. Researchers have documented a mere awareness that others expect members of a social group to do poorly in math is enough to create anxiety and decrease the performance among members in the less represented social group (Cici, 2015). It has been documented that males are not, in fact, better at math than women. Likewise, the number of high school girls with high scores on the math section of the SAT has significantly increased. An OECD report has also shown the gender gap has reversed (Hill, 2010). Yet, the stereotype continues and has continually been mentioned as a reason why many girls have not pursued a computer science degree. Carol Dweck (2006) discussed how even having more males in a room before a math test was a factor in lowering female scores. She

explained that the mere stereotype of males being superior in math ability filled the females' minds with distracting thoughts and with the anxiety of confirming the math stereotype.

Fear of Failure

Another problem which can plague women in computer science is an overall fear of failure. Women have been socialized that they cannot fail; they must achieve perfection. Yet, coding never goes as planned and when the code doesn't run, women often feel a failure (Vu, 2017). Females in college are more likely to drop courses in which they consider their grades to be lower than the males, experience serious anxiety in quantitative classes, and often underestimate how well they will do in the workplace (Bohnet, 2016; Seymour, 2000). Women that succeed in a computer science career or in completing the academic program are often viewed as 'exceptional' which again promulgates the stereotype that women don't belong in computer science (Beyer, 2004). And, once in the work world, females feel they must prove themselves by working harder than men (Taylor, 2011).

Confidence with Computers

Women's overall confidence with computers is another factor cited as a reason for women's decreased interest in pursuing a computer science degree (Bohnet 2016). Using a multivariate investigation, Beyer (2004) showed that men had more confidence in using computers than females. In fact, female computer science majors had far less confidence than male non-majors. The low confidence manifests itself in less playful and relaxed attitudes toward computers and programming and also highlights why boys are more prone to playing video games from a young age. In high school, girls are less likely to take programming courses and to complete the computer AP test prior to college (Cheryan, 2015; College Board, 2013). The NSF 2012 research study documented that by the time students enter college, males are already four times more likely to express the intention to major in computer science and engineering, whereas females make the academic decision while in college (Cici, 2015). A 2016 Harvard study found that women with up to eight years of programming experience report the same level of confidence as men with zero to one year of programming experience (Rayome, 2017). Why would an individual chose a field of study they lack confidence within themselves?

Career Knowledge

Dwek's (2006) research suggests women have an unrealistic image of the field and lack accurate information about computer science careers which also causes fewer women to enroll in the academic program. The career is more focused on male values and competition, money and accomplishment. Yet, it has been shown that females are motivated more by intrinsic motivators – the desire to engage in activities because they value it for the inherent satisfaction provided (Pollak, 2015; Colvin, 2015). The perception then exists that computer science will not be a satisfactory career choice and may not fulfill the females' interpersonal needs. When computer science careers are sold to students using extrinsic values and rewards such as financial rewards and number of jobs available, it will not entice females to the area; quite the contrary, it may focus their attention away from the career.

Role Models

The lack of female role models in computer science has continually been identified as an additional issue (Cici, 2015; Bohnet2016). Male computer science majors have easy access to role models in academia and at work. They have multiple individuals to turn to that can assist them with homework or issues with work and coding and to provide support and encouragement.

Female academic role models will continue to be difficult to provide if more women don't enter the field and are open to working with female students and recruiting for additional female students. Currently, only 15% of tenure track computer science faculty members are women (Rayome, 2017). And, the question remains if, perhaps, having a role model that embodies the stereotype of a computer science 'nerd' would actually hinder a female choosing to major in computer science.

Obviously, there are a multitude of reasons women have not completed (nor sought) degrees in computer science and technology. We have only included the issues mentioned in most research. There are still underlying areas that have not been identified nor addressed. Yet, the time is now for colleges, universities and the industry to respond to the continual low number of women in computer science programs and to address the institutionalization of the stereotypes now faced by both men and women.

