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Diversity and Inclusion in Automation

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Abstract. Diversity and inclusion are the vital to the long-term success of any business. In Industry 4.0 and 5.0 there is a requirement that engineering firms have the best talent to foster innovation, entrepreneurship and growth. The best talent means offering engineering education to all members of society, including minority groups. Traditionally automation is not an engineering sector that attracts a diverse cohort. This paper looks at why science, technology engineering and math (STEM) in general, and automation in particular, flourishes when opened up to a more diverse and inclusive community and it offers insight as to how to attract this more diverse and inclusive society.

Keywords: *Industry 4.0 (5.0), Automation, Inclusion, Diversity Education.*

1   Introduction

All sectors, including STEM, need diverse communities. Creating an environment where everyone has an equal opportunity to succeed is not only fair – evidence shows that diversity leads to better, more impactful scientific research. Meanwhile, imbalance in academic research takes many forms. In a publication in 2018 by Elservier by Bert called *"3 reasons gender diversity is crucial to science"* it states that *"scientific research is more accurate when gender is considered, women bring unique perspectives to research and scientific conversation and we need more STEM professionals."* [1]

The World Economic Forum has published a white paper entitled Accelerating Gender Parity in the Fourth Industrial Revolution. It states, 'women account for 11% of employees in the architecture and engineering job families, a lower share than other related STEM industries including 23% of those related to Information Communication Technology (ICT) and mathematics, and far less than 30% of world's science researchers.' [2]

There has been some focus in this century on encouraging diversity, but the challenges persist. In a study by Doyle-Kent et al in 2019 it is stated that the experience of two of the authors is that a shortage of female engineers in the Irish workforce. There has been no significant improvement over the past 20 years, and it looks like this will continue into the foreseeable future unless radical changes occur. [3]

Elsevier CEO Kumsal Bayazit stated "*we have more work to do to address issues of diversity and inclusion in research. There is no single solution here; the entire research ecosystem must come together to drive lasting change. To this end, we will accelerate our work with all stakeholders, including funding bodies, governments and institutions worldwide that share our goal of advancing science and improving health outcomes through greater diversity in research.*" Figure 1 below starkly paints a picture of women as a minority group in the global research landscape in the field of engineering. [1]
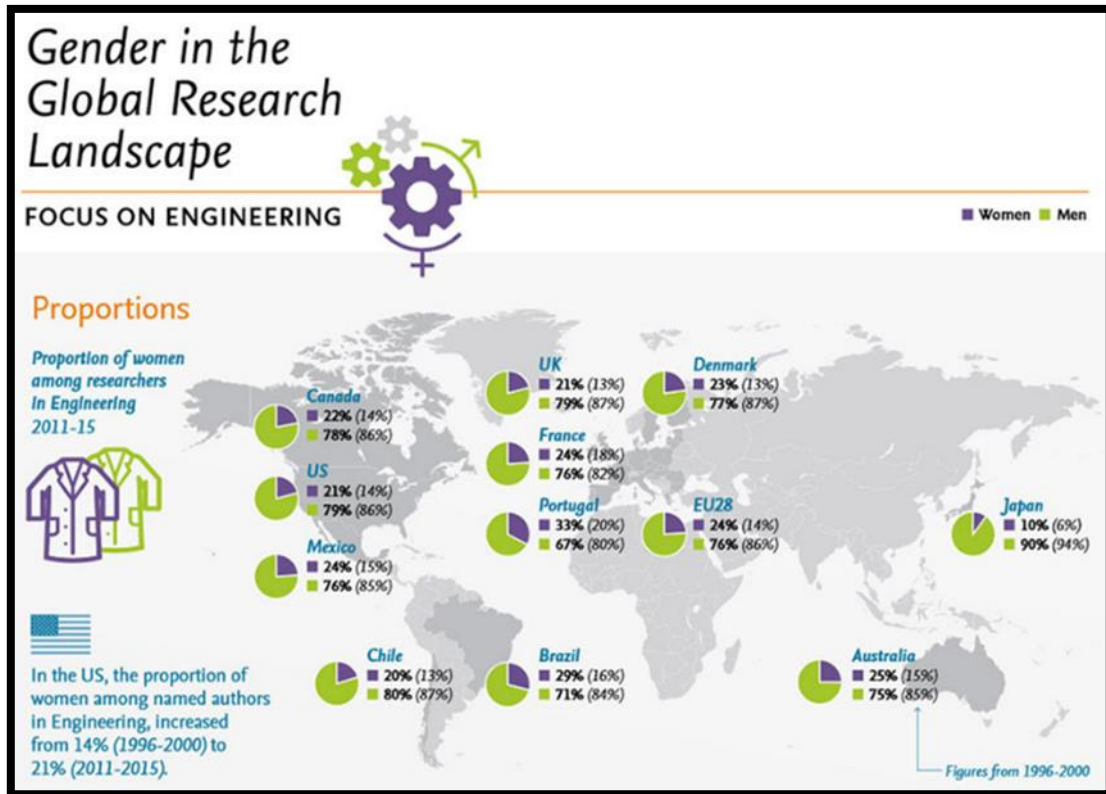
Fig. 1. Men significantly outnumber women in engineering research around the world. [1]

