DIVERSITY, EQUITY, AND INCLUSION IN ENGINEERING EDUCATION: AN EXPLORATION OF EUROPEAN HIGHER EDUCATION INSTITUTIONS' STRATEGIC FRAMEWORKS, RESOURCES, AND INITIATIVES.

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ABSTRACT

Significant efforts have been made to promote gender equality in higher education (HE) in Europe. Examples include the establishment of the Athena Swan Charter in the UK in 2005 and the 2019 launch of the Irène Curie Fellowship scheme by Eindhoven University of Technology. But which initiatives address broader diversity, equity, and inclusion (DEI) challenges in HE? And which are specifically focused on engineering education?

This exploratory study aims to improve our understanding of the ways in which a set of European HE Institutions engaged in engineering education address DEI at an organisation level, and how this is communicated within the public domain. The analysis of online data provided by a purposive sample of institutions is guided by the following research questions (RQ):

1. How is DEI addressed and defined in institution-wide strategic frameworks?
2. How many institutions describe having an institution-wide DEI organization?
3. What specific policies around DEI are being developed, and what areas are mentioned, defined, and prioritized?
4. What structures and resources noted as part of their DEI activities are specific to engineering faculties and departments?
5. What engineering-specific DEI initiatives exist that are not available in the public domain or are not written in English?

Our sample is composed of the host institutions of the authors of the paper, and represent different European countries: Belgium, Denmark, France, Ireland, Portugal, Switzerland, and the UK. The findings of this exploratory study will be used to inform the design of a large-scale survey to identify DEI practices across the SEFI community.

1. INTRODUCTION

1.1 Motivation

A recent New York Times article [1] posed the question “What does it mean to say ‘I’m in favor of diversity’ when you haven’t even reckoned with what the state of diversity is in your own institution?”. Whilst the article focused on academic publishing, the same could be asked of engineering education in Europe. The current paper represents the beginning of our attempts to map how diversity, equity, and inclusion (DEI) are defined by our institutions.

SEFI has been engaged in diversity, equity, and inclusion. In its Diversity Statement, SEFI affirmed to “continually review its policies and practices to fulfil this commitment and to ensure that it influences SEFI’s activities and liaisons” (2018). Respect for diversity and different cultures, as well as institutional inclusiveness, are core values adopted by SEFI’s Board of Directors. More recently, and following SEFI’s Position Paper on Diversity, Equality and Inclusiveness in Engineering Education [2], SEFI and ASEE produced a joint statement [3] calling for examination, reflection, and active promotion of diversity, equity, and inclusion in engineering.

However, it is our experience that definitions of diversity and inclusion vary considerably between institutions, and that many initiatives are concerned only with widening the participation of women in engineering. Although gender imbalance remains a critical issue in the European engineering context, this narrow definition of diversity is inadequate to represent the different aspects that simultaneously form essential aspects of people’s identities and can lead them to experience exclusion, stereotyping, and microaggressions [4]. We argue for the importance of clear, comprehensive definitions of DEI and why data on the current way these terms are used by European engineering institutions can help us increase awareness of diversity, equity, and inclusion issues, but also identify, share, and celebrate good practices and initiatives across the SEFI community.

1.2 Literature review

A number of recent studies, such as the 2018 McKinsey Report [5], assert that diverse and inclusive teams are more creative, providing their companies with a competitive advantage. Many companies have established policies to both promote diversity in their hiring practices and encourage more inclusivity in the workplace. However, more effort is needed in this regard. Hilary Leevers, Engineering UK chief executive, writes [6]: “While engineers have responded fast, flexibly and with huge personal commitment at this time of corona-crisis – we know that it could have been better. We know this because workforce diversity improves innovation, creativity, productivity, resilience and market insight and the engineering workforce could and should be much more diverse.” Also, to fill in the continued shortage of engineers, Neelie Kroes [7] states that education and industry should focus on underrepresented groups and make Europe stronger. The latter is also highlighted by IEEE Innovation [8]: “Although 80% of future professions will require STEM expertise by 2020, millions of students in under-resourced communities lack the opportunities necessary to prepare for careers in these fields.” Engineering stereotypes can also play into the difficulties experienced. Pawley [9] observed that engineering schools often characterise “the ideal student” as a young, single White male. Assumptions about who engineering students are can negatively impact students from underrepresented groups. While this research was US focused, many in Europe will agree that this is also germane to European engineering schools - engineering education, research and practice lacks diversity of people and cultures, which ultimately affect the diversity of approaches to teaching, learning and research, and diversity of knowledge and skills.