EDUCATIONAL CHANGES NEEDED

There are many initiatives currently to address some of the imbalance of women pursuing computer science and technology degrees. The initiatives involve a combination of community building, mentoring, education and training. There are more examples today of efforts underway to address the disparity. For example, NSF has invested $2million in a longitudinal study to identify best practices for keeping women and people of color in the field. BRAID (Building, Recruiting, and Inclusion for Diversity) was initiated with funding from Facebook, Google, and Microsoft, to increase the percentage of women and minorities in undergraduate computing programs. The initiative partners with fifteen universities that have pledged to increase diversity and inclusivity within their own computer science departments (Vu, 2017). Yet, educational efforts must begin prior to women entering higher education.

Elementary and Secondary Education

Andy Kessler (2017), writing for the Wall Street Journal, suggests the US is falling behind in making our students computer literate. He explained that in 2014, England made computing a part of its national primary education. Kessler suggests that the US could start by requiring high schools and colleges to allow computer languages to count for foreign language credit.

Saujani began Girls Who Code in 2012 as a nonprofit organization which aims to support and increase the number of women in computer science. They offer training, summer immersion programs, clubs and a book series among other things. The aim is to inspire, educate, and equip young women with the computing skills to pursue 21st century opportunities. Statistics are still depressing. Saujani reports that about 74% of young girls express interest in STEM fields and computer science; yet, by the time they make decisions about what to study and where to start their careers, the number drops significantly to less than 18% (Mylavarapu, 2016).

As mentioned, most females start college with little to no experience with computers or an understanding of computer science degrees. Colleges and universities must work with elementary and secondary educators to get the message out that no prior experience is needed. University personnel need to be present on high school campuses, offer courses with college credit to high school students, and improve and expand recruiting tools for perspective female students. The fundamentals of computer science and programming must be taught earlier, perhaps even being required (merely to allow students to function in a quickly changing and more technical world).

College and University Programs

Increasing the number of women in computer science and technology continues to frustrate college administrators who have offered special boot camps, internship programs, guest speakers, etc., yet the numbers continue to decline. Korn (2017) pointed out that a majority of the computer courses taken the first two years consist of technical courses with a programming emphasis. Recognizing females have (or believe they have) little or no experience with programming, redesigning the four year academic program to be less technical in the early stages may help.

Recognizing most females don't choose computer science until they are in college, a critical course to attract females is the introductory computer science course. Choosing instructors who understand the importance of the course for attracting majors, who are in no way seen as biased, and who recognize and can empathize with the women students' lack of confidence, while helping both men and women students in the class to successfully work together becomes significant. The course should incorporate values that arise when both sexes work together. The course should not be merely a technical course, but rather more of a personal exploration.

At an early juncture, students should be exposed to the historic role of women in computer science. The recent success of the popular movie Hidden Figures opened many people's understanding of women's historic role in computer science (and the space race). Gender intelligence and an awareness and appreciation for the gifts each gender brings should be as important as learning a program language. The difference between men and women should not be seen as a weakness, but rather be promoted as a strength – a strength that is often misunderstood, undervalued, and criticized. For example, mixed gender teams may recognize and make use of women's connective and consequential way of thinking to enhance problem solving and decision making; while helping women to appreciate the direct feedback and the sharing of statistics and facts that men bring to teams. Such differences can

only be appreciated when the students all work together and the instructor opens discussion of strengths and weaknesses individuals bring to group work. These lessons will then follow to the work place.

Beyond academic courses, there needs to be more support staff due in part to the high grade demands that women especially put upon themselves. Female students need to have support people to talk with and allow them a safe place to share their grade and program fears. Research has also confirmed that women are more influenced by teachers and counselors in a positive way (Pollack, 2015).

Organized activities which help to create a community of women should be a priority. Speakers should be brought in. Workshops on computer usage, programming, app development, security, and other professional activities should be offered (in addition to what is covered in required courses). Outreach activities should be planned, as well as dinners and group outings which all allow female students to bond and have a safe place to discuss their concerns and, perhaps, insecurities. Staff and faculty role models need to be continuously involved.

