TInnGO

Transport
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Deliverable

D9.4 Gender and Diversity Bias in Academic Outputs in Smart Mobility

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Abstract

This deliverable explores gender and diversity bias in research. It takes a systems-oriented approach, drawing together experimental, qualitative and desk-based research to argue that gender and diversity bias in outputs and outcomes are symptomatic of a wider malaise in the Transport Business Ecosystem (TBE) which not only effects women's research footprints but also the direction of transport research. Drawing on existing research from academia and industry (cybersecurity and automotive design) the benefits of increasing diversity across the TBE are outlined. The similarities in the barriers and enablers women experience if they are to achieve leadership positions in the two areas is striking. Using a contemporary feminist approach (Davis, 2008 and Finlayson, 2016), the deliverable highlights lack of diversity (gender and ethnicity) in both industry and academia. It emphasises the importance of addressing wider diversity issues to reposition transport, especially smart mobility, in a social context, to generate new transport roadmap proposing the use of Mor Barak's (2000) concept of diversity management. Understanding and addressing systemic issues across the industry is seen as the best opportunity of achieving an increase in gender and diversity in academic outputs. The deliverable closes with mapping the barriers on to the Hexagon Spindle model of Educational Ergonomics (Benedyk et al, 2009 and Woodcock et al, 2009) and a series of recommendations.

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1. Introduction

TInnGO (Transport Innovation Gender Observatory, https://www.tinngo.eu/) is funded under the H2020 programme to create a framework and mechanism for a sustainable game change in European transport. The team has argued, on the one hand, that far reaching change is needed in education, employment, transport planning, operation and usage[1]; and on the other, that a Smart City (which by definition is served by a smart transport system), is one that is both inclusive and sustainable.

This is in line with the ethos behind Smart City initiatives, i.e. urban strategies using technology to increase the quality of life in urban space, both improving the environmental quality and delivering better services to the citizens (Hall, 2000). Here, the Smart City can be described as "a city performing well, in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of activities of self-decisive, independent and aware citizens" (Giffinger et al., 2007). Smart Mobility is one of the mechanisms through which key benefits may be delivered for citizens (e.g. reduction in pollution, traffic congestion, noise pollution and transfer costs) while at the same time increasing transport safety and improving transfer speed (Bencardino and Greco, 2014).

Of key interest is the emphasis on intersectionality and joined up thinking. Transport forms part of a bigger picture. It is an enabler, as such it needs to work closely with, and be informed by diverse disciplines and groups. This deliverable looks across the TBE, recognising that research and research outputs are part of this greater endeavour, and that they are shaped by (and also inform) the wider system. If there are biases, these effect each part of the system.

Until recently, gender and diversity issues have been marginal in Smart Mobility and Smart Cities research, even though both aim to reduce social inequity (Staricco, 2013). Technology has and continues to drive innovation. New, unproven, smart mobility systems infiltrate urban structures and modify behaviours, with whole cities becoming living labs. This in unprecedented, and not without danger.

For example, market disrupters such as on demand ride hailing services, have revolutionised the way people travel, pay for rides and are willing to get into cars with strangers. The rapid introduction of these services has not only displaced the taxi driving industry (without any employment safety nets for displaced taxi drivers) but has also been found to put passengers at such levels of risk (e.g. though unsafe vehicles, fraudulent use of licences and lack of regulation of drivers) that some schemes have been withdrawn. Airbnb based around the same technology - enabled trust economy has created problems for local housing markets and residents, by inflating the housing market and criminal use of residents and its booking processes reveal levels of gender and ethnic discrimination (which necessitate

[1] All these comprise the Transport Business Ecosystem (TBE) for the purposes of this deliverable

people creating false profiles). Connected and autonomous vehicles (C-AV) may be technologically safe, as road trials are proving, but modelling has not considered social and behavioural effects of who such systems will (dis)advantage. Research and innovation no longer happens just in universities, but also by start-ups, and in local authorities who use real world trials to test technology. It is all around. This has been a significant change. Therefore, attention also needs to be placed on the wider Transport Business Ecosystem (TBE), especially on its diversity. However, in many cases technology is designed by and for early adopters, who form a small segment of the population (Woodcock, 2014).

The contribution of women, and those from more diverse backgrounds to technological advances has, until recently been significantly overlooked. Social media campaigns spearhead attempts to celebrate and increase visibility of women in science and the arts. It is hoped that the effects of these campaigns, on the confidence, ambitions, and career trajectories of young people will become more evident in the next few years.

In the meantime, gender and diversity gaps in STE(A)M subjects and related industries remain. The roots of Smart Mobility lie in traditionally male-dominated STEM (Science, Technology, Engineering and Mathematics) subjects such as computing, engineering, manufacturing and planning. These have become associated with fractured and gender-biased transport TBEs that, if unchecked, will impede the ability of Smart Mobility to deliver equitable transport. This has become a persistent problem – with gender and diversity equity gaps hard to reduce. Current academics, research agendas and innovations work in, on or through projects and environments, which have been guided by the beliefs and research interests of, for the most part, older, white, middle class males. Given this tradition and the culture it promotes, it is not surprising that gender gaps in research outputs are resistant to change.

Given that transport employment, operation and usage as well as education lack diversity in its broadest sense (including age, gender, sex, ethnicity, disability, economic status and race) should the (resistant) gender gaps in research outputs be regarded in isolation? Focussing on gender may play a disservice to wider issues around lack of diversity within transport and the R and I sector. It might also hide intersectional factors, cross overs, enablers and barriers, that could be apparent from a more holistic approach. This deliverable touches on the need to recognise that gender-based issues are part of deeper issues around lack of diversity in transport

TInnGO responded to a call for a paradigm shift in approaches to gender in transport, in particular in relation to Smart Mobility which needs new approaches if it is to deliver its promised benefits. We have signalled that gender mainstreaming (GM) now extended to include Diversity Mainstreaming (as GaDM) as our approach to create this shift. This calls for top down and bottom up approaches.

This deliverable fits into project by looking at research and development/innovation as a key top down influencer of the TBE. Research teams are responsible for route maps, technological innovation

and thought leadership which permeates the whole of society. Such teams may be part of, or inform, senior decision makers within organisations and governments. If their makeup lacks diversity, if they have inherent biases, are not committed to equality and create a culture around them in which they feel safe, the future will replicate the same inequalities as the past.

1.1. The wider picture

The relevance of this topic has a worldwide dimension, featuring in the United Nations' Sustainable Development Goals (SDGs) relating in particular to:

- Goal 5 - Gender equality;
- Goal 8: Decent work and economic growth;
- Goal 10: Reduce inequalities;
- Goal 11: Make cities inclusive, safe, resilient and sustainable;
- Goal 16: Promote just, peaceful and inclusive societies.

These goals are embedded in the heart of TInnGO. The project seeks to help EU advance towards these by promoting the need for a greater consideration to be given to gender and diversity in future transport innovations, and in the makeup of teams. This has the dual role of increasing societal inclusivity and competitive growth by increasing the creative and innovative capacity of industry.

Intersectionality is central to the consideration of multiple levels of deprivation experienced by minority and excluded groups, for example in relation to gender transport poverty (Hamilton et al, 2005; Woodcock et al, 2019: Iqbal et al, 2020) where poor transport systems reduce accessibility to resources, and create further poverty for women.

Following a statement by the European Commission (1998) that gender equality "*does not mean that women and men will become the same but that women's and men's rights, responsibilities and opportunities will not depend on whether they are born female or male*", the concept of equality between women and men has been a core value of the European Union. This has led to a large body of legislation to promote gender equality in various areas: equal pay, work-life balance, health and safety at work, social security, access to goods and services, protection from human trafficking, gender-based violence, and other forms of gender-based crime (European Commission, 2019).

Moreover, the European Commission underlined the importance of changing the European transport to meet the ambition of a safe, efficient, technologically advanced, sustainable and accessible transport system (European Commission, 2011). Hortelano et al.'s (2019) review (summarised briefly below) includes European regulations which have considered women and transport.

The equal representation of women in the (transport) industry is not simply a matter of balancing numbers. Diversity in teams creates greater innovation and creativity. Organizations which

embed diversity within their culture, which are committed to and understand diversity are those which are in a better place to create new services and serve diverse communities. It is the 'diversity' in thinking, feeling, knowledge and experience which are key. The short case studies in Section 4 illustrate the far-reaching steps which industry is taken to 'diversify' their workforce and the value they see in doing this.

The smart mobility sector needs a diverse range of talent, backgrounds and disciplines, in order to meet the pressing challenges of climate change, urbanization, growing population etc. At both European and national levels, there are still serious gaps when it comes to the recognition and inclusion of gender and diversity aspects in transport strategies, research, and innovation.

As depicted in TInnGO Roadmap (TInnGO, 2019), the transport sector is a highly gender-biased workplace where women form only 22% of workers in Europe (European Commission, 2018)[2] . Female staff may be found largely in service jobs and seldom in areas of technology, manufacturing and construction. Several reasons explain the underrepresentation of women: "difficulty to find a work-life balance in shift work, lack of appropriate working environment and equipment, lack of training and life-long learning opportunities or inadequate targeted recruitment, persistence of stereotypes, harassment, and bullying" (Ortega Hortelano et al., 2019). The gap is slowly narrowing – not at the level one would have expected – and maxes even greater ethnic inequalities.

It has been estimated that the demand for STEM and associated professionals would grow by around 8% by 2025. However, women's participation in this area, in particular in engineering, remains low in most EU countries: in 2012, graduates in STEM-related subjects accounted for 12.6% of female graduates as compared to a share of 37.5% among male graduates (Caprile et al., 2015). The Danish Technological Institute (2015) found that computing and engineering were the two most heavily male-dominated STEM disciplines in EU, with more than 80% male graduates in both disciplines in 2012, while life sciences - the third-largest STEM discipline - is dominated by women.

This deeply gender-biased domain is replete with resistant barriers for the participation of women and those from minority backgrounds[3]. Well documented barriers include stereotypes, social norms and cultural practices, welfare policies, family backgrounds, the absence of female role models, limited access to networks, information, funding, or institutional support; horizontal segregation that favours the presence of men or women in some sectors and excludes them in others; underrepresentation of women in technical-scientific jobs; expectations and identity definitions whereby women exclude themselves from occupations in the IT, technical and scientific sectors.

[2] It is appreciated that these figures do not represent smart mobility sector, in which women may have opportunities to enter transport through other avenues e.g. planning. This is considered in other deliverables.

[3] Explored further in the case study on cybersecurity and finance

As commented earlier, these barriers are similar to those found in the wider industry. Berra and Cavalletto (2019), argued for a combined approach from school and at labour levels to bring young women closer to technical disciplines.

2. Purpose

This deliverable also argues for a more holistic approach to create a paradigm shift, which could permeate the whole of the sector, using Mor Barak's (2000) definition of 'inclusive workplaces'. He defines this as a

> 'work organization that is not only accepting and using the diversity of its own work force, but also is active in the community, participates in state and federal programs to include working poor people, and collaborates across cultural and national boundaries with a focus on global mutual interests.'

This appears to align closely with what we would wish of smart mobility and transport – where it could work in concert with other industries to deliver societal goals and work on global problems. Both industry and academia lack diversity, intersectional or interdisciplinary thinking in this wider sense. Their resistance to change not only impedes the career pathways of women it could mean that they are not able to deliver again wider needs, because they do not understand diversity. As such the same issues are found, the same solutions put forward.

Borrowing from Mor Barak's (2000) (written in relation to the social work sector), workforce diversity could be recast as follows.

> "The problems arising from today's workforce diversity are caused not by the changing composition of the work force itself but by the **inability of work organizations to truly integrate and use a heterogeneous work force at all levels of the organization** (Cox, 1991, Fernandez, 1991). Granted, some corporations are including diversity goals in their strategic planning and are changing organization wide policies, but even those **changes are focused mainly on internal processes of the organization**…… organizations need to expand their notion of diversity to include not only the organization itself, but also **the larger systems that constitute its environment**. Organizational policies and actions that are inclusive can benefit all system levels from the individual worker through the work organization to the wider community."

This approach resonates well with the TBE (including both industry and education) which still may struggle to

- 'value and use individual and intergroup differences within its work force
- cooperate with and contribute to its surrounding community
- alleviate the needs of disadvantaged groups in its wider environment
- collaborate with individuals, groups, and organizations across national and cultural boundaries.'

Looking at the wider ecosystem may provide a new perspective and position transport in a different place. Bearing this in mind the deliverable is organised into four main sections:

- Overview of EU legislation
- Gender and diversity biases in transport and related fields
- Research footprints of women in academia, with special reference to transport.
- Gender and intersectional analysis of research outputs
- Recommendations and action points based on the above.

2.1. Aims

This deliverable aims to show the effects of lack of diversity and inherent biases on women's careers, research footprints and research outputs and provide recommendations drawn from existing good practices industry and academia from transport and related sectors. It is a complementary activity to deliverables from WP4 and WP9. It comprises:

1. Desk top research considering the lack of diversity in academia and industry (cybersecurity and automotive design) and the effect of gender on 'research footprints'.
2. Original research looking at the
    a. composition of women PIs in H2020 projects
    b. investigation of the experience of women in transport related research teams,
    c. quantitative corpus linguistic exploration of the use of gender in research papers
    d. quantitative analysis of intersectionality in representative research papers using NVIVO
3. Set of recommendations and action points that could be used by policy makers to address skills, opportunities, and training needs in the transport and mobility ecosystem to reduce gender gaps

The scope of the deliverable has been hampered by two things. Qualitative research was planned to understand women's roles within R and I. Data collection was planned for March and April 2020. At this time, conferences closed, face to face meetings and travel within UK was no longer possible. As such data collection was moved to a more quantitative on-line survey (Section 5.4.5 and Appendix 2) which despite running over an extended period (necessitating the extension of this deliverable) has

simply not produced many returns. We have found that in the early parts of COVID, the capacity and willingness of staff to engage in work not central to their core activities/interests was reduced as they had to manage and construct new ways of coping with additional work (service, pastoral and mental health support) and family matters. This may have explained the small sample size.

