U.S. Science and Engineering Workforce: Underrepresentation of Women and Minorities

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Abstract
Increasingly, industrial leaders, governmental officials, and academic scholars have become concerned whether the United States can successfully compete in science and engineering (S&E) fields. This is when employment in S&E jobs has grown faster than employment in all occupations in the United States. It is proposed that the United States has not been able to build its S&E human capital necessary for technological innovations and economic growth. Women and minorities are seen as essential to fill the perceived gap. There is a higher representation of women in S&E education and occupations. Yet overall demographics of S&E fields have remained unchanged. The U.S. technology industry has been progressively employing workers from foreign countries to meet their S&E internal workforce needs. Many have been outsourcing the work to developing countries, namely China and India. This article shows that technology companies that embrace the United States’s changing demographics would gain the economic benefits from a diverse S&E workforce.

Keywords
diversity, immigration, outsourcing

In the era of globalization, industrial leaders, government officials, and academic scholars have become concerned whether the United States will be able to sustain its international competitiveness in the long run. The Harvard Business School noted that the United States is, in fact, failing the test of economic competitiveness (Porter, Rivkin, Desai, & Raman, 2016). One of the major concerns is due to the United States’

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inability to build qualified science and engineering (S&E) human capital. According to Richard Ellis, “It is widely accepted that the STEM [science, technology, engineering, mathematics] workforce has a disproportionate impact on America’s ability to compete in a global economy” (cited in Gawlowicz, 2007, p. 1). President Barak Obama (2007) had declared that to restore America’s competitiveness, we must recruit a new generation of science and technology leaders by investing in diversity.

The U.S. S&E workforce is relatively small compared with the civilian workforce in the country. In 2016, the S&E workforce accounted for about 5% of scientists and engineers—people who hold S&E degrees or have a job in S&E occupations (Congressional Research Service, 2017). Yet the significance of the S&E workforce to the society is huge since scientists and engineers contribute to new scientific knowledge, technical leadership, industrial innovation, economic growth, and the preparation of future scientists and engineers. The National Science Board (2016) considers the S&E labor force a national resource in continuous productivity increases and innovative capacities that fuel long-term economic growth and raise public welfare. A large majority of scientists and engineers work for the business sector, mostly for-profit businesses. In 2013, the business sector employed about 70% of scientists and engineers, followed by the education and government sectors that employed 19% and 11%, respectively (National Science Board, 2016). Although the business sector is the largest employer of scientists and engineers, the academic sector is the largest employer of those holding doctorates.

Despite numerous national efforts, the S&E workforce is no more diverse now than was a decade ago. While there is a higher representation of women and racial/ethnic minorities in the S&E workforce, overall demographics of S&E fields have not changed significantly. Women make up 51% of U.S. population and 46% of U.S. civilian labor force, but only 29% of scientists and engineers. Most important, their presence varies widely across S&E occupations. In 2013, women constituted 15% of engineers; among engineering occupations, women accounted for only 8% of the workforce of mechanical engineers and about 11% to 12% of the workforce of electrical and computer engineers and of aerospace, aeronautical, and astronautical engineers. Within physical sciences occupations, women made only 11% of physicists and astronomers. Within computer occupations, women made 24% of computer and information scientists. Gender parity was close among life scientists (48% women) (Landivar, 2013; National Science Board, 2016).