Internships and research opportunities must be expanded for female students. Female students shouldn't have to continually compete with males for such opportunities. Research opportunities can be used for recruitment purposes. Additionally, undergraduate research experiences have been shown to be a key factor in retaining students in computer science, particularly in the undergraduate to graduate school transition (Alvarado, 2012). Women are much less prone to apply for internships and research assistant positions, believing male students know more and are more deserving of such opportunities (Seymour, 2000). With many of these offerings, it would enhance the experience if once again men and women can work together and open lines of communication and understanding.

Pollack (2015) reported that a male professor suggested changing the name of the major from computer engineering to computer arts. He was convinced that this would double the number of women overnight as it would recognize women's creative side and ability to use the right side of their brain. This suggestion goes along with the idea to reframe the skills needed to succeed in computer science to stress communication, teamwork, creative problem solving rather than mere technical skills (Korn, 2017).

WORK WORLD CHANGES NEEDED

Challenges for Women in the Work World

Women are not well represented in computer science in higher education. Females are even less of a force in the corporate world where just 5% of the leadership positions in the technology industry are held by women (Mylavarapu, 2016).

Stereotyping and discrimination of women with computer and information science degrees does not stop once women are in the work world. For example, evaluating women's work is skewed if they are working in areas where there are few females. "Stereotypes shape our perception of competence. We hold women to a higher standard in evaluating and also women tend to evaluate themselves to a higher bar." Gender bias in male dominated areas is considered almost automatic (Bohnet, 2016). Most recently, Facebook data revealed that code written by females was rejected more frequently than that written by male colleagues (Seetharaman, 2017).

Lazlo Bock, formerly Senior Vice President of Google's People Operations, after viewing national and data specific to Google about women in technology, exclaimed, "Suddenly you go from being completely oblivious to going, 'Oh my god, it's everywhere" (Manjoo, 2014). Mr. Bock went on to publicly offer data on diversity at Google and to confront how personal bias often interfered with how women were treated in the workplace (Bock, 2015).

Research shows men are promoted in the work world based on potential, while women are promoted on past accomplishments. This again leads to women being evaluated and scrutinized differently than men for positions and promotion. Additionally, females may be evaluated for the same qualities/values that a male brings to the table, rather than being recognized for the skills they bring to the table such as inclusiveness, problem solving capabilities, empathy, and the use of right and left brain thinking in tandem.

Hiring decisions are, in part, based on a candidate having the right "fit" with the company and its culture. Women don't exactly 'fit' in occupations or companies where the number of men dominate. Because they are few in number

and don't 'fit' with the majority of employees, women are often excluded from men's social and professional networks where information is shared and personal and professional alliances are built. Because of the exclusion, women are often not privy to office politics or to hearing about new projects or jobs. With time, again, females will be seen as inferior in work abilities and not recognized for the strengths they bring to the work place.

The real challenge becomes supporting women once they are hired and then integrating, not marginalizing, females into the work environment. Women leave technology companies at twice the rate of men according to a survey from the University of Wisconsin Milwaukee. "Most major tech companies are revolving doors in which women and people of color quit at similar rates to which they're hired due to poor treatment, lack of advancement opportunities, and unfairness" (Alba, 2017).

Employer Incentives to Improve Gender Diversity

How then do companies find and keep women in the tech work world? Immediately what comes to mind is to work diligently to overcome the stereotypical beliefs and sexism that impacts the field. After the gender differences in the coding jobs were found at Facebook, the company began to help employees identify and offset inherent prejudices (Seetharaman, 2017). Companies are going to have to reach out, actively seek women, determine what females are looking for, and promote them. Companies need to become active in scientific and tech organizations that women are members of. They need to use LinkedIn and other social media, partner with universities and colleges, offer research opportunities and internships. Women need to be included in the interview process to make it more inclusive and less intimidating for perspective candidates. More collaborative programming exercises or individual projects should be used in the interview process.

Recognizing that women do want to make a difference and be part of something more than just holding a job, tech advances should be broadened. For example, when speaking about jobs in digital media, perhaps the design of and beauty aspects should be highlighted. Web security should recognize the need to make not only the web but the world a safer place for children and families. The digitization for online sales should be addressed as an important way to make life easier and more adequately address consumer needs in timely fashion. None of these conceptions are wrong by any means and they open up a different way of viewing the jobs therein.