A second issue has been the lack of available data on the gender make up of research teams. Such data is routinely collected by research funding bodies. While some statistics are shared in dashboards, gender, ethnicity and other measures of diversity are not. The deliverable rested in part on the ability to find such data. With many research councils in lock down, or moving their attention to funding related research, it was impractical to ask them for such data, even if they are able to share it. The question remains pertinent and will be revisited. Sections 3 and 5 therefore rely more heavily on summarising existing work than intended.

2.2. Data collection and analysis methods

A mixed methods approach has been used to tease out gender and diversity issues in authorship, the constitution of research teams and the way in which gender and intersectionality are presented in smart mobility related papers. The methods include,

- Literature review,
- Case studies on lack of diversity in the automotive industry and cybersecurity,
- Online survey of females working in research teams related to transport,
- Corpus linguistic analysis investigating gender bias in a selection of representative papers,
- NVIVO study of intersectionality in selected research papers.

with the last 2 methods have been used exploratively to examine the presence of bias in written academic outputs.

3. EUs position

Using TRIMIS, and other sources, the Joint Research Centre (JRC) (Ortega Hortelano et al, 2019) undertook a comprehensive review of women's issues in European transport Research and Innovation sector. This was presented at the 6th International Conference on Women's Issues in Transportation (WIiT 2019). The following sections have been extracted from this. The interested reader is referred to the original for full details.

3.1. Gender and research in EU

Gender equality has been enshrined in over 13 directives since the EEC signed the treaty of Rome in 1957. Originally considering the gender pay gap, this has been extended to wider areas of equal opportunity, including the participation of women in European research. Highlights include:

- The 1999 Communication (COM (1999)76) on women and science, which aimed to increase female participation in Community programmes and set up a women and science working group. The Helsinki Group on Gender in Research and Innovation was set up as an advisory group to assist in tackling disadvantages women faced in the fields of research and science (ERA, 2019).

- The Science and Society Action Plan Communication COM (2001)714 included proposed specific actions to establish more gender equality including a European platform of women scientists; monitoring of progress towards gender equality in science; mobilisation of women scientists in the private sector; and promotion of gender equality in European science (European Commission, 2001 and Society Action Plan (European Commission, 2002).

- The European Commission (2005) working document "Women and Science: Excellence and Innovation - Gender Equality in Science" provided an overview of women and science actions implemented at European level through activities to promote gender equality in research framework programmes and the progress made in increasing the participation of women in science.

- In 2007, the EC Green Paper entitled "The European Research Area: New Perspectives" (COM(2007)0161) and the accompanying staff working document (SEC(2007)0412) sought to establish equal opportunities and attractive working conditions for both men and women in research careers (European Commission, 2007) as one of the European Research Area's targets.

- Moving to H2020 funding, Regulation (EU) no 1291/2013 of the European Parliament and of the Council of 11 December 2013, establishing Horizon 2020 noted that within the H2020 context, gender would be addressed as a cross-cutting issue to rectify imbalances and to integrate a gender dimension in R&I programming and content (European Union, 2013).
  In her forward, the EU Commissioner for Research, Innovation and Science, Máire Geoghegan-Quinn noted her commitment to strengthen the gender dimension in H2020, stating

  > "It really is a win-win situation: gender analysis contributes to excellence; it stimulates new knowledge creation and technologies; opens new niches and opportunities for research teams and results in products and services that all members of society need and demand, p6."

- European Parliament Resolution of 9 September 2015 on women's careers in science and universities, and glass ceilings encountered (2014/2251(INI)) called for positive and corrective measures towards equal opportunities, to achieve balance and an increase of women's involvement at all levels. It highlighted the need for a balanced professional and personal life, institutional changes and projects and called for action at European and Member State level (European Parliament, 2015).

The strategy recognises a 3-fold relationship between women and research (European Commission, 2014), namely that

- women's participation in science and research must be encouraged through the equal participation of men and women in research teams at all levels and the create working conditions and culture that allow men and women to have equally fulfilling careers,
- research must address women's needs as well as men's by taking into account both men's and women's realities and considering gender specific research fill knowledge gaps,
- there should be research on the gender question itself, to enhance understanding of gender issues in science and research.

Many inroads have been made to improve working conditions, yet bullying, discrimination and gender pay gaps exist within the transport domain, STEM and the wider educational sector. The impact on careers and research outputs may be quantifiable, but real questions remain about how research is shaped – for example, what issues are prioritised, how is research conducted – and who shapes it. Perhaps there would be no difference if there was greater diversity and less discrimination in R and I.

Also, while gender is at the forefront of activities, issues around wider diversity are not being given the same attention[4].

3.2. Gender and transport in EU research

Within the FP5 Key Action on Sustainable Mobility and Intermodality, researchers were encouraged to:

> "… take into account the needs of women, where they are specific, when carrying out research on the impact of transport policies and projects. In research relating to accessibility, fares policy and urban public transport, assessment will include the question of whether different social groups, including gender, are fairly treated and have fair access to these systems" (European Commission, 1999).

This sees a split along two lines of activity.

1. Ensuring that the effects of transport on 'women' and 'different social groups' were considered
2. Addressing the gender gap in research.

Under the FP7 framework a central concept was to develop a safer, 'greener' and 'smarter' pan-European transport system that would benefit all citizens, respect the environment, and increase the competitiveness of European industries in the global market. Gender was seen as relevant because of persistent gender differences in the use of transport and the fact that transport was seen as a male-dominated sector, characterised by masculine values and practices.[5] This dominance is still noted in design, research and transport models which prioritise the man's journey over that of a woman.

Due in part to gendered roles within society, women make more complicated journeys everyday (when acting as chief housekeeper and carer as well as an employee), yet journeys relating to circles of care have not been considered. Despite this, transport research and policies remain highly androcentric, focusing on men's travel patterns and interests (European Commission, 2014). Developing sustainable, inclusive travel needs to recognise the needs of all citizens.

> 'the integration of a gendered users' perspective while seeking to guarantee equal opportunities for women and men in the sector. A continuous awareness of creating and maintaining equal opportunities, and a working climate in which women feel welcome as professionals too, will result in more women in the sector, which in turn will promote

[4] For this reason a small case study has been included on diversity the cybersecurity industry.
[5] Transgen Project Team (2007), Gender Mainstreaming European Transport Research and Policies;
Building the Knowledge Base and Mapping Good Practices. Copenhagen

> women's values and experiences, ultimately leading to more socially sustainable transport systems.' (European Commission, 2014, part 3.4)

As an example, the FP7 METPEX project, led by the PI of TInnGO (see Tovey et al 2019) aimed to develop a methodology for measuring end to end, multimodal journeys of all passengers. Such a methodology could be used by different sectors, to discover where passengers were least satisfied with their journeys and use this information for targeted action to encourage people to use more sustainable transport. In this we aimed for inclusivity, defining 10 transport disadvantaged groups seen as 'hard to reach'. Interestingly the same barriers to women's mobility raised in METPEX are still being highlighted as problematic; e.g. lack of lighting in stations, CCTV.

Many changes have been witnessed in the last 5 years relating to women and transport. Notably, women can no longer be viewed as a minority or as a homogenous group, gender mainstreaming and other initiatives are beginning to reduce some of the recognised gender gaps. Also the use of a more feminist lens in research and transport has emphasized the need for a greater consideration of intersectionality and diversity. Worryingly, the spotlight on gender, may have taken attention away from lack of diversity in other areas. The following section looks at issues around diversity in industry and attempts at reducing the 'diversity gap'.

4. Gender and diversity biases in transport and related fields

4.1. The case for gender diversity in research teams

The Toolkit, 'Gender in EU funded research and innovation' (EC, 2014) and Nielsen et al (2018) among others have commented that gender diversity in the research environment can drive scientific discovery, but to fully realize the potential for innovation, inclusivity must be cultivated at multiple levels — from the research team to society.

Diversity is more than simply putting diverse research teams together. An institutional culture needs to be created which values difference and appreciates how the incorporation of intersectional issues (such as gender, sex, age, disability, ethnicity and culture) shape the questions asked and methods used to reach scientific insights.

> "predominantly white, middle-class social scientists focus their research programs primarily on white, middle-class populations, which may lead to conclusions that are not generalizable." Medin et al (2014).

They design for early adopters.

A diversity of scientists is important for reducing bias and for providing different ways of looking at the world. Gender and culture influence what we choose to study, our perspectives when we approach scientific phenomena and our strategies for studying them, For example, when more women became involved in medical research in the 1980s and 1990s, more attention was paid to women's heart disease, breast cancer; rethinking osteoporosis research, highlighted that this also effected men. Nielsen commented:

> "The question is no longer what the benefits of diversity are, but how we can best support the potential benefits of diversity,"

Incomers ask novel questions, and see things from different perspectives, which may spark innovation. Nielsen further comments that the way to do this is by :

- integrating gender - and sex - analysis methods into core curricula and evaluation practices.

- integrating the research questions and methods used to assess the degree to which the differences between male, female and other gender identities might shape research outcomes
- advocating for policies that link the diversity of teams and research questions to funding success

Although most are now familiar with and accept the value of interdisciplinary working, social diversity - including diversity of race, ability, ethnicity, gender and sexual orientation is still problematic. For example, it can cause discomfort, rougher interactions, a lack of trust, greater perceived interpersonal conflict, lower communication, less cohesion, more concern about disrespect. However, it enhances creativity the search from new information and perspectives, leading to better decision making and problem solving. Members of heterogenous groups may report greater feelings of efficacy about their tasks (Lee and Farh 2004) and better morale (Jehn et al. 1999).

Bear and Woolley (2011) explored the influence of gender diversity in team processes and performance finding that collective intelligence is greatly improved by the presence of women in the group. This may be explained by the higher levels of social sensitivity exhibited by women, based on their greater ability to read nonverbal cues and make accurate inferences about what others are feeling or thinking.

With regard to gender differences in interpersonal communication, Eagly and Johnson (1990) found that women were significantly more interpersonally oriented than men. Groups with more women exhibit greater equality in conversational turn-taking, further enabling the group members to be responsive to one another and to make the best use of the knowledge and skills of members. Men's style was more autocratic than women's, i.e. involved giving orders, whereas women's style was more democratic, i.e. focused on participation. In conversation, men display more social dominance-related behaviour while speaking than women, such as chin thrusts, gesturing, and direct eye contact, while women engage in more smiling whether they are speaking or listening (Dovidio et al. 1988).

However good management is needed for gender heterogeneity to deliver its rewards, as it is context dependent (Bear and Woolley,2011). For example, a solo woman in a group will speak less, but a solo man in a group of women will speak more (Myaskovsky et al. 2005). In occupations dominated by males (such as STEM professions) gender diversity can have strong, negative effects on team performance, whereas in gender-balanced occupations, gender diversity has significantly positive effects on team performance both in terms of objective (e.g. financial outcomes, product quality) and subjective (e.g. self-rating, supervisor rating) measures (Joshi and Roh 2009). Having a few 'token' women on scientific teams does not appear to be sufficient in order to improve performance, and,

could even have detrimental social consequences in the short term (Allmendinger and Hackman 1995). The worst results in team performance are when a woman's expertise is overlooked or undervalued.

Bear and Woolley (2011) concluded that it was not enough to simply examine the number of women in a particular institution or role. Women should be represented in collaborative scientific teams at parity to men and the role they play in scientific teams should also be taken into consideration and promoted in order to yield the arising from increased gender diversity.

Gender sensitivity was integrated into the research cycle (EC, 2014, part 2.1) as shown in Figure 1. This will be revisited in Section 5 and again in the conclusions, along with an argument to emphasize wider diversity.

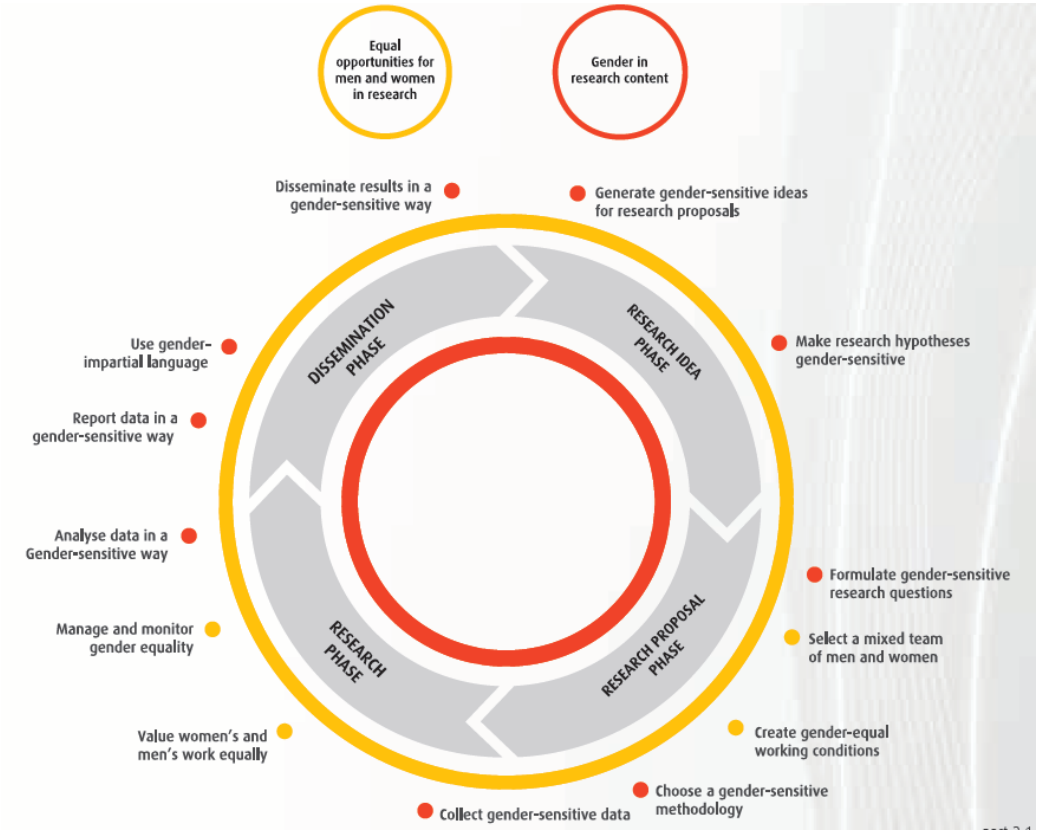


Figure 1: Gender in the Research Cycle

This has been informed by the Gendered Innovations project[6] that argued strongly for three strategic approaches to gender equality over the past several decades:

1. "Fix the Numbers of Women" focuses on increasing women's participation.