But what does ‘diversity’ mean? “Equality, equity, diversity and inclusion are terms that are often used interchangeably, despite the fact that they may mean different things.” [10, p.23].

Diversity is the presence of differences within a given setting. In the educational sphere and in the workplace, that can mean differences in race, ethnicity, gender, gender identity, sexual orientation, age and socioeconomic class. According to the INVITED Report [10, p.23], diversity is “a multi-dimensional concept, dependent on the cultural context and level of awareness of difference. Certain dimensions of diversity have received particular attention because the groups identified as either under-represented, disadvantaged or vulnerable (or any combination of these three). In terms of gender, there is a clear under-representation of women in academic and leadership positions”.

Equity is the process of ensuring that processes and programs are impartial, fair and provide equal possible outcomes for every individual. ‘Equity’ goes beyond ‘equality’, as it “includes needs-based support to level out relative disadvantage. It thus often comes along with measures such as positive action or positive discrimination. Equity also takes into account that there are often structural barriers towards participation which, if they cannot be removed, make such needs-based individual support necessary.” [10, p.44].

Inclusion is the practice of ensuring that people feel a sense of belonging in a given community. This means that every person within the community making up an HEI feels comfortable and supported by the organization. Inclusion requires “awareness about different aspects of diversity” [10, p.44].

2. METHODOLOGY

This study adopts a critical discourse theoretical framework for analysing and assessing how diversity, equity and inclusion are communicated via university websites, and defined in strategic documents, such as mission or diversity statements. The approach works well because “website content is a form of institutional discourse” [11, p.67] and the internet provides “a rich cultural data source” [12, p.247] particularly about the higher education institutions (HEIs) in Europe that provide engineering education and participate in SEFI. Merkl [13] looked at the diversity statements of 11 universities in the United States, identifying themes to assess what they addressed equality and to “identify whether university Diversity Statements aid in maintaining or disrupting inequality in the university” (p.ii). Merkl proceeded to focus on 4 universities that were selected for maximum variation. She “compared the Mission Statement to the Diversity Statement, analyzed common university statistics, and evaluated website pictures” and then “conducted a cross-case analysis to identify patterns and considered the implications of those patterns” (p.ii).

At this initial pilot phase of our study, we have focused on the eight host institutions of the authors of this paper. Lažetić [14] studied HEI websites of a similar European sample; his study used content analysis alongside MANOVA to assess messages of

corporate branding versus public-service orientations of the sampled HEIs. Similarly, Creamer and Ghoston [15] conducted a content analysis of the mission statements from 48 random colleges/schools in the United States, followed by a quantitative phase to explore the correlation between the inductive codes and three measures of the representation of women among those same colleges of engineering. To date, our research team has harvested publicly available data, organized it in tabular format, and conducted initial analysis. As we progress from this pilot to full study, we will adopt either Pauwels' [12] six-step process for assessing websites from perspectives that are both medium-specific and socio-cultural, or Merkl's [13] approach, to explore RQ1: How is DEI addressed and defined in institution-wide strategic frameworks? This paper focuses on the description of the institution as a DEI organisation, its policies and priorities (RQ2, RQ3) and engineering-specific structures, resources and activities (RQ4, RQ5).

2.1 Institutions

The eight institutions included in this exploratory study are: 1) Technical University of Denmark (DTU), Denmark; 2) École polytechnique fédérale de Lausanne (EPFL), Switzerland; 3) Instituto Superior Técnico (IST), Portugal, 4) University of Leuven (KU Leuven), Belgium; 5) École Polytechnique de l'Université d'Orléans (Polytech Orléans), France; 6) Swansea University, United Kingdom/Wales; 7) Technological University Dublin (TU Dublin), Ireland; 8) University College London (UCL), United Kingdom/England.