Likewise, it has been proposed (and used by many) to remove names from resumes. Further, checklists of qualifications should be used to make the interview and evaluation of candidates more objective. Rubrics could even be used to more objectively and consistently evaluate candidates' responses in interviews.

Finally, the pay scales need to be evaluated to eliminate gender bias. Data shows that a female web designer makes less than a male ($.79/$1.00). Statistics from Forbes show that, for example, a woman holding a computer job makes 80.8% to 86.7% less than the equal male counterpart. You may attract the female scientist to begin, but you certainly won't keep them (Kauflin, 2017).

So how then do you retain the women you hire? Bock (2015) recognized the lack of women in critical professional positions at Google. He explained the first step to mass empowerment was making Google safe for all people to speak up. Bock also felt it critical to document and share data. Sharing data goes a long way toward combatting work bias which often happens 'behind closed doors'. He believes individuals are unaware of their innate stereotypical views of the opposite sex. Ways to help recognize and deal with workplace biases must be identified.

Mentors and sponsors have been shown to make a critical difference in male dominated workplaces. Mentors and sponsors have been shown to advance women's (and men's) careers by showing one the ropes, making connections, and putting one's name forward for career enhancing opportunities. Stratigakos (2016) found that men in architecture were significantly more likely to be sponsored. She explained that mentors tend to choose protégés who remind them of themselves and who are similar in personality and background. In architecture as in computer science, men are going to need to be selected and trained to serve as effective mentors to women – to recognize and expand the positive change and outlook women bring.

Networking with other women and professionals from various computer science jobs and areas is important. Networking opportunities in and outside the organization should be planned and actively supported by all

executives. Mentoring, sponsorships, and network initiatives are first steps in motivating and retaining women. But, due to the disparity in numbers of male and female computer scientists, more systematic interventions become critical.

Female role models in computer science are important. Role models can counter negative stereotypes and have been shown to increase motivation for career advancement and success. This hasn't always been the case. Note, in 2010 Mattel introduced a stylish and pink clad "computer engineering Barbie". It came with a book that was taken out of print when it was shown to represent Barbie as an incompetent engineer needing the help of the males to succeed (NPR, 2014).

More mixed gender teams and work is essential. Sandberg (2013) supported the idea of more teams. "There is a wealth of evidence that diversity helps teams and organizations perform better in terms of innovation, creativity, revenue, and profits. Using the talents of our full population is critical to our economic growth, corporate productivity, and individual happiness." Ms. Sandberg's quote captures the importance of growing the number and retaining women in computer science and the job force. The time is past due to seriously focus on and address the weak numbers and full use of female gifts in computer science.

SUMMARY

To capture the overlooked advantage women bring, computer science has to be redefined to make it more attractive to females. As Tim Cook said, the lack of women in tech is an enormous issue that must be addressed in its totality. We do need more studies, publications, workshops and symposiums, protests and redesigned academic programs to raise awareness about computer science and the entrenched gender disparities. We do need to become more inclusive of both genders working together for the overall betterment of the profession and those in it now and considering it for the future. Technology is our future and our survival. Despite the barriers outlined in this paper, it may be that financial forces will drive greater gender equality and accelerate growth for the global technology industry. How can we continue to overlook the advantage of women in such critical areas which profoundly impact all our lives?

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Kristin Holmberg-Wright is Distinguished Lecturer of Management and Organization Behavior at the University of Wisconsin-Parkside, and author of numerous publications and presentations in the areas of soft management skills, leadership, and business management.

David J. Wright is a Professor of Finance at the University of Wisconsin – Parkside since 1992. Previously, he was a faculty member at the University of Notre Dame and Indiana University, Bloomington. The author of more than 60 peer-reviewed publications, Dr. Wright specializes in the study of capital markets, security analysis, security market indexes, with a special emphasis on bond indices. Other activities of Dr. Wright included eight years as an advisor to Ryan Labs Asset Management in New York City and he received the U.S. Congressional Merit of Recognition by Speaker Paul Ryan for over 10 years of volunteer service as the Finance Committee Chair to the Kenosha Area Business Alliance (KABA) in Wisconsin.