[6] http://genderedinnovations.stanford.edu/what-is-gendered-innovations.html

2. "Fix the Institutions" promotes gender equality in careers through structural change in research organizations (European Commission, 2011).
3. "Fix the Knowledge" or "gendered innovations" or the "gender dimension" stimulates excellence in science and technology by integrating sex and gender analysis into research

With regard to transport, they specifically, advocate for

- Adding "mobility of care" to data collection variables to increase public transportation's responsiveness to users' needs.
- Adding "trip chaining" (found largely among women) and its ramifications for the design of public transport systems.
- Gathering data disaggregated by sex and other factors intersecting with sex and gender (such as income, family status, etc.) to improve transportation research and policy.

The Sustainable Urban Mobility Planning Process (SUMP2.0)[7] stresses the need for wider diversity and meaningful engagement and diversity in decision making bodies to ensure that all groups are represented, and that transport becomes more inclusive.

4.2 The benefits of wider diversity

Unwittingly, a focus on 'gender diversity' has perhaps taken attention away from wider diversity issues. Although contemporary feminism points to the needs from intersectionality and equality so that men and women can achieve their best, social and ethnic diversity have not received such a high level of attention. Examples of studies that have looked at the effects of widening diversity include:

- Richard's (2000) study of US financial institutions which showed that for innovation-focused banks, increases in racial diversity were clearly related to enhanced financial performance.
- Phillips and Neil (2006) cited in Phillipe (2014) experimentally examined the impact of racial diversity on small decision-making groups. Groups with racial diversity significantly outperformed groups with no diversity. Being with similar others leads us to think we all hold the same information and share the same perspective.
- From another student based, US study, Antonio et al (2014) concluded that hearing dissent from someone who is different from us, provokes more thought than when it comes from someone who looks like us.

[7] https://www.eltis.org/mobility-plans/sump-concept

- In terms of research outputs, Freeman and Huang (2014) found that papers written by diverse groups received more citations and had higher impact factors than those written by members of the same ethnic group. Geographical diversity, and a larger number of references, reflects more intellectual diversity.

Phillipe (2014) concluded that being in a socially diverse team enriches and stretches thinking, as we become more aware that others may not be thinking the same way. They have different experiences, world views, and beliefs. This causes conflict and tension, but ultimately stretches the team, and it makes more inclusive decisions. Larson (2017) claimed that a diverse makes better business decisions 87% of the time, and that teams with an inclusive process make decisions two times faster with half the number of meetings (as shown in **Error! Reference source not found.** below[8])

Figure 2: Effects of Team Diversity on Decision Making

Professor Francesca Gino is quoted in the report as saying.

> "That our decisions get sidetracked by biases is now well established. While it is hard to change how our brains are wired, it's possible to change the context of decisions by architecting the composition of decision-making teams for more diverse perspectives."

[8] From https://www.forbes.com/sites/eriklarson/2017/09/21/new-research-diversity-inclusion-better-decision-making-at-work/

Again, management of diverse teams has been shown to be problematic. Diverse groups are more likely to encounter operational friction when executing business decisions. Less diverse teams make worse decisions, but diverse teams struggle to put their decisions into action. The worst situation is to have an all-male team make a decision that is executed by a gender-diverse group. This results in underperformance by 15%. The most inclusive decision-making and execution teams performed 60% better than average.

In a typical large company, all-male teams make about 38% of the decisions, higher in STEM and transport related companies. Larson (2017) quoted from Hunt et al's (2015) McKinsey report of 366 public companies which found that those in the top quartile for ethnic and racial diversity in management were 35% more likely to have financial returns above their industry mean, and those in the top quartile for gender diversity were 15% more likely to have returns above the industry mean. Likewise in a global analysis of 2,400 companies conducted by Credit Suisse (2012), showed that organizations with at least one female board member yielded higher return on equity and higher net income growth than those that did not.

A Spanish study by Garcia et al (2013) showed that gender diversity within R&D teams generates certain dynamics that foster novel solutions leading to radical innovation. Of the 4,277 companies studied they found that companies with more women were more likely to introduce radical new innovations into the market over a two-year period. Similarly, a UK study (Nathan and Lee, 2013) of 7,615 firms revealed that businesses run by culturally diverse leadership teams were more likely to develop new products than those with homogenous leadership. Rock and Grant (2016) cite studies which show that diverse teams are more likely to re-examine facts, remain objective, encourage greater scrutiny of each other's actions, and change the way the team processes information.

Heterogenous teams challenge people to think in new ways and stimulate performance.

4.3 Diversity in the HEI Sector in the UK

HEIs are thought to be one of the most culturally diverse organizations. Research centres are embedded within them and will reflect the ethics/culture of the university or the faculty in which they are placed. They are strongly influenced by the university's leadership, its long-term goals and the makeup of the staff and student body. Although many universities may enshrine diversity and equality in their manifestos and student numbers may show diversity, however leadership figures show a very different story. In the UK,

- women are now **29%** of all Vice-Chancellors, **37%** of all executive team members, 31% of heads in the top tier of the academic structure and **25%** of professors (Jarboe, 2019).

- **94%** of vice chancellors at the top 50 universities in UK are white, with just **6%** from a Black, Asian and minority ethnic (BAME) backgrounds[9]
- Russell Group universities have an ethnocultural representation that is **97.6%** white amongst the senior leadership[9]

  Raj Tulsiani, CEO of Green Park, said**:** "The findings in the Colour of Power serve to underline the reasons why political leaders are being confronted with a steady erosion of public trust in institutions. For many the absence of diversity in educational leadership is a clear signal that institutions don't understand the need to modernise to reflect their constituents. The upper echelons of management in UK universities in no way resemble the diverse backgrounds of their student populations and it simply isn't acceptable."

  Simon Woolley, Director of Operation Black Vote, stated: "The findings are deeply troubling: educational institutions would be immeasurably more effective with a greater diversity of views to serve our increasingly multifaceted, multicultural society. By honestly recognising the challenge and effectively dealing with it, we will massively unleash potential talent which would benefit every aspect of our society."
- Additionally, a 2014 study[10] found that out of **3,220** heads of major academic areas and head of schools, **20** were black and **90** were Asian
- And that, out of a total of **19,855**, heads of sub-sets of academic areas, and professors, **95** were black, and **1,025** were Asian.[11]
- In 2017[12], less than **4%** of UK academics reported a disability.

  'Creating an environment in which all staff can flourish, irrespective of disability, will require a cultural shift, but it has enormous potential to change universities. Younger researchers told me that when they were students, they had been inspired to pursue a university career by a senior academic who had declared their disability. But disabled students continue to report considerable stigma, as well as variations in the availability and usefulness of adjustments.

  Having more disabled staff could have profound effects on the curriculum and cultures of universities, making accessibility the norm, and thereby reducing the need for individualised adjustments. And, in general, a more inclusive, forgiving and flexible working culture could only be good for all members of the academic community who have lives, commitments – and human bodies.' (Sang, 2017)[12].

[9] https://www.green-park.co.uk/news/94-percent-of-vicechancellors-at-top-50-universities-are-white/s3307/
[10] https://theconversation.com/race-and-academia-diversity-among-uk-university-students-and-leaders-24988
[11] https://theconversation.com/there-are-fewer-than-100-black-professors-in-britain-why-24088
[12] https://www.timeshighereducation.com/features/disability-campus-challenges-faced-and-change-needed

Research centres operate within this wider ecosystem, hostile to those from diverse backgrounds. They work on roadmaps set by and perpetuated by a small group of privileged people. This is illustrated in Figure 3, which shows the fall off in seniority by gender.

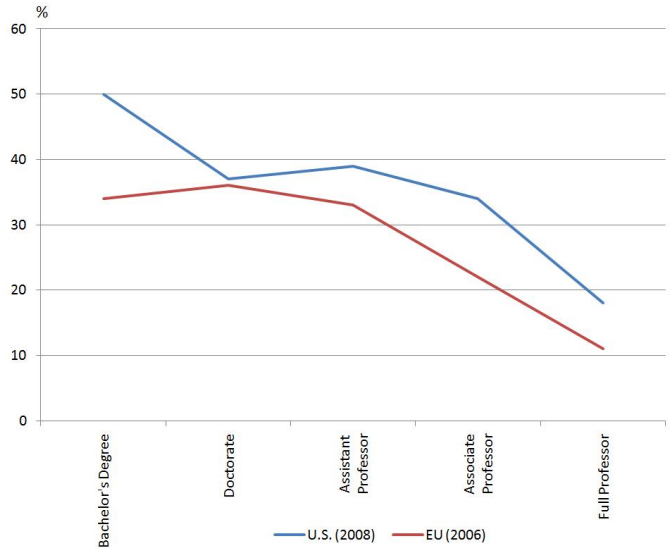


Figure 3: Women´s Shares of S&E Degrees and S&E Academic Positions in the US and EU

Using Mor Barak's earlier quote, the figures demonstrate that the HEI sector is unable **to truly integrate and use a heterogeneous work force at all levels of the organization.** Working within them, one is subjected to **changes focused mainly on internal processes of the organization,** which are set by the short term nee to ride up league tables. Although outreach programmes may address some of the issues, as a whole they **do not value and use individual and intergroup differences within its work force.** While research centres may create islands of opportunity and exemplars of good practice, they are rooted in the HEI sector which influences their makeup and operation. This has significant effects for women's research footprints, their ability to lead and shape research and the way in which gender can be taken into account in the research cycle.

4.4 Beyond gender: cultural diversity and employment equity

The previous sections presented the case for gender and wider diversity in research teams and innovation - led organisations and shows the truly startling picture of the lack of diversity in HEIs. This section provides four case studies on approaches to creating diverse workforces in finance, cybersecurity and automotive manufacturing and design. These industries either demonstrate good practice or are aligned to the Smart Mobility Sector. The cases have been included to demonstrate

ways in which the HEI sector – responsible for academic outputs could be changed. Section 5 evidences that women in academia (in transport) face the same challenges as their sisters in the transport sector. The work echoes the approach of Mor Barak (2000), showing opportunities for a more ecosystems approach to diversity management

4.4.1 Embracing Diversity in the Financial Sector: The BMO group (Canada)

Taggart (2007) studied the ways in which the BMO Financial Group (BMO) responded to demographic changes within the Greater Toronto Area, by embracing cultural diversity. Obviously, financial organizations have a vested interest in the different life courses of market segments. Predicted demographic changes included half the population belonging to a visible "minority;", over 20 percent of Canadians will be over the age of 65 by 2025; Aboriginal people forming one in five entrants into the workforce; and by 2017, 7.6-million Canadians will be *allophones*, having a mother tongue that is neither French nor English.

BMO commissioned a series of Task Forces [Women (1990), Aboriginal People (1992) and People with Disabilities (1992), Visible Minorities (1995)] to examine the status within the bank of the four groups and to create equity and diversity in the workforce that would lead to

- an equitable workplace in which all employees have an equal opportunity to enhance their careers
- a diverse workforce that reflects, at all levels and in all groups, the communities that BMO serves.
- a supportive work environment in which equity and diversity inform and influence all our business goals.

A key message was that adopting a culturally diverse approach entailed more than equal representation on committees. It required a paradigm shift with investment in time, effort and money. Wide spread changes looked at developing cultural competence and understanding, through human resource policies, donation policies, principles of behaviour and conduct, corporate values and governance, communications, infrastructure, learning and development, and an annual monitoring system (the Diversity index) to measure employee attitudes and progress towards a supportive and equitable workplace.

Tools to achieve this included:

- workshops, seminars, leadership development programs – where diversity and cultural competence training were embedded in the curricula to make people aware of their "blind spots," i.e., when their best intentions do not align with their actual behaviour.
- A 360° Review which offered robust feedback, providing individual employees with comments from all the colleagues they interacted with on a regular basis (peers, bosses, subordinates) regarding their attitudes towards diversity and managing for inclusion.

- Use of Affinity Groups and Diversity Councils to develop cultural competence at a grass roots level to spearhead learning, promoting awareness, removing barriers, providing support, and networking opportunities and learning how to work more productively and effectively together. These provided a sounding board for leadership and meet quarterly with senior executives from across the company.

Knowledge transfer to academia

- Universities need to recognize their lack of diversity and the effects it will have on their business, and the wider country.
- Development of Gender and Diversity Action Plans e.g. task forces, annual monitoring.
- Realign core objectives to develop a holistic approach to cultural diversity.
- Use current or develop new mechanisms to promote greater diversity and support staff such as staff development programmes and 360° appraisals.