2 Diversity and Inclusion

2.1 Definitions

Gender imbalance in academic research is manifested in many different ways: from the low proportion of women who are tenured professors, to the extremely low rates of grants awarded to female researchers, to the monetary value of these grants and how the research itself is produced. Elsevier Inclusion and Diversity Advisory Board's mission is to:

- Drive I&D initiatives that lead to positive change in gender balance in academic research
- Help set standards and best practices that drive unbiased, robust decisions incorporating I&D principles in research
- Influence and improve the gender balance in research funding, peer review, publication and career progression [4]

Workplace diversity is understanding, accepting, and valuing differences between people including those of different races, ethnicities, genders, ages, religions, disabilities, and sexual orientations, with differences in education, personalities, skill sets, experiences, and knowledge bases.

In a report by Deloitte they state that diversity is perceived differently by generations. Millennials view workplace diversity as the combining of different backgrounds, experiences, and perspectives, and they believe taking advantage of these differences is what leads to innovation. [5]

Inclusion in the workplace is a collaborative, supportive, and respectful environment that increases the participation and contribution of all employees. As a matter of fact, true inclusion removes all barriers, discrimination, and intolerance. When applied properly in the workplace, it is natural for everyone to feel included and supported.

Diversity and inclusion ns a company's mission, strategies, and practices to support a diverse workplace and leverage the effects of diversity to achieve a competitive business advantage. Companies that create diverse and inclusive work environments are more adaptable, creative, and become magnets that attract top talent.

2.2 Diversity and inclusion priorities
A survey by *Forbes Insights* of more than 300 senior executives shows the following statistics:
- Diversity is a key driver of innovation and is a critical component of being successful on a global scale.
- A diverse and inclusive workforce is crucial for companies that want to attract and retain top talent.
- Nearly all respondents reported that their companies have diversity and inclusion strategies in place.
- Organization's diversity goals and priorities won't change significantly over the next three years.
- Responsibility for the success of company's diversity/inclusion efforts lies with senior management.
- Significant progress has been made to build and retain diverse workforces, but there are still some impediments to companies' efforts.

65% of senior executives believe the responsibility for implementing diversity and inclusion programs falls on HR, while 45% say it's the responsibility of senior leaders within a business unit or division. 56% of the companies surveyed strongly agree that diversity helps drive innovation. It's clear that they believe this innovation advantage is achieved through their ability to attract and recruit diverse talent. [6]

2.3 Diversity and inclusion best practices
A survey of 330 HR executives by Professor Roberson found that diversity and inclusion best practices include:
- fair treatment
- equal access to opportunity
- teamwork and collaboration
- a focus on innovation and creativity
- organizational flexibility, responsiveness, and agility
- conflict resolution processes that are collaborative
- evidence of leadership's commitment to diversity (e.g., appointing a Chief Diversity / Equality Officer)
- representation of diversity at all levels of the organization
- representation of diversity among internal and external stakeholders
- diversity education and training

The interesting thing to note is that employees perceive their company as diverse and inclusive based on practices that aren't even directly related to diversity such as a focus on innovation and creativity.
Instead, these best practices are ones that are desired by everyone in the workplace. [7]

2.4 Diversity and inclusion strategies
According to Bersin in 2015 vital company strategies to support diversity and inclusion include:

- *"Creating a focus and strategy at the CEO/COO/CHRO level*
- *Assigning a top executive, the responsibility for leading and sponsoring the diversity and inclusion program*
- *Creating behavioral standards and holding leaders accountable for results*
- *Training people at all levels on topics like unconscious bias*
- *Integrating diversity and inclusion strategies in recruitment, performance management, leadership assessment, and training*
- *Creating employee networks (e.g, employee resource groups, community outreach groups)*
- *Holding your company accountable to compete and win in external award programs*
- *Accepting and honoring multiple religious and cultural practices*
- *Strengthening anti-discriminatory policies*
- *Reporting goals and measuring progress*
- *Creating an externally visible scorecard to measure progress including metrics for recruiting, promotion rates, compensation levels, turnover, participation in ERGs, and supplier diversity"* [8]