3. RESULTS

This section summarizes the main findings of the following research questions:

- RQ2. How many institutions describe having an institution-wide DEI organization?
- RQ3. What specific policies around DEI are being developed, and what areas are mentioned, defined, and prioritized?
- RQ4. What structures and resources noted as part of their DEI activities are specific to engineering faculties and departments?
- RQ5. What engineering-specific DEI initiatives exist that are not available in the public domain or are not written in English?

An overview of these findings, as well as a brief description of each university (type of institution, population, and female ratio) is provided in Table 1.

4. DISCUSSION AND CONCLUSION

Of the institutions examined, almost all have an institution-wide DEI organisation while departmental or faculty-wide policies in engineering are prevalent in most cases. The area that is prioritised in most institutions is gender balance, followed by disability, while socioeconomic background and other areas are also mentioned. Engineering faculties appear to focus on gender balance. This is in line with existing research on diversity in engineering, which indicates that gender tends to monopolise the discourse on DEI.

Table 1. Overview of DEI focus and activities

University	Type	Population	Female ratio	Institution wide DEI (main) focus	Institution wide DEI activities	Engineering specific DEI themes	Engineering Specific DEI activities/ resources	Engineering Specific DEI initiatives not in the public domain
DTU	Public. Technical university. University focused in technical and natural sciences.	DTU has a student population of 11,200 students, and employs more than 6,000 staff.	Across all disciplines, 31% of the enrolled students are female, and 38% of staff are female.	Gender, ethnicity, age, sexual orientation, culture, educational background, physical ability	Recruitment practices DEI Strategy DEI teams and working groups Senior manager (provost) with DEI responsibilities	N/A	N/A	Bias training for staff
EPFL	Public. Research intensive technical university. Specialized in natural sciences and engineering.	Over 12,000 students and 4,000 researchers from more than 120 different countries.	Approximately 30 % of students are female	Gender (LGBTQ+) (Ethnicity) (Disability)	DEI Strategy Senior manager with DEI responsibilities Vice presidency for Sustainable Transformation	N/A	N/A	Recruitment practices Bias training Training for students' project teams
IST - University of Lisbon	Public. Research University. School of engineering and technology.	It has 11.000 students of 60 nationalities, 700 academic staff, 25	28% of IST students and 26% of academic staff are female	Gender	CIEG (Interdisciplinary Centre for Gender Studies).	Gender	Diverse recruitment policies. Policies to support female staff. Gender Balance Group tracks	

		research centres and more than 1.000 researchers.			PhD program in Gender Studies.		female staff and student numbers, organises activities such as the Maria Pintasilgo Prize for alumnae and liaises with external associations	
KU Leuven	Public Research University Comprehensive university, organised in 3 groups: Humanities & Social Sciences, Biomedical Sciences, and Sciences, Engineering & Technology (SET) (15 faculties incl. 3 engineering faculties)	KU Leuven has 60.687 students (22.356 in SET) from 150 nationalities (more than 12.500 international students), 21 605 staff members, 7637 researchers and professors (3786 in SET), 6236 Phd Researchers (Aug. 2020)	in SET faculties: 30% female students, 31% female researchers	Gender Age Ethnicity Nationality LGBTQ+ Religion Disability Neurodiversity Socio-economic background	DEI Strategy Senior manager with DEI responsibilities Dedicated DEI teams and working groups Staff and student networks/committees DEI training Diverse recruitment policies	Diversity of student cohort International students Career development (particularly with respect to gender)	Senior manager with DEI responsibilities Dedicated DEI teams and working groups Faculty level policy Integration with Institution level activities	Report Diversity (student inflow and outflow) per faculty (only accessible for DEI teams and working groups) KU Leuven SET: Strategy Document incl. DEI (only accessible by KU Leuven staff)
Polytech Orléans	Public. Polytechnic university (Grande École)	Yearly intake of 1000 undergraduates and 250	27% female students			Socio-economic Background		