HEIs have become lean organizations, with performance measured against national league tables. They offer little time for staff to engage with development courses, task forces are set up, but focus improving performance metrics; new staff induction programmes just on process, not underlying cultural values; 360° reviews, student feedback are linked to appraisal and progression. A paradigm is shift is needed in order to increase staff diversity in both teaching and research.

4.4.2 Case study: Cybersecurity needs diversity

As Smart Cities experiment with, and adopt new technology, they may inadvertently put the health and wellbeing of citizens at risk. Smart Mobility is at the forefront of research and innovation in this area. For example, C-AV (connected and autonomous vehicles) collect, send and receive data to other cars, roadside infrastructure, the local authority, technology providers, vehicle manufacturers, security agencies and other users. They also collect information about the state of the driver e.g. in terms of their health, driving behaviour and journeys. This can be linked to the retail sector, enabling targeted and personalised campaigns. Each interaction is an opportunity for a cyber-attack on one, or many vehicles and drivers, and provides a routeway into other systems e.g. finance and energy sectors.

Data breaches, social engineering, and cybercrime continue to escalate (Lewis, 2018). With our increased reliance on technological innovations such as IoT, smart devices, cloud storage and mobile technologies at the heart of everyday living, each one provides an entry point and routeway for attacks which can paralyse businesses and customers. Social media now has to be used with caution as it

provides opportunities for identity fraud, cyberbullying and stalking. These place the most vulnerable members of society are most at risk (e.g. children and those with mental or physical illnesses).

Because of this cybersecurity has recognised the need for diversity and interdisciplinarity as it crosser over from data and technology to concerns over quality of life, victimisation and privacy. Many problems have little or no technical component. Cyber threats and harm do not always come from malevolent outsiders but can arise simply through lack training or mistakes (Hurley, 2017). Deeply entrenched in computer studies and macho military systems, current computer science graduates and courses lack the diversity needed to tackle the challenges (Azha et al, 2019).

4.4.2.1 The case for gender and diversity

Unfortunately, cybersecurity has a very big image problem. Not only is it seen as related to high end IT and STEM disciplines, but has its roots in male-dominated military discourses which are seen as highly gendered and white. The cybersecurity community recognizes both behavioural and technical components and the implications this can have on different sectors of society. It is therefore measuring and trying to redress gender and ethnic imbalances in employment (O'Flaherty, 2018).

Women use social networks differently. Female networks function and communicate differently to male ones. This needs to be factored more comprehensively into cybersecurity and the overall design of systems and security measures. Honeypots, catfishing, gaslighting are all emergent properties of social media. The rapid uptake and sharing of information, leaves users and networks at risk. Gender and diversity within social media development teams is needed to understand the dynamics of on – line groups, prior to cyberattacks. The industry needs diversity in it's workforce to tackle these issues[13].

Women and men also gauge risk differently. Frankland[14] commented that "Typically, women are more risk averse and their natural, detailed exploration makes them more attuned to changing pattern behaviour – a skill that's needed for correctly identifying threat actors and protecting environments." She points to a study performed by the US military, titled 'Women in Battle: What Women Bring to the Fight', which found that the collective intelligence of a group grows as the percentage of women increases.

Failures to account for women's needs in IT or show any empathy towards them has resulted in major problems for women's use of IT. Sharland and Smith (2019) noted a need for wider perspectives because technology plays a significant role in perpetuating inequality across society. Metadata and the information gathered for geolocation services can enable abusers to track partners or harass individuals through multiple mediums, meaning that technology acts as enabler for domestic abuse. Failures to

[13] There is a parallel with automotive design in the next sectiion
[14] https://jane-frankland.com/women-in-cybersecurity/

account for women's needs in IT or show any empathy towards them has resulted in major problems for women's use of IT. For example:

1. Cyberviolence

Alter (2O15) quotes the U.N. Women and the U.N. Broadband Commission that 73% of women have endured cyber violence and are far more likely to be victims of cyber bullying and shaming through online platforms and that women are 27 times more likely than men to be harassed,

> 'cyber violence against women and girls (cyber VAWG)' could run rampant and significantly impede the uptake of broadband by women everywhere…… cyber VAWG already exists in many forms, including online harassment, public shaming, the desire to inflict physical harm, sexual assaults, murders and induced suicides. [15]

In Europe, nine million girls have already experienced some kind of cyber violence by the time they're 15. Mlambo-Ngcuka (Under-Secretary-General of the U.N. and Executive Director of U.N. Women) added

> "If the woman is tormented, she may then decide that 'I don't want to have anything to do with technology," she said. "To be disconnected from technology in the 21st century, it's like having your freedom disrupted: your right to work, your right to meet people, your right to learn, your freedom of speech. So if women become so intimidated and traumatized from the experiences they may have, it's a whole world that will be lost to them for the rest of their life."

2. Compromises to women's mobility

Returning to mobility, technology can also be misappropriated to suppress women's rights. For example, Saudi Arabia's mobile app Absher[16] was developed by the government as a portal for citizens to access government services. Alongside its ability to lodge license applications and view documents, the app allowed male guardians to approve or withdraw permission for women to travel internationally and to register women's names and passport numbers, select how many journeys she can take and how long she can travel for. While many argued that this had positive effects in simplifying travel, it raises significant questions about the ethics of platforms like Google and Apple that facilitate apps that could be used to oppress women. With greater gender diversity on

[15] https://www.unwomen.org/en/news/stories/2015/9/cyber-violence-report-press-release
[16] https://time.com/5532221/absher-saudi-arabia-what-to-know/

development teams such issues could be openly debated prior to operationalisation. Practical resources, tools and government responses need to consider these threats to women's security

3. Perpetuation of gender stereotypes and gender biases

Widely used devices such as Apple's Siri and Amazon's Alexa, puts women's voices in service roles, reinforcing perceptions of traditional feminine and masculine roles. AI female helpers are portrayed as "obliging and eager to please", reinforcing the idea that women are "subservient", giving "deflecting, lacklustre or apologetic responses" to insults. Wakefield (2019) reviews the study from UNESCO entitled, 'I'd blush if I could', a phrase borrowed from a Siri's response to being called a sexually provocative term! She quotes, from the report:

> "Companies like Apple and Amazon, staffed by overwhelmingly male engineering teams, have built AI systems that cause their feminised digital assistants to greet verbal abuse with catch-me-if-you-can flirtation…….Because the speech of most voice assistants is female, it sends a signal that women are... docile helpers, available at the touch of a button or with a blunt voice command like 'hey' or 'OK'. The assistant holds no power of agency beyond what the commander asks of it. It honours commands and responds to queries regardless of their tone or hostility……. In many communities, this reinforces commonly held gender biases that women are subservient and tolerant of poor treatment."

The origin of the names of the devices point to a corporate 'laddish culture' Wakefield (2019). Microsoft's Cortana was named after a synthetic intelligence in the video game 'Halo' that projects itself as a sensuous unclothed woman. Apple's Siri means "beautiful woman who leads you to victory" in Norse. While the Google Assistant has a gender-neutral name, its default voice is female." Although subsequent releases have included male voice options, in 2018, 100 million smart speakers were sold globally, with a prediction that by 2020 some people will have more conversations with voice assistants than with their spouses.

4.4.4.2. The Gender and diversity employment gap in cybersecurity

"The cybersecurity environment is not poisonous to women; it just looks that way sometimes"[17]

It is predicted that globally there will be a 3.5 million deficit in workers by 2021 (Morgan, 2017). Unsurprisingly, men outnumber women at a ratio of 9:1. Gender disparity is greater at higher levels of

[17] https://www.scmagazineuk.com/10-global-cyber-security-workforce-women/article/1476739

the profession. For example, in the EU women form 39% of non-managerial staff, but only 1% are found at the director/middle manager level, and none at more senior levels. Statistics from Information is Beautiful[18] in the US highlight, the need to look at both gender and ethnicity in technology companies. Infographics show that females account for between 17 and 50% of the workforce – with NVIDIA having on 17%, Microsoft, Dell, Youtube, Apple and Google all having a female workforce of under a third. The Women in Cybersecurity study conducted in 2016 with over 19,590 respondents from 170 counties showed that

- Women comprise only 11% of the information security workforce, with some regional variation with North America at 14% and Europe at 7%.
- Women have higher levels of education than men. 51% have a master's degree compared to 48% or men). However, there are more male graduates with a wide range of technical and engineering degrees (22% or men vs 14% of women)
- 51% of women as opposed to 15% or man have faced discrimination in the workplace. Including 87% unconscious discrimination, 53% unexpected denial or delay in career advancement, 29% exaggerated highlighting of mistakes; 22% tokenism and 19% overt discrimination.
- The higher women rise in the organization, the greater the levels of discrimination.
- Where women do rise in the organization, they will be likely to have a wider variety of backgrounds than men illustrating that they bring a different skill set to their jobs.
- Wage gap – with women being paid 3-4% less than men.
- Women who felt valued were more likely to have received training and leadership development. These women also had the highest levels of job satisfaction. More than half the women who felt undervalued would take up career development programmes if available.

In terms of ethnicity, for the US at least half of the tech companies have a predominately white workforce, with Latino and Black employees forming lees than 10% of the workforce across many large organizations. Focussing on cybersecurity, DataUSA[19] showed that for 2017, 81% of Information Security Analysts were male, and 73% were white. The next largest ethnic group identified as black (12.5%). A report by (ISC)[20] found slightly better statistics for ethnic minority representation when viewed across a wider spectrum of cybersecurity employment – with 26% of the workforce coming from a minority group. The report highlighted that people from ethnic minorities who held managerial

[18] https://informationisbeautiful.net/visualizations/diversity-in-tech/
[19] https://datausa.io/profile/soc/151122/#demographics
[20] (ISC)² , Innovation Through Inclusion Report: https://www.isc2.org/-/media/Files/Research/Innovation-Through-Inclusion-Report.ashx

positions were more highly qualified than their Caucasian counterparts. In terms of salary, minority groups were paid less than their male Caucasian counterparts, with Black females fairing the worst. Recurrent issues related to

- Discrimination and bias [21] . Although Asians were hired at a reasonable rate, they were less likely to progress up the career ladder than white men. The same was found for black men and women. Asian women fared worst, with a 66% under-representation in the tech industry
- Disenfranchisement**.** The Kapor Center for Social Impact found that almost 25% of under-represented minorities and women of color experienced stereotyping, with 40% of Black, Hispanic and Native American men leaving their jobs due to unfairness and racism in the workplace. (7)[22]

Attracting women is needed to reduce the workforce gap. Again, data from McKinsey found that companies with better minority employment records had a 35% greater financial return than the industry median [23]. This led to the conclusion that diversity in the workplace provides the creative thinking needed by the industry and helps to address the ever-changing set of challenges this presents. However, enterprise and government efforts have been slow to reduce the gap or attract women and those from diverse backgrounds. Surveys show that young women may be interested in cybersecurity if they are told about it and encouraged to give it serious consideration. A survey conducted by Kaspersky in 2018[24] of 2,000 women aged 16 to 21 revealed that 72% want a career they can feel passionate about and 83% of respondents felt that a career in cybersecurity would not be dull. Some studies do however point to a rise in numbers, at the RSA Conference USA in 2019, 46% of keynote speakers and 32% of the overall speakers were women.

The cybersecurity community has recognized the need to consider behavioral and technical components and the implications of cybersecurity issues for different sectors of society through measurement and guidelines to redress gender and ethnic imbalances in employment (O'Flaherty, 2018). Diversity comes in many forms, including race, gender, sexual orientation, age, physical abilities and religious beliefs. Taking this into account, the first step is to recognize the benefits of each type of diversity.

[21] Ascend: https://www.ascendleadership.org/page/research

[22] Kapor Center for Social Impact, Tech leavers: http://www.kaporcenter.org/tech-leavers/

[23] McKinsey, Why diversity matters: https://www.mckinsey.com/business-functions/organization/our-insights/why-diversity-matters

[24] https://digitalterminal.in/news.html?n_id=11927

Other initiatives include looking at the benefits the employment of neurodiversity staff bring to the industry. As such IASME has hired 14 neurodiverse staff. Michael O'Malley, from Radware commented that: "Often those with atypical brains can quickly identify clues while sorting through large data sets. When you incorporate neurodiversity into the workforce, you begin to remove cognitive blind spots that have limited your team in the past." Nicola Whiting, who was diagnosed with autism aged 45, is COO at Titania, a company that employs multiple neurodiverse people. She says firms and technology leaders can encourage diverse candidates to apply for jobs by explicitly saying these applicants are welcome. She says: "Make it clear that the organisation will be supportive of any needs they might have and that you have a zero-tolerance attitude towards discrimination."

To increase gender diversity the Global Information Security Workforce Study recommended that:

- Companies need to create inclusive workplaces and support advancement of women
    - Develop KPIs to measure progress towards this
    - Remove bias in recruitment
    - Understand female pipeline and progression
    - Tie gender equality to business goals
- Increase satisfaction and succession through mentorship, spotting of high-performance women, gap analysis to make sure events are accessible to women
- End pay inequity
- Value all educational backgrounds
- Avoidance of male-oriented and military-inspired messaging which promotes "boy's club" .

Knowledge transfer to academia

- Common to the financial, and automotive design case study (following) one of the incentives for increasing diversity is the financial or business case, not just the moral imperative. Cyebrsecurity not only needs women to make up the workforce, it has appreciated the need for different skill sets and, in the case of neurodiversity, different ways of thinking
- Key enablers include the role of training and leadership in job satisfaction and retention
- The pernicious effects of the laddish culture in R and I is apparent through the usage of female voices in our most ubiquitous and widely used systems (eg GPS , SIRI)
- The evidence of deeper issues around ethnicity
- The use of 'exaggerated highlighting of mistakes as a form of control and discrimination
- Dallaway's (2016) holistic approach to addressing gender diversity in the CREST report, shown in overleaf.