2.5 Benefits of Diversity & Inclusion in the Workplace

Builtin.com is an interesting American website which gathers interesting statistics for high tech industry supporting diversity and inclusion. They say that *"aside from being a clear social, political, ethical and moral responsibility, there are some serious benefits associated with diversity in the workplace".* Following are some of their insights.

Table 1. Insights from Buildin.com on diversity and Inclusion [9]

Ethnically diverse companies are 35% more likely to yield higher revenue, while gender diverse companies are 15% more likely to yield higher revenue.
Diverse companies are 70% more likely to capture a new market audience.
When employees perceive their organization as committed to diversity and inclusion, and they actually feel included, employees are 80% more likely to rank their employer as high performing.
As of March 2019, 25 (4.8%) of Fortune 500 CEOs are female (up from 2.4% in 2008).
In addition to white men, as of 2018, there are more white women at every stage of the corporate pipeline than men or women of color.
Only 17.9% of people with a disability were employed in 2016 compared to 65% of people without a disability.
Of people who post personal religiously affiliated content on social media, Muslims are 13% less likely to receive a call back for an interview.
Men earn a 6% higher wage when they have a child, whereas women earn 4% less when they have a child.

3 Diversity and Inclusion in Automation

Engineering is one branch of STEM. Automation and robotics celebrate the 100th anniversary in 2020 as it is now 100 years since the word robot was used first by the Czech writer Karel Čapek. Robot comes from a Czech word, *"robota"* meaning *"drudgery"* or *"servitude"* [10] This century old establishment is need of diversifying and in order to become more attractive to a more diverse community, must now undergo a transformation. [10]

In modern manufacturing plants robots and automation play a central role in Industry 4.0. One of the more difficult tasks companies now have is finding suitably qualified staff for this high-tech working environment. In addition, engineering managers ask themselves how do they maintain the staff that they have in the more longer term? What do these highly qualified employees want from their employer to keep them motivated? [11]

As expressed by Doyle Kent et al in 2020 *"the modern manufacturing environment will require both robots and humans to collaborate and work together harmoniously, each bringing their positive attributes to the table. Anecdotal evidence suggests that industrialists are finding it more and more difficult to find the appropriate staff for this high-tech working environment. When staff are hired and trained a significant investment is made. It is then a high priority of the company to keep the staff employed for the longer term. Favourable working conditions and opportunities and career development are essential to keeping staff engaged and motivated."* [12]

Doyle-Kent et al in 2020 state that jobs will be more *"non routine and cognitive. This will require greater investment in ICT related skills (software skills and programming). They suggest that these skills, and complementary skills in engineering, need to be "offered in ways that are inclusive to ensure that women and men can benefit from these opportunities". There is growing pressure to ensure that diverse communities have opportunities to upskill in future manufacturing factories if the best talent is to be available."* [13]

3.1 The International Federation of Automatic Control (IFAC)

IFAC was founded in Paris in 1957, IFAC is the worldwide organization tasked with promoting the science and technology of automatic control in all systems, whether for example, engineering, physical, biological, social or economic, in both theory and application. IFAC is also concerned with the impact of control technology on society.

IFAC's Technical Committees (TCs) are responsible for the technical areas covered by IFAC, which are specialized topics in control engineering. The technical areas are placed into nine groups, called Coordinating Committees (CCs) where each technical area within a CC coincides with a TC. [14]

3.2 The IFAC TC 9.5

In the science and engineering community TC 9.5 is a unique community of scientists, engineers, practitioners and people from other disciplines. What unites us is a common interest in applying advanced control and automation technologies and systems in the service of humanity. TC 9.5 have currently 5 Working Groups.

Figure 2 The TC 9.5 Inclusion and Diversity logo.