The participation of racial and ethnic minorities in S&E occupations has been even lower than the participation of women. In terms of race and ethnicity, White and Asian groups tend to dominate the S&E workforce. In 2013, Whites constituted 66% of the U.S. population aged 21 years and older and 70% of scientists and engineers; Asians made only 5% of the U.S. population aged 21 years and older, but 17% of scientists and engineers. Overall, Hispanics accounted for 15% of the U.S. population aged 21 years and older, but only 6% of scientists and engineers. Similarly, Blacks comprised 12% of the U.S. population aged 21 years and older, but only 5% of scientists and engineers. American Indians or Alaska Natives were 0.6% of the U.S. population aged 21 years and older, but only 0.2% of scientists and engineers (Landivar, 2013; National Science Board, 2016). It should be noted that participation of racial and ethnic groups varied across the broad STEM occupation.
The U.S. Census uses the word minorities for every ethnic and racial group other than Whites. In S&E fields, Blacks, Hispanics, American Indians, and Alaska Natives are considered “underrepresented” minorities because they are a smaller percentage of S&E graduates and of S&E occupations than they are of the U.S. population. Asians, on the other hand, are not underrepresented in S&E because they are a larger percentage of S&E graduates and of S&E occupations than they are of the U.S. population. Therefore, they are considered what has been called “overrepresented” minority in S&E, similar to Whites. It should be noted that the U.S. Census uses the term Asian to diverse populations, which have origins in East Asia, Southeast Asia, and South Asia. However, not all Asian groups are overrepresented in S&E; for instance, many Southeast Asians have lower educational and occupational achievements in S&E (Varma, 2004). Nonetheless, in this article, the word minority is used in reference to Blacks, Hispanics, American Indians, and Alaska Natives.

A question of importance is, why is there so much concern about representation of women and minorities in the S&E workforce? For one thing, there has been tremendous growth in S&E occupations. Since 1960, the S&E workforce has grown much faster than the U.S. workforce as a whole. Employment in S&E occupations grew about 1.1 million in 1960 to about 6.2 million in 2013. This represents an average annual growth rate of 3% compared with a 2% growth rate in total employment during this period (National Science Board, 2016). The Bureau of Labor Statistics has projected that for the period 2016 to 2026 total employment in S&E jobs will increase at a somewhat faster rate (1.1% compound annual growth rate) than employment in all occupations (0.7%) (Congressional Research Service, 2017). Even though women and minorities now constitute an emerging workforce, these new jobs are unlikely to be available to them.

There are many reasons why women and minorities should be included in the workforce, which is true for most organizations—public and private, industry and academia, big and small, profit-making and nonprofit, S&E and non-S&E, and so forth. Rapid demographic changes require organizations to adapt to the changing reality. People are becoming less alike in terms of their social identities. Theoretically, the practice of hiring, retaining, and promoting qualified women and minorities would improve responsiveness to the public; increase the reputation of organizations; and result into more democratic decision making. Organizations with homogeneous workforce are unlikely to operate effectively in an environment that is constantly changing and diverse. Most important, it is an issue of fairness and justice. Democracy demands that qualified people are not excluded from the rest of the society. U.S. organizations, therefore, ought to create economic opportunity for all and contribute to reduction of economic disparity.

Equal representation of women and minorities in the workforce is a good thing for society in general and for organizations in particular. However, their equal representation is must in the S&E workforce. For one thing, we are living in a high-technology society where the technology revolution has been transforming society and dramatically changing the way we live and work (Forester, 1987). Scientific and technical inventions have been converted into innovations, which have spread on most aspects of the American society. Women and minorities cannot just remain the users of benefits of high-technology society; instead, they need to become designers and producers of scientific and technical inventions. Without them, S&E organizations are likely to miss out on new
innovative ideas. Women and minorities differ in their social backgrounds, experiences, and knowledge, which can lead to a wide range of products and services. This way, tech-companies would understand complex concerns of their audience and move closer to their customers. A technology company without women and minorities is unlikely to reflect its user base, whereas a technology company with women and minorities is likely to benefit from its user base. According to Intel Dalberg (n.d.), improving gender and ethnic diversity in the U.S. technology workforce represents a massive economic opportunity, one that could create $470 to $579 billion in value for the technology company, and could add 1.2% to 1.6% to national gross domestic product. In other words, having women and minorities in technology companies would is good for the business.