Figure 4:Dalloway's Holistic Approach to Addressing Gender Diversity in Cybersecurity

Time for Action

Derived from the outcomes of the workshop, the following action plan has been put together with the objective of closing the gender gap in the cybersecurity industry.

	Educate	Change Industry Perception	Raise Awareness	Inspire	Offer Support
School Children	Schools careers guide with female profiles	School pathway descriptions linked to primary subjects	Ambassador attendance at academic events. Create and maintain register of initiatives, challenges and materials	Female cybersecurity YouTube channel for promotion of female industry speakers with emphasis on careers	FAQ's and profile descriptions
Apprentices	Apprenticeship careers guide with female profiles	Create an industry film and increase the number of female 'Day in Life' films at junior levels	Ambassador attendance at academic events. Create and maintain register of initiatives, challenges and materials	Female cybersecurity YouTube channel for promotion of female industry speakers with emphasis on careers	FAQ's and profile descriptions
General University Students	University careers guide with female profiles	Create an industry film and increase the number of female 'Day in Life' films at junior levels	Ambassador targeted 'milk round' attendance. Ambassador attendance at academic events. Create and maintain register of initiatives, challenges and materials.	Female Cyber Security YouTube channel for promotion of female industry speakers	FAQ's and profile descriptions
Specialist University Students	University careers guide with female profiles	Create an industry film and increase the number of female 'Day in Life' films at junior levels	Ambassador targeted 'milk round' attendance and career social media channels	Female cybersecurity YouTube channel for promotion of female industry speakers with emphasis on careers	One to Many Mentoring
Conversion From Other Academic Disciplines	University careers guide with female profiles. Create conversion courses and loans for training and certification with marketing aimed at women	Create an Industry film and increase the number of female 'Day in Life' films at mid and senior levels	Ambassador targeted 'milk round' attendance and career social media channels. Create and maintain register of initiatives, challenges and materials	Female cybersecurity YouTube channel for promotion of female industry speakers with emphasis on careers	One to Many Mentoring
Conversion from Other Industries	Active participation in existing social networks and expand to other areas. Create conversion courses and provision for loans for training and certification with marketing aimed at women	Create an Industry film and increase the number of female 'Day in Life' films at mid and senior levels	Create job board profiles, develop and maintain register of initiatives, challenges and materials	Female cybersecurity YouTube channel for promotion of female industry speakers with emphasis on careers	One to Many Mentoring
Career Changers / Returners	Active participation in existing social networks and expand to other areas. Create conversion courses and provision for loans for training and certification with marketing aimed at women	Create an Industry Film and increase the number of female Day in Life Films at mid and senior levels	Create job board profiles, develop and maintain register of initiatives, challenges and materials	Female cybersecurity YouTube channel for promotion of female industry speakers with emphasis on careers	One to Many Mentoring
Retention Of Existing	Maintain this newly-formed network and commit to these actions as a group and extend membership. Create Conversion Courses and provision for loans for training and certification with marketing aimed at women	Create an Industry film and increase the number of female 'Day in Life' films at mid and senior levels	Active participation in existing social networks and expand register of initiatives, challenges and materials	Female cybersecurity YouTube channel for promotion of female industry speakers with emphasis on careers	Active participation in existing social networks and expand to other related areas

Figure 4:Dalloway's Holistic Approach to Addressing Gender Diversity in Cybersecurity

4.4.3 Gender diversity in transport

The automotive industry is a similarly highly gendered sector, tracing its roots to STE(A)M, and having a dominant laddish culture. Increasing diversity in R&I teams is needed if future vehicles are to be adopted and trusted by women and other disadvantaged groups, and future transport systems produced that meet the needs of all groups in society.

Slight gender differences have been reported in the way men and women view future transport. However the need for more sophisticated intersectional approached have been recognised. For example, based on findings from the AAA[25] report for the US where only 20% of U.S. drivers trusted an autonomous vehicle to fully drive itself with them in it, Howard (2016) pointed out that although women may be less trusting of technology in general and more suspect of and afraid to use AVs US, (in the US 81% of women and 67% of men express safety concerns), greater familiarity with autonomous driving features may be more important than gender in ultimately establishing consumer trust. Women's concerns related to their "not knowing enough" about autonomous features and difficulties in learning new features. over 50% were interested in the technology because it could reduce stress, compared to 42% of men[26].

If AVs follow the normal technology acceptance curve, Melissa Cefkin, an anthropologist and principal researcher at the Human Centered Systems practice at the Nissan Research Center, explained people will eventually get comfortable with autonomous vehicles once they realize they aren't that unusual. Riding in a human-driven taxi today, after all, requires giving up control.[27]

Looking at women in the automotive sector as a whole in 2018, only 16 women (8%) were executives in the top 20 motor vehicles and parts companies in the Fortune Global 500. This was a 1% increase from 2014 (where there were 7% of women). Within Europe the ratio of men to women employed by gender in the EU, in the manufacture of motor vehicles, trailers and semi-trailers was 3:1, with national variations as shown in Figure 5. In the US, women held 23.6% of jobs in the motor vehicles and motor vehicles equipment manufacturing industry in 2019. For the US statistics are also collected on ethnicity (with Black women making up 5.6% of the workforce, Asian women: 1.8% and Latinas, 3.0. In terms of where women are employed, women made up the majority (74.8%) of office and clerical workers in 2018 but were underrepresented among higher level positions like first/mid-level officials and managers (18.1%) and at

[25] publicaffairsresources.aaa.biz/wp-content/uploads/2016/02/Automotive-Engineering-ADAS-Survey-Fact-Sheet-FINAL-3.pdf

[26] The technology road map for introducing AVs has been addressed in other deliverables.

[27]https://www.theglobeandmail.com/globe-drive/culture/technology/the-ethical-dilemmas-of-self-drivingcars/article37803470/

executive/senior-level officials and managers (17.6%). In 2014, Mary Barra became CEO of General Motors in the United States and the first woman to run a major automaker.

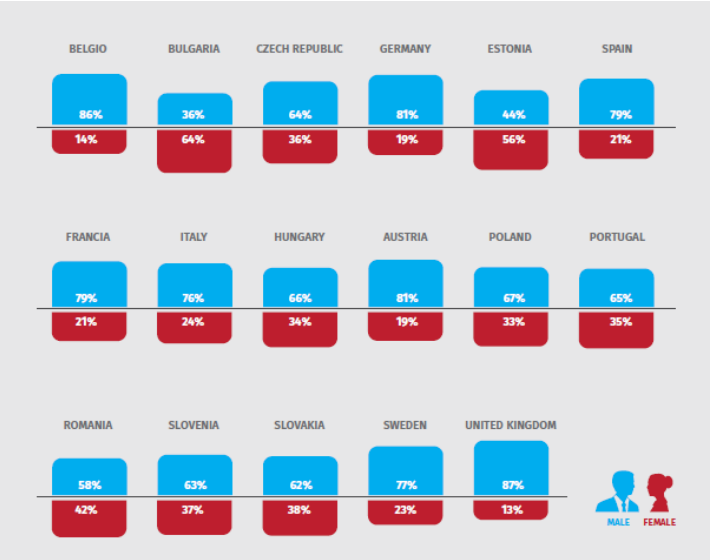


Figure 5: Distribution of Persons Employed by Gender in the EU in the Manufacture of Vehicles, Trailers and Semi - trailers

A survey conducted by Automotive News and Deloitte (2018) of more than 200 women representing original equipment manufacturers (OEMs), suppliers, dealers, finance companies, and other organizations throughout the automotive value chain, revealed the barriers shown in in Figure 6 [28].

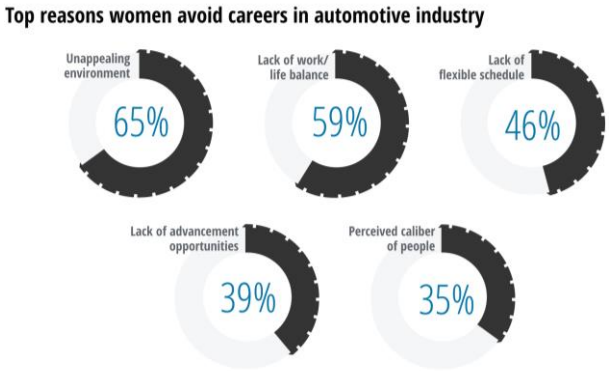


Figure 6: Top Reasons Women Avoid Careers in Automotive Industry (taken from Deloitte and Automotive News, 2018 Women at the wheel)

Additionally:

[28] From https://www2.deloitte.com/us/en/insights/industry/automotive/women-in-automotive-sector-gender-diversity.html

- more than half (53 percent) of the respondents said the promise of competitive remuneration and opportunities for challenging and interesting assignments were the top two reasons they would choose the automotive sector if they were to start their career over again.
- 79% commented on the gender pay gap
- only 1% of the survey respondents ranked auto as the best sector to work in.
- 47% would consider moving to another industry if they were to start again.
- only 14% would fully encourage their daughters or female family members to pursue a career in the automotive industry, down from 21% in 2015
- 74% felt that different standards of employment were set for them, with 86% believing that higher standards were set
- The percentage of women in the automotive industry aspiring to senior executive positions has dropped by ten percent since 2015.

Compared to 2015, the position of women in worsening as shown in Figure 7.

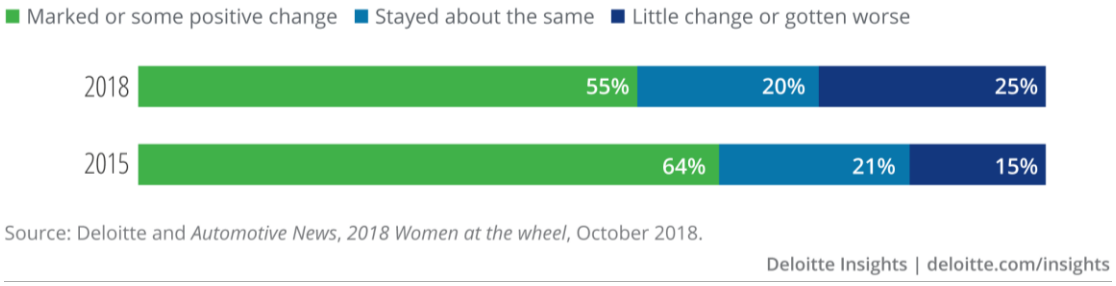


Figure 7:What Women Think of the Auto Industry´s Attitude toward Them (taken from Deloitte and Automotive News, 2018 Women at the wheel)

The sexism in the automotive industry survey [29] conducted in 2017 with over 900 women, summarized in [30], revealed issues relating to feedback and promotion; harassment and safety; inclusion; and unconscious higher rates of sexism and sexual harassment compared with the tech and advertising industries, including:

- Being tasked with lower-level assignments compared to their male peers (65%).
- Unwanted sexual advances (65%).
- Feeling unsafe at work (25%).

[29] Downloadable from https://www.autonews.com/article/20171022/OEM02/171029978/sexism-alive-and-well-in-auto-industry

[30] https://www.autonews.com/article/20171022/OEM02/171029978/sexism-alive-and-well-in-auto-industry

Figure 8:Summary of the Results of the Sexism in the Automotive Industry Survey (Menchin)

Women did not raise issues relating to sexism with line managers as they felt they would be seen as a problem employee. They moved jobs rather than risking their reputations.

> "The wider industry still has a way to go when it comes to listening to us when we speak up about the difficulties we still face in the working world," said one survey respondent. "Many people who have worked in the industry for a long time perpetuate the 'this is how things are' mindset, which makes it hard to be taken seriously when you complain about sexist treatment by a client or colleague."[32]

In more detail , the survey found the following:

- Feedback and promotion. Women could not strike the right balance between being pushy, quiet, aggressive, emotional or bossy; they received comments about the clothes and appearance rather than their work; 43% believed they were held back because of their gender
- Harassment and safety. 25% had felt unsafe at some point while working; in dealerships the turnover rate is 96% of the female workforce
- Inclusion. 57% missed out on social and networking activities because of their gender (e.g. with outings to strip clubs and 63% felt they had been excluded from key business events because of their gender. Even so they were asked to represent their company at external events to highlight gender diversity of the company;

- Unconscious bias. 83% said clients and colleagues addressed questions to their male counterpart and 71% said male colleagues and clients avoid eye contact with them in meetings.
- 84% had heard demeaning comments from men,
- 64% have been asked to do lower-level tasks that their male counterparts.

Commenting on the survey, Lytle et al (n/d)[31] stressed the need for change from the top, at industry leadership level. For example, through

- Addressing underrepresentation of women in executive ranks
    - 81% of women feel a key contributor is a general bias towards having men in leadership positions.
    - Women were hindered through inconducive organizational cultural norms (66 %) and the lack of management support for women (50%)
- Increasing the effectiveness of formal and informal networking groups. Although nearly 60% had participated in these they had not been considered effective in advancing their careers
- Mentorship and executive sponsorship are critical for women seeking career advancement. This is reinforced in a study by the Center for Talent Innovation[32] which showed that women in STEM careers with sponsors were:
    - 22% more likely to be satisfied with their rate of promotion;
    - 37% more likely to ask for a raise;
    - 70% more likely to have their ideas endorsed;
    - 119% more likely to have their ideas developed; and
    - 200% more likely to have their ideas implemented.
- Encouraging women to pursue their career ambitions early e.g. through STEM subjects, engagement in the manufacturing sector, high school programs, and innovation competitions.
- Learn from other sectors which have higher attraction and retention rates.