The latest and youngest working group in TC 9.5 is in the area of "Diversity and Inclusion" It was created in Sozopol in 2019 after a meeting set up by Professor Fahmida Chowdry to discuss Women in STEM. This WG currently has 34 members from 10 countries. The main idea is to promote Inclusion and Diversity in STEM and to support fellow TECIS members in their careers and research endeavors. The mission statement: *to understand status quo, to inspire future generations and to mentor and support current researcher in their careers.*
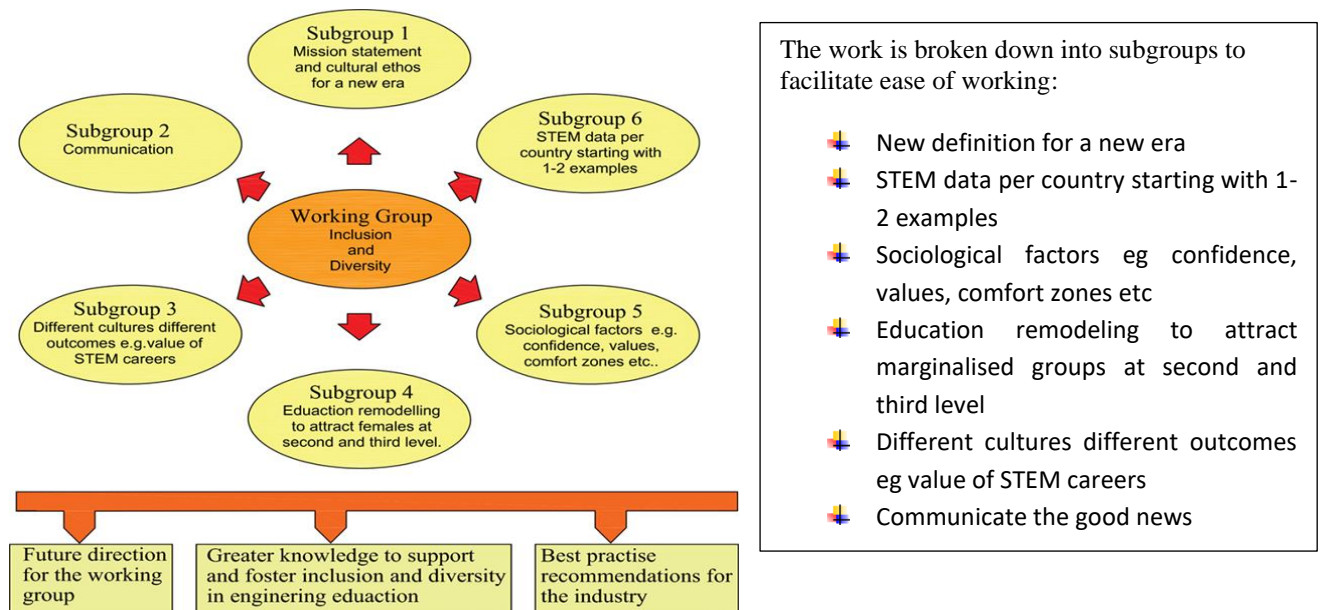
Figure 3. The subgroups of the TC9.5

WG Diversity &Inclusion: The importance of the work of the WG in D&I has been formally recognized at council level and attempts into align the WG with the D&I Task Force have resulted in Mary Doyle Kent being appointed as a chair of this new Committee in D&I reporting to Council. Major achievement for TECIS, and underlines the importance of TECIS initiatives in IFAC.

Until now there are some publications from the group – 10 are in preparation – an own webpage and a Videoclip. These are the aims of the working group:

- We will work as a cohesive multicultural group listening to all and appreciating all contributions
- Data gathering is an essential element of this process as understanding sociological, cultural and educational influences are key to unlocking trends and paradoxes.
- Investigating the role of the engineer in modern society is necessary so as to attract diverse communities into modern techno-engineering fields.
- It is strongly felt that engineering education needs to be remodeled to attract diverse communities at third level.
- Expression of the core values of our youth needs to be incorporated into engineering disciplines so that the value of this education is more highly appreciated.
- This working group will promote careers and education in engineering by highlighting positive role models and communicating the good news stories through diverse digital mediums and through IFAC and TECIS.
- Networking and mentoring are vital for people working in and considering STEM careers.
- Publish academic papers and present at conferences, symposiums and workshops in TECIS and elsewhere.
- Investigation of funding opportunities to support future cross-cultural projects
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4 Conclusion

In conclusion research has shown that a diverse and inclusive working environment greatly enhances productivity, innovation, and entrepreneurship. Historically, the area of automation in engineering doesn't a attract diverse community. To future-proof the industry and to ensure that the best talent in the world is engaged in Industry 4.0 and 5.0, efforts are being made to inspire future generations.

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