Without women and minorities, high-technology companies are likely to miss out on much needed talent. Increasingly, scientific and technical work in high-technology sector is undertaken as a group project. When scientists and engineers are engaged in group problem solving, diverse perspectives brought by women and minorities enhance the progress. Page (2008) has shown that innovations in modern time depend less on lone thinkers with enormous intelligence than on diverse people working together and capitalizing on their individuality. He has outlined a mathematical model, which shows how groups that display a range of perspectives tend to outperform groups of like-minded experts. In other words, it is different perspectives brought by women and minorities are likely to promote innovation, in addition to bringing flexibility and fluidity in the technology industry.

In theory, technology companies have embraced that their workforce should reflect society by in large. There is an agreement that representation of women and minorities matters. In fact, they have invested in diversity by appointing chief diversity officers. Yet high-technology companies have only achieved the meager results as reflected by data presented earlier in the article. Many have shifted the blame on the lack of supply of qualified women and minorities in S&E. For instance, Microsoft Chairman Bill Gates (2008) testified to the House Committee on Science and Technology that U.S. companies face a severe shortfall of scientists and engineers with expertise to develop the next generation of breakthroughs.

Since the 1990s, there is a growing perception that the United States is facing a shortage of scientists and engineers in high-technology industry (Alvarez, 2000; Information Technology Association of America, 1997). To deal with the nation’s ability to meet its technical workforce needs and to maintain its competitive position in the global markets, the United States has opened its doors to foreign-born. For instance, the 1990 Immigration Act created a category of 65,000 temporary workers (H1B visas) admitted for up to 6 years based on education and technical skills in demand. In 1999, the quota was increased to 115,000 for fiscal years 1999 and 2000. In 2000, the quota for H1B visas was expanded to 195,000 for the following 3 years. With the slowdown of the U.S. economic growth, H1B visas are back to 65,000 as the law had specified. India has been providing nearly half of the H1B petitions; the next share has been going to China (approximately 10%). In 2013, foreign-born individuals accounted for 27% of college-educated workers employed in S&E occupations in the United States (National Science Board, 2016). It should be noted that the idea of shortage of
technical workers is highly controversial (Matloff, 2002). Meanwhile, U.S. technology companies have been increasingly employing scientists and engineers from foreign countries, namely India and China, to fill their S&E workforce needs.

Another controversial step undertaken by technology companies to fulfill their S&E workforce needs is to outsource the work mostly to developing countries (Liberman, 2004). Many developing countries are now producing educated people who can accomplish work of U.S. technology companies at much lower cost. China and India with more than two billion people have experienced exponential growth in enrollment in higher education and degree production. Though U.S. technology companies gain a competitive advantage by working around the clock, and secure potential foreign markets for U.S. products and services, outsourcing has serious negative impacts on the American economy and its people. Outsourcing results in loss of jobs, threatens U.S. national security, exerts downward pressure on high-skill wages, diminishes U.S. tax base, and risks core competencies, in-house expertise, and future talent (Varma & Frehill, 2010). As U.S. technology companies are sending more S&E jobs to China and India, outsourcing has become a hot political issue in the United States.

In the end, a holy alliance has been formed between people interested in U.S. global competitiveness and people interested in social justice by bringing women and minorities in S&E. Aspray (2016) has provided a social history of activities aimed at increasing the proportion of women and underrepresented minorities in S&E fields and computing in higher education institutions. Despite such efforts, women and minorities remain underrepresented in S&E in educational institutions and technology industry. So the question of importance is, what can be done? The era is gone when women and minorities were simply barred from entering S&E fields. But, there are cultural, social, and institutional biases, which make their recruitment, retention, and experience undesirable by the prevailing culture. Scholarly literature on why women and minorities are underrepresented in S&E has grown tremendously in the past two decades (Aspray, 2016). However, there findings are yet to be converted into outreach efforts. There is a need to bring together scholars who have conducted research on women and minorities and organizations that have done outreach efforts. Most important, attracting women and minorities in the S&E workforce require changing the prevailing culture of technology companies so they are more family-friendly and open to broader participation and inclusion.

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