4.4.3.1 Automotive design

Automotive design is the interface between how a product functions, how it feels and how accessible it is. It is a combination of attributes, in addition to aesthetics, all geared towards serving its user. Good design generates confidence, identity, and a sense of wellbeing that empowers its users. Only a small number of colleges and universities offer bachelor's degrees in automotive design, typically called transportation design and often a subset of industrial design. Coventry University offers one such course. Here, in line with most of

[31] https://www2.deloitte.com/us/en/insights/industry/automotive/women-in-automotive-sector-gender-diversity.html

[32] Sylvia Ann Hewlett et al., *Athena Factor 2.0: Accelerating female talent in science, engineering, and technology*, Center for Talent Innovation, accessed May 10, 2019.

the sector, female students are on average less than 10%, and there is only one female lecturer in the department.[33] Female students enroll expecting a lack of gender diversity and believe that facing this in their degree courses will prepare them better for industry! Indeed, some express the same opinions as those raised by female employees in terms of the need to have to work harder, a laddish culture tolerated by male lecturers, exclusion from male cliques and activities. Those promoting women into STEM careers comment that we do prospective entrants a disservice if a rosy picture of equal opportunities in portrayed.

Common to all design disciplines, students regardless of gender, have a passion for and natural ability in design. Successful students become leaders. Design departments of large automotive companies are the centers for research and innovation in industry. Their outputs are not academic reports, but concepts and visual forms which have impact every time we walk along a street. The recognition that women influence 85% of car purchases has opened the door for female designers. Along with the fact that:

> "For a car guy, an automobile just needs to be low, wide and fast. But think of the range of experiences autonomous vehicles will bring. They'll require more attention to all five senses — and a more sensitive approach to design." (Snyder)

If a car does not appeal to a woman, or meet her needs, it will not sell. As with the financial and cybersecurity sectors market forces have led to greater gender diversity. The industry needs different perspectives. Although few in number, female designers rising to the top are extremely influential. One of the recognized, distinct contributions' women designers bring to the world of automotive design is the capacity to understand that the multi-dimensional woman values product consequences over fads. [34]

As such female automotive designers are found as directors of design teams, where they are responsible for R and I and mid to long-term transport design futures (working with 10, 20 year or more distant horizons). The following quotes have been[35] selected to demonstrate research and innovation within automotive design, the side which is responsible for the vehicle forms (as opposed to engineering).

- Rossella Guasco, Head of the Color & Materials Style Center for FCA (including Fiat, Abarth, Alfa Romeo, Lancia and Maserati), sums up the feeling of most designers, in her comment "It's not a job, it's a way of being."

[33] A conference paper is being authored in relation to this subject based on interviews conducted with staff and students. This does not fall under the remit of this deliverable

[34] https://www.forbes.com/sites/forbesstylefile/2016/03/29/women-of-influence-meet-the-women-auto-designers-behind-the-wheel/

[35] https://www.forbes.com/sites/forbesstylefile/2016/03/29/women-of-influence-meet-the-women-auto-designers-behind-the-wheel/

- This passion is replicated in Nora Arellano's comments where, as Toyota Principal Design Engineer, she advocates campaigns to promote STEM among Michigan students. She says, "Automotive design has a big role in daily life; deciding what car you drive is a major life decision. Knowing that my work has a direct impact to improve usage and safety for our customers is a major motivator. Also, I find it very empowering to be able to own and present my design ideas, have technical debates, defend and justify those ideas in name of the customer."
- Women designers see the 'multi-tasking woman' as an important cornerstone from the start of the design process, from the initial concept to the end of the production. Designer Nicole Fonseca, Nissan Design America Senior Color & Materials Designer, comments "We really want her car to feel like a home away from home. We want it to function for her when she's got her kids in the car, when she's working in the car, when she's applying her makeup [dashing between meetings] …we really try to make an environment where she feels inspired, but also has a sense of peace and harmony."
- Helen Emsely, General Motors Executive Director of Design for Global GMC and User Experience. Her design team creates vehicle exteriors and interiors and supports the designers changing how consumers live with their cars through in-car infotainment technology systems. In terms of the influences of gender on her work, she says "I find a lot of inspiration for vehicle design from being a mom, and I have brought many learnings from my adventures traveling with my son, Connor, into designing vehicles for families, like the GMC Acadia." and "Not to mention that being the mother of a young child gives you unique perspective on the importance of seat fabrics that are liquid repellent and easy to clean, durability of areas that are easily scuffed like the back of seats and door plates, the location of cup holders, storage and arm rests, and ease of entry way into the rear seats."
- Diane Allen, Senior Design Manager Nissan Design America, has managed many design programs at NDA, including the Nissan 350Z and 370Z sports coupes, the Rogue crossover SUV, as well as the first-generation Nissan Titan full-size truck and Infiniti QX56 SUV. She comments "And, as with any industry that makes products for a diverse group of customers, we also need a diverse group of people making those products."

These women, work in design studios, where concepts often precede production by decades — what Ms. Gauci calls "the landscape of the future." With the advent of self-driving autos and an anticipated decline in privately owned cars, vehicles will become more like homes or offices. However, many undergraduate car design students persist in designing cars for themselves and their peer group. This mindset is not what the industry needs.

Knowledge transfer to academia

Similar items arise here, but given that research and innovation in smart mobility feeds directly into this sector the knowledge transfer and lessons are more acute. The aspirational and sensitive nature of the work

in the design studios jars against the gender and ethnic discrimination characteristic of the wider industry. Design is embracing diversity. The different skills and life experiences which female designers bring to their work is valued by OEMs and women are shaping the design of future vehicles. These women leaders also bring new management styles, which may, with some difficulty, be transferred down the organisation. They provide mentorship, placements and are active in promoting STEM and act as role models for other women in the industry, showing what may be possible.

Key items include:

- Not replicating the same biases at undergraduate level as are found in industry
- Development of networks, mentorships and apprenticeships as key relationships between industry and academia to support new female entrants
- Industry led projects which focus clearly on diversity not styling
- Breaking of the laddish culture by encouraging diversity amongst staff

The next section deal with women in academic research and innovation. In this it will be shown that the barriers to gender equality are similar to those faced by women in industry.

5 Research footprints of women in academia, with special reference to transport

Having addressed issues relating to lack of diversity in key industries, the focus of the deliverable now turns to the research environment. Here, many of the same issues arise as barriers, and similar solutions are being put forward e.g. in terms of mentorship and leadership training.

Key reference documents for this section include

- Elsevier (2020). The Researcher Journey through a Gender Lens
- EC (2012). Enhancing excellence, gender equality and efficiency in research and innovation;
- EC (2014). Toolkit: Gender in EU Funded Research and Innovation:
- H2020 Gender Equality.
- Ortega Hortelano, A., Grosso, M., Haq, G., Tsakalidis, A., Gkoumas, K., van Balen, M., & Pekár, F. (2019). Women in European transport with a focus on Research and Innovation - An overview of women's issues in transport based on the Transport Research and Innovation Monitoring and Information System (TRIMIS).

This section includes a summary of pertinent results from these, supplemented, where appropriate, by research conducted by the TInnGO project. It is highly recommended that the interested reader read these key publications. Section 4. has discussed the lack of gender diversity in academia and asserted the benefits of widening diversity e.g. to make research results stronger, more reliable and impactful.

5.1 Gender and Transport in the EU

Ortega Hortelano et al (2019) used the TRIMIS open access database to understand gender aspects of transport projects. TRIMIS supports the implementation and monitoring of STRIA that outline future transport. The priorities of which are to decarbonise the European transport sector, as outlined in seven roadmaps relating to: Cooperative, connected and automated transport (CAT), Transport electrification (EV), Vehicle design and manufacturing (VDM), Low-emission alternative energy for transport (ALT), Network and traffic management systems (NTM), Smart mobility and services (SMO), and Infrastructure (INF). Approximately 7,000 projects are grouped according to these seven roadmaps. Using five keywords (Women, Gender, Equality, Inequality and Equity) these were classified (from a review of the description, methodology and results) in terms of whether they strongly or weakly connected to women and transport, and addressed one of the following key topics: safety and security, travel behaviour and travel patterns, socio-economic

issues including job generation and job equality, and finally, other, which encompasses additional aspects (e.g. ergonomics).

In this way, 142 projects were analysed. Approximately 63% had a weak connection to women's issues in transport, and the remaining 37% had a strong connection. Regarding the type of funding, 52% were funded by EU Member States, whereas the remaining 48% received European funding. Approximately 2% of the projects addressed women's issues.

Ortega Hortelano et al (2019) also presented a case study of the presence of female researchers engaged in H2020 funded transport R&I projects, and their educational qualifications. For this, a sample of projects was taken from the TRIMIS database to examine gender representation, typology and level of educational qualification obtained. The final sample of transport researchers consisted of 769 people, working in 223 organisations and participating in 21 European projects.

The results may be summarised as follows:

- Women accounted for 22% of the transport researchers
- More than half of the researchers had an educational background in engineering (53%) of which only 19% were women.
- 208 researchers held a degree with 25% of them being female.

With regard to grant application rates, across 33 EU countries "women are less likely to apply for funding than men" with significant differences between countries, academic fields, and grant types depending on underlying levels of gender equity."

The analysis of the EU project data base for transport R and I shows that women are less represented than men, regardless of educational attainment and confirms a gender bias in the transport sector

5.1.1 Gender of project co-ordinators

TInnGo conducted a further study of the gender of H2020 Project Coordinator. This was undertaken through analysis of datasets available at EU Open Portal[36]. These datasets contain projects and related organisations funded by the European Union under the Horizon 2020 framework programme for research and innovation from 2014 to 2020.

The file 'H2020 Projects' contains the public grant information for each project. It includes the following information: Record Control Number (RCN), project ID (grant agreement number), project acronym, project status, funding programme, topic, project title, project start date, project end date, project objective, project total cost, EC max contribution (commitment), call ID, funding scheme (type of action), coordinator, coordinator country, participants, participant countries. The search was restricted to entries

[36] https://data.europa.eu/euodp/en/data/dataset/cordisH2020projects

under 'Funding and Tender opportunities' portal which used the keywords 'Smart mobility', Urban mobility', 'Mobility and transport', 'Electric vehicles'.

Additionally, projects presented in the last version of the INEA brochure[37] were analysed. This document manages urban transport and mobility projects in the Horizon 2020 societal challenges 'Smart green and integrated transport', including the CIVITAS initiative, and 'Secure, clean and efficient energy', including 'Smart Cities and Communities'. This joint search helped in collecting a significant number of information on projects, however, **no gender data are available in those datasets**. Therefore, it has been necessary to search for this information on the websites of the projects and in the corresponding documentation.

The procedure resulted in a total of 59 projects being identified with associated Project Coordinator names and gender. In some cases, it was not possible to identify a unique person, especially when the coordinator is a big society or industry. Thus, these projects are not considered in further analysis.

Key Findings

- Only 19 projects are led by a woman (32% over the total). Of these
    - 41 projects followed the RIA (Research and innovation actions) funding scheme,
    - 12 were IA (Innovation actions),
    - 6 were funded as Coordination and Support Action (CSA).
- The presence of women as coordinator is higher in RIA (37%), CSA actions (33%), while only 17% of Innovation Actions projects are led by a female.
- A focus on the type of calls in the dataset analysed shows that most of the projects answered 'Mobility for Growth' calls (as reasonable due to the topics we are investigating). However, it is interesting to observe that no female PI is seen in projects answering calls in topics 'Societal Challenges', 'Green Vehicles' and 'Automated Road Transport'.
- a significant number of projects began their actions in 2017, in line with the calls. Of these, the vast majority were led by men (Figure 9).
- The only year showing a different trend (4 projects with female PI against 3 with male PI) is 2019. Only MG-4-3-2018 "Demographic change and participation of women in transport", directly addressed women in transport, which might have attracted more women as PI.
- We are instead accounting for the following calls relating to: "Harnessing and understanding the impacts of changes in urban mobility on policy making by city-led innovation for sustainable urban mobility", "Sustainable multi-modal inter-urban transport, regional mobility and spatial planning" and "Driver behaviour and acceptance of connected, cooperative and automated transport".

[37] https://ec.europa.eu/inea/sites/inea/files/urban_mobility_brochure_2019_web.pdf

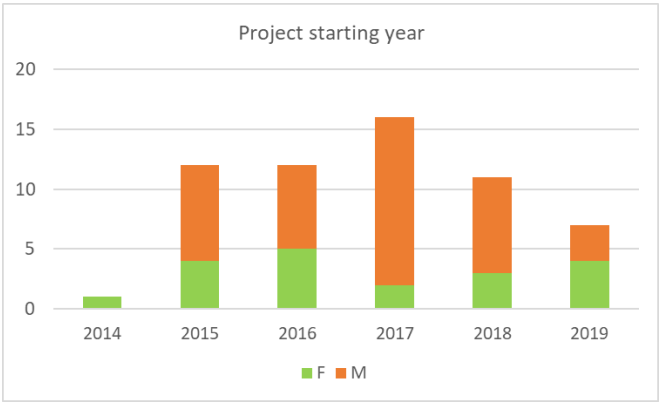


Figure 9:Project Starting Year and Gender of PI

The investigation of the country of origin of the Project coordinators (Table 1) shows most came from Germany, which has a lower proportion of female applicants, when compared to Spain, Denmark, UK (with 5 projects lead by a woman against only 2 by a man) and Sweden both projects led by a woman). Moreover, in this particular dataset, some countries only "provide" men as leaders of projects. This is the case of Switzerland, Luxemburg, Holland, Norway, Portugal and Slovakia (Table 1).