		postgraduate students (Master's).						
Swansea University	Public. Research university. The College of Engineering (CoE) is one of 8 university colleges.	In 2019, the CoE delivered 22 UG courses to around 3500 students, 22 courses to 157 postgraduate students, and 27 PGR courses to 281 research students Approximately 30 % of UG students are international	17% undergraduate and 20% postgraduate taught and postgraduate research female students.	Gender Age Ethnicity LGBTQ+ Religion Disability Neurodiversity Personal Circumstances	DEI Strategy Dedicated DEI teams and working groups Diverse recruitment policies Staff and student networks/committees DEI training	Gender, BAME (Black, Asian and Minority Ethnic)	DEI Officer	
TU Dublin	Public. Technological University. TU Dublin is organized in 5 Colleges & Schools – one is the College of Engineering and Built Environment.	TU Dublin is the second-largest third-level institution in Ireland, with 3500 staff members, 29,700 students, 138	46% female staff, regarding student diversity: 2854 international students from 105 countries, 13% of student body classifies as mature, 5%	Gender Age Ethnicity LGBTQ+ Disability Socio-economic background	DEI Strategy Diverse recruitment policies RINCE (centre for research and practice on EDI) Projects: GE Academy;	N/A	ESTeEM, a mentorship programme for female students in Engineering and Computing to address gender equality	N/A

		nationalities and 3 locations in Dublin.	as access, and 8% as disabled		GenderEX; RESISTIRÉ; SAGE for interventions to advance gender equality TU Dublin EDI Fund supports innovative projects that promote EDI within the uni			
UCL	Public. Research university. UCL is organized in 11 faculties – one is Engineering Sciences	UCL has 43,800 students and 14,300 employees 53% of students are international and 37% of staff Of those, 6,317 students are within the Engineering Faculty	In 2019, in Engineering 31.5% of Undergraduates were female (55.5% in the whole of UCL), 45.9% of Postgraduates (66.5%), 35.8% of Postgraduate researchers (54.7%) and 36.9% of staff (53.2%)	Gender Age Ethnicity LGBTQ+ Religion Disability	DEI Strategy. Dedicated DEI teams and working groups. Diverse recruitment policies. Staff and student networks/committees EDI training	Same as institution-wide	Senior manager with DEI responsibilities. Dedicated DEI teams Faculty level policy Integration with Institution level activities. DEI UCL Engineering public website.	UCL Engineering: Equality, Diversity and Inclusion Strategy Document 2020-2030 (only accessible by UCL staff)

Initiatives to address diversity are centred around recruitment of students and staff, however recruitment is only the first step towards addressing balance in engineering. The appointment of a DEI officer or team, to ensure integration with institution-wide policies seems to be a common next step practice.

There are some indications of regional variation of institutions that demonstrate high awareness of a variety of DEI issues in their literature (DTU, KU Leuven, UCL etc.), which appear to be clustered in Northwestern Europe, as opposed to institutions elsewhere that focus mostly on one issue (IST) or use generic terminology (Polytech Orleans). This variation may be due to the level of detailed information shared in the public domain, but it can also be a reflection of the differences in local practice and cultural norms, as well as the variety of legal frameworks and education policies that govern universities across Europe. Further work will be required to investigate trends in a wider range of institutions, covering more European countries, especially of the East and South and they could further be complemented with observations of strategies and policies that are in place or are being planned.

The limited scope of this preliminary study does not permit a high degree of certainty in generalising the results. However, it is evident that among the institutions studied there are various interpretations of the definitions of diversity and inclusion, but initiatives tend to run along similar, relatively narrow paths. The ambiguity on what constitutes DEI affects how progress is measured, because different definitions and associations lead to different interpretations of the outcomes. There is therefore a need for better definitions of DEI, which will be the focus of the future work of this study. Policy evaluation is also needed to investigate best practice and to determine the causes of the apparent limited variation of initiatives, however this may also reflect self-selection bias, because the institutions examined are the authors' employers, that provide support for the authors' interest in DEI in engineering education.

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