	AT	BE	CH	DE	DK	EL	ES	IT	LU	NL	NO	PT	SE	SK	UK	Total
F	1	1		2	1	1	4	2					2		5	19
M	4	4	1	8	1	2	4	6	1	1	2	2		1	3	40
Total	**5**	**5**	**1**	**10**	**2**	**3**	**8**	**8**	**1**	**1**	**2**	**2**	**2**	**1**	**8**	**59**

Table 1: Number of PI per Gender for their European country

Whilst these figures are interesting, they do not show the origin of the project, i.e. how it was conceived, how the consortium was shaped, or even what the role of the PI is. In some cases, they may be a 'manager', in others they may be more involved in research. Understanding the way in which gender and diversity shapes proposals, and the contribution of those of different genders to shaping the research requires a more qualitative approach using the data set in Appendix 3 and some of the questions in the TInnGo survey (shown in Appendix 2) [38]. This would add substantially to the knowledge base about the role of women in R and I in transport.

[38] This will be continued in the next phase of the project, based on the results of this deliverable via interviews with PIs.

Another dataset is available, 'H2020 Organisations' at EU Open Portal[39], which collects data on the participating organisations. This file includes project Record Control Number (RCN), project ID, project acronym, organisation role, organisation ID, organisation name, organisation short name, organisation type, participation ended (true/false), EC contribution, organisation country.

The combination of this dataset with one containing the information about the projects (namely 'H2020 Projects') can help in identifying the type of the organisation from which the PI comes. This result can be observed in Table 2. 63% of coordinators belong to Higher Education Institutes, with this percentage rising to 68% in for female PIs. Different trends are found analysing the columns PRC and OTH. A higher rate of women comes from Private For Profit organisations, while the opposite happens for the column containing all other types (OTH). This class, in fact, collects 23% of male PIs and only 5% of female coordinators.

	HES	**OTH**	**PRC**	**REC**	**Total**
F	13	1	3	2	19
	68%	*5%*	*16%*	*11%*	*100%*
M	24	9	2	5	40
	60%	*23%*	*5%*	*13%*	*100%*
Total	**37**	**10**	**5**	**7**	**59**
	63%	***17%***	***8%***	***12%***	***100%***

Table 2: Type of organisation of the PI per gender (HES: Higher Education Institutes, PRC: Private For Profit, REC: Research Organisation, OTH: other organisation)

Looking at the projects belonging to 'H2020-MG-TwoStages' process, 40% are led by a woman. A more detailed investigation based on their total cost, shows that the 2 with the highest value have male project coordinators (Figure 10)Figure 10: Total costs for H2020-MG-Two stages projects per PI gender. This accords with the findings from the Elsevier report relating to the research footprint of women (see below).

[39] https://data.europa.eu/euodp/en/data/dataset/cordisH2020projects

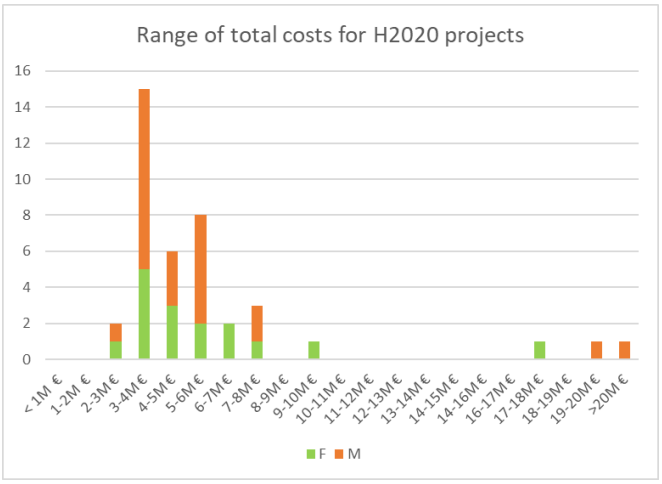


Figure 10: Total costs for H2020-MG-Two stages projects per PI gender

Other information in the cited dataset includes the number of participants belonging to each consortium. In this case, it is interesting to observe that ¼ of the projects coordinated by a man has 8 participants collaborating in the activities (Figure 11). Another interesting number is the percentage of teams made up of at least 10 organisations. In fact, this accounts for 44% of the cases if we consider all the projects having a woman as PI, while this percentage reduces to 25% for male PIs.

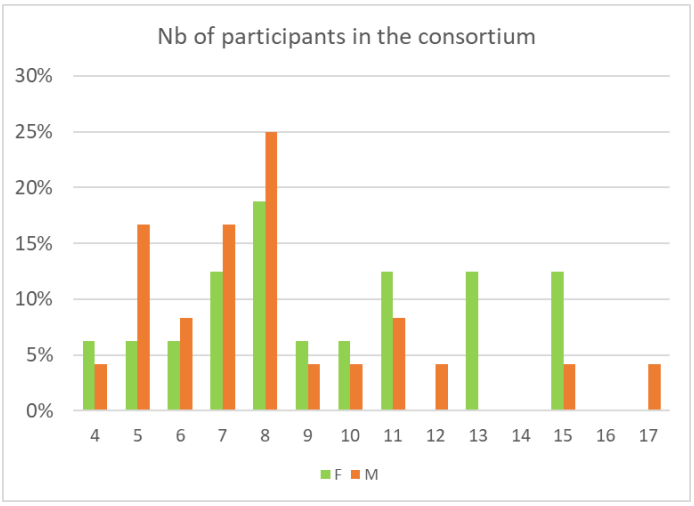


Figure 11: Percentages for the number of participants in the consortium for H2020-MG-Two stages projects per PI gender.

The Eu has provided guidance documents and training for both FP7 and H2020 projects as a Toolkit[40], web site[41] and videos[42] for potential PIs and evaluators which emphasize the need to take gender into account in

[40] https://www.yellowwindow.com/genderinresearch/index_downloads.html
[41] https://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/gender_en.htm
[42] https://www.youtube.com/watch?v=Hq4eWo30RfY&feature=youtu.be and

research actions. However, more information is needed regarding how such information is used and how a gender dimension is integrated into projects, and the extent to which others from a 'non traditional' background shape proposals. Section 4 has already releveled the lack of gender and ethnic diversity at senior levels in academia. The following section examines this more closely using data from Elsevier's report.

5.2 The Research Footprint

This section discusses findings related to the research footprint of women, based on the survey by Elsevier[43] using data mining of the Scopus abstract and citation database of peer-reviewed literature. This comprises over 62 million documents in more than 21,500 serials by some 5,000 publishers, inclusive across all major research fields, with 6,900 titles in the Physical Sciences, 6,400 in the Health Sciences, 4,150 in the Life Sciences, and 6,800 in the Social Sciences. Transport studies were not mentioned specifically, where applicable STEM related figures have been used instead.

It evaluated two gender-based aspects of the global research enterprise:

1. the landscape of global researchers—their publication productivity, impact, and collaborations—viewed through a gender lens
2. the scope of gender research activity.

With the aims of :

- clarifying the scope of gender research as well as gender-related characteristics of the STEM workforce, and how these have changed over time,
- informing development of evidence-based initiatives by a range of stakeholder groups, including funders, policymaking bodies, government agencies, and research institutions, to help to promote diversity and specific policies to improve gender equality
- building organizational structures that will support women in their pursuit of careers in STEM research.

A key concept here is the 'researcher's footprint', measured in terms of the number of publications, awards, citations and patents etc. Gender (and diversity related) disparities in the size of research footprints might indicate obstacles and lack of equal opportunities in the research community. Those with the largest footprints control the discourse, type of investigations which are funded, and the direction of innovation. Research footprints start to grow at mostly doctoral or postdoctoral level, with small footprints belonging to PhD students and early career researchers. Each toe may represent a different output – publications (from conference presentations to peer reviewed articles), research awards, citations and the holding of key

https://www.youtube.com/watch?v=i672z34vW6A&feature=youtu.be

[43] https://www.elsevier.com/research-intelligence/campaigns/gender-17

positions as policy advisors, on steering groups and on editorial boards. Citations of research publications are a means of crediting the originators of an idea or finding, as well as recognizing expertise. The number of citations received by a publication is indicative of uptake of knowledge (Dion et al, 2018) and can serve as a proxy for the academic impact of the publication. Editorial boards decide on what research is important enough to be distributed to the wider research community, when and how it is released. This in turn influences the direction of future research.

The lack of gender and other forms of diversity in academia and research centres in the transport domain has already been noted. It is therefore not surprising to find that women's research footprints are smaller than men's. For new research areas such as smart mobility, which is predicted to have effects on society and inclusivity, providing opportunities from women to be part of research teams is vital, especially when they might counteract existing biases within the discipline. It is important to find out how their voices are heard, and how women and gender issues are represented in the sector, through research outputs and in the way in which research is funded.

5.2.1 The influence of motherhood on research footprints

In the US, Mason, Wolfinger and Goulden (2013) studied the effects of successful careers in academe on professors personal lives, arguing for more family-friendly institutional policies, which could save money by reducing "brain drain and even out the work -life balance of mothers and fathers. Misra (quoted in Flaherty, 2015), in a study of University of Massachusetts at Amherst, found that mothers spend 7.2 fewer hours per week on research than fathers whilst maintaining their time spent on teaching, mentoring or service functions. Men with young children, meanwhile, tend to "protect" their research time. Lesbians without children did the most service, suggesting higher expectations for women who don't have a husband or children at home. Goulden commented

> 'Certainly our most important finding has been that family negatively affects women's, but not men's, early academic careers. Furthermore, academic women who advance through the faculty ranks have historically paid a considerable price for doing so, in the form of much lower rates of family formation, fertility, and higher rates of family dissolution.' For men, however, the pattern has been either neutral or even net-positive.'

Even in highly educated couples, women devote significantly more time to household work than men. For example, when married mothers and fathers in the United States are compared, the former spends almost twice as much time on housework and childcare. In gender-egalitarian countries of northern Europe, women still do almost two-thirds of the unpaid work. Among heterosexual couples with female breadwinners, women do most of the care work.

In early career stages, graduate students with babies may simply leave the profession due to the lack of family -friendliness; they are concerned about childcare, and that people will not take them seriously. Young female professors with children also leave the profession in greater numbers than their cohorts. In the US the National Science Foundation's Survey of Doctorate Recipients[44], tracked 160,000 PhDs in the sciences, social sciences and humanities since the 1970s and found that tenure-track female professors were more likely to be unmarried, divorced and childless than their male counterparts (12 years after receiving their PhD's, only 44% of female tenured faculty were married with children, compared to 70% of male tenured faculty). Women academics who do have children are more likely to do so later in life, between 35 and 39 years of age, once their careers are already established. Additionally, it is estimated that a woman's salary incrementally decreases by 1% for each child. It has been estimated that this can account for a wage gap of 29% by retirement.

Those who do take a career break may find it challenging to return to work (Powell, 2011). In the UK, the Daphne Jackson Trust[45] provides fellowships for (women) engineers, which includes a 2-year part time placement in a research team, training to update skills, mentorship and a network. Career breaks lead to significant gaps in research outputs, and with little institutional support women may find it difficult to win back academic status. This has a significant effect on career progression (Van den Besselaar and Sandström, 2016; Neilsen et al, 2018).

The 'leaks in the pipeline' are costly, given the level of investment put into academics. It has also been noted that a lot of targeted STEM initiatives, show opportunities for women which just are not there, or which come at a cost

Recommendations include:

- paid maternity leave for graduate students,
- Faculty family friendly program for families with small children, including modified duties and tenure clock stoppage following birth or adoption and part-time options,
- child and infant care options, reentry services for postdocs and relocation services,
- postponement and suspension of grants for childbirth, adoption and family leave,
- providing supplements to cover research technicians to maintain labs while principal investigators are on leave,
- publication and promotion of entitlements.

[44] https://www.nsf.gov/statistics/srvydoctorates/

[45] https://daphnejackson.org/about-fellowships/. TInnGOs PI benefitted from this award after her career break.

5.2.1.1 Case study: Covid-19, women and academic outputs

The dual burden of women as employees, homemakers and carers is widely recognised .The effects of this on senior academics was witnessed first-hand in the Wemobile study (led by Woodcock) which engaged female researchers in Pakistan and Malaysia, UK and USA to look at gender transport poverty in Low-Middle Income Countries (e.g. Woodcock et al, 2020). Female academics fitted their day around their care duties with 'work' stopping at 4.30 until the children were in bed and household chores completed. Even when chairing international meetings, they were expected to entertain and feed the children, break up fights between siblings even if their husband was present. In effect, female academics work two shifts, leaving little free time, energy, cognitive, emotional resources to write research publications – let alone the sanctuary of a home office.

This effect has also been seen in the gendered effects of Covid -19 (Flaherty, 2020) on journal submissions, with journals in the field of political science reporting a reduction of solo authored journal articles by women (8 out of 46 papers i.e. 17% compared to 22% in the wider data set), yet an increase in the number of articles in which they were included (41%).

> 'scholars and women in all fields…. are desperately trying to balance teaching and otherwise working from home with increased caregiving responsibilities. Those responsibilities include all-day minding of children due to school and daycare closures, homeschooling, and the cooking and cleaning associated with having one's family at home all day, every day. Women are also spending time checking in with friends, relatives and neighbors.' (Flaherty, 2020).

Covid has exacerbated existing inequalities by stripping away the supports women had in place to walk this tightrope, including childcare. Not only do female academics, as a group, struggle more with their work- life balance, numerous studies show they take on more service work than men and are less protective of their research time, to their detriment. Marking coursework and giving support to students, delivering online lectures, attending online meetings, require space, time and peace which women in particular, have not been able to gain during lockdown.

> 'Instead of working, my colleagues and I are aiming to make it through daily life. Of course, when compared with the drastic consequences of contracting COVID-19, this is a trifling matter. And we know that we are all lucky to have the jobs we do. Wealth, or lack thereof, and other social inequalities are affecting people's access to work, health care, shopping and other services.' Minello (2020)

Minello raises the issue of the effects of the lockdown in terms of career progression, calling for policies to be put in place to recognize the lockdown period as 'care leave', so that this time does not count against

women. Joya Misra, Professor of Sociology and Public Policy at the University of Massachusetts at Amherst, said her institution has been flexible with, and supportive of faculty members in spring 2020, assuring them that their performance during the disruption will not negatively affect their careers. However, she also noted that

> "some faculty don't believe that this won't be held against them, due to the culture of their department or college." Some female colleagues in the sciences and engineering with young children have even doubled down on research, "putting in proposals for studying this particular moment" or writing regular grant proposals because they can't be in their labs.

5.2.1.2 Service work

As well as looking after their immediate family, female academics are more likely to support their academic family - their students, colleagues and department by taking on service roles more than their male colleagues. This is to the detriment of their, teaching and homelife. Although some forms of 'service workload' may be acknowledged in appraisals, if it can be reported against external esteem, many female academics also perform administrative, housekeeping and support tasks for their colleagues. Making time for such activities can lead to salary and promotion gaps. In order to reduce the disproportionate gaps in service duties, Guarino and Borden (2017) suggest:

- monitoring of service requests and allocations,
- mentoring female faculty to be more selective in their service-related choices and cultivate their ability to say no ,
- increase overall awareness of this issue to improve overall attitudes toward service loads, remove traces of gender bias from service expectations and enable both women and men to accept or decline service requests with equal ease and impunity,
- Internal auditing.

5.2.2 Women's academic outputs

Figures such as those produced by UNESCO and She Figures (2015), show slightly more men than women engaged in graduate research, with around 44% being female (40-60% in EU) depending on discipline and region. In all countries studied the number of women authors has increased between (1996-200, and 2011-2015), as shown in figure 12 below. An analysis by subject area for the EU28 and US for the latter period are shown in figure 13.

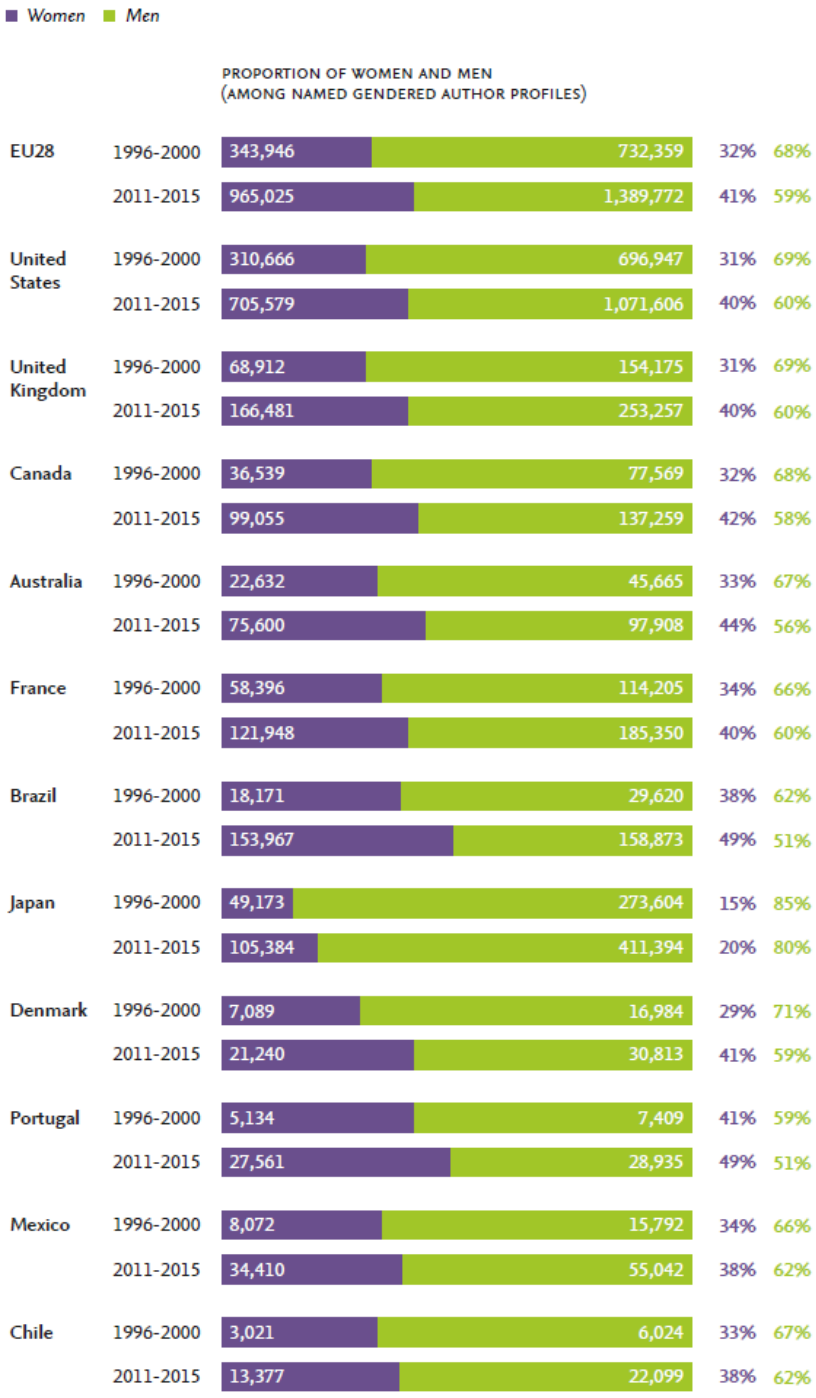
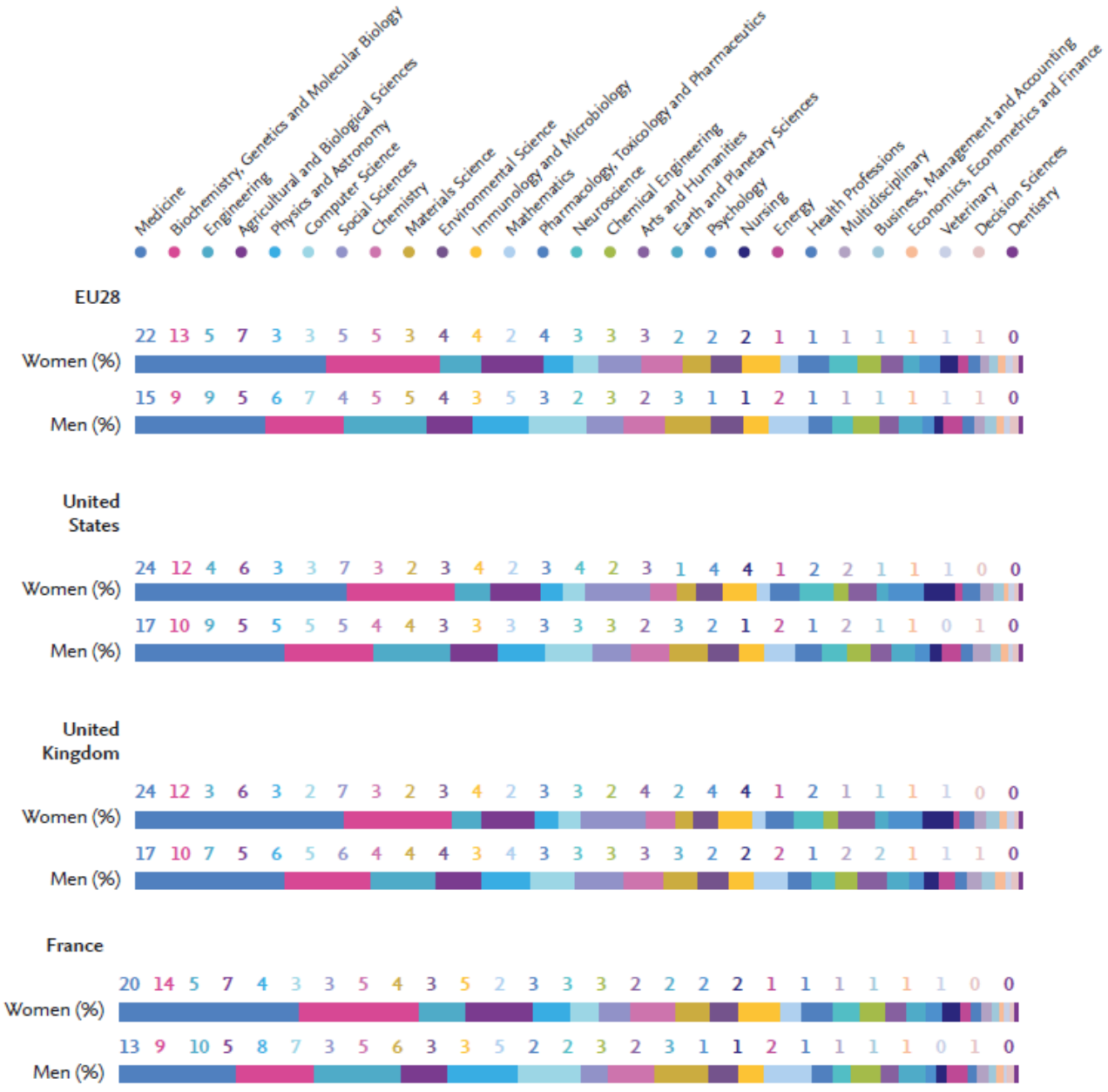


Figure 12: Proportion and Number of researchers by gender (among named and gendered author profile) of each comparator period (taken from Elsevier report, p1)

Women author fewer publications than men, with differences in scholarly output varying by subject. Denmark, Portugal and Australia show the greatest rise in the number of outputs, where in each case women are now producing more outputs than men over the two time periods. There is highest representation of

women among researchers in the Health and Life Science fields and the lowest proportion of fields of Computer Science, Energy, Engineering, Mathematics, and Physics and Astronomy. Elsevier present some evidence, from US, to suggest that underlying causes of the discrepancies (at least in mathematics) are social and cultural in nature. If this is the case, then interventions promoting STEM and addressing stereotypes will reduce gender (and diversity) gaps (Makel et al, 2016; Lynn and Kanazawa, 2011 and AAUW, 2010). However, to be most effective the time to do this is at primary school age.



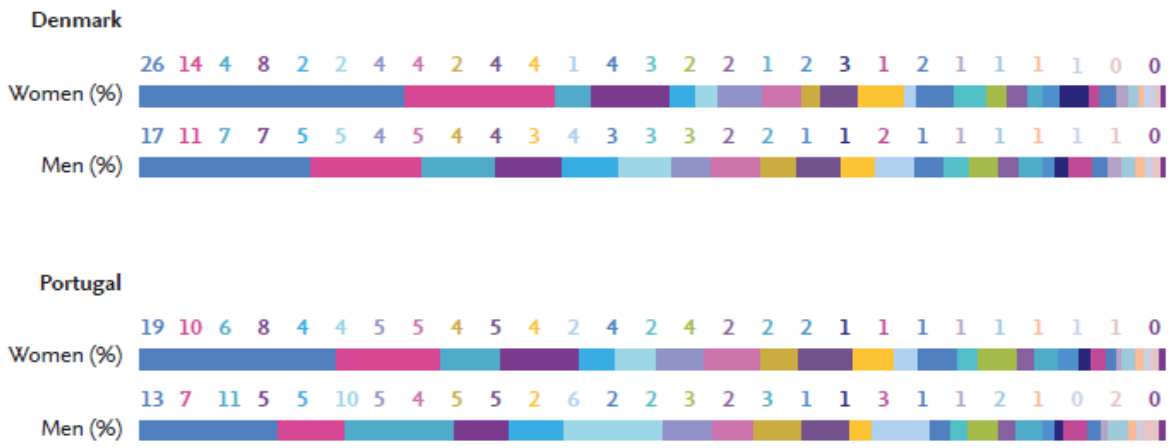


Figure 13: Proportion of Researchers (among named and gendered author profile) by Subject Area, 2011-2015 taken from Elsevier report

Portugal, which has the highest number of women in 20 out of 27 subjects. It was recognised by the UN in 2012[46] for its efforts to support the equality of women. For example, it prohibits gender discrimination in school textbooks and promotes the participation of girls and women in STEM including the Portuguese Association of Women in Science, Rails Girls, Girls Lean In, Portugal Girl Geek Dinners, and Geekettes.

Of especial interest for this deliverable is the number of researchers by gender in subject areas related to (smart) mobility. This is somewhat difficult to ascertain as it can be fed by many disciplines, so people may come into transport from a non-scientific background. It can certainly be argued that this diversity is to be welcomed and valued.[47] Using Elsevier's data Figure 14 has been produced which shows gender differences in publication rates for 4 representative discipline areas which could inform smart mobility. The full data set is available on p24- 27 of Elsevier report.

With regard to the number of scholarly outputs produced per researcher (total number of papers for the period divided by total number of researchers for the period), by five-year period men publish more papers on average than women (except in Japan), but women (except in Australia, Denmark, and Chile) published fewer papers on average in 2011 – 2015 than in 1996 – 2000. The complexity of this picture is reproduced in its entirety in the figure 15 (taken from p29, Elsevier report).

[46] IEEE Women in Engineering. *4 Reasons to be a Tech Girl in Portugal*.sites.ieee.org/portugal-wie/index.php/4-reasons-to-be-a-tech-girl-in-portugal

[47] The PI of TInnGO has a background in psychology, social biology and ergonomics and affiliate herself with arts and humanities, not engineering. Outputs from her projects are entered under UoA34 (Art & Design: History, Practice and Theory) under the UK's Research Excellence Framework

Figure 14: The Number of Researchers by Gender in Subject Areas Potentially Related to (Smart) Transport

Citations

Citations are a widely used proxies for scholarly impact. Using a Field-Weighted Citation Impact (FWCI), Elsevier showed that the number of citations increased for both men and women between the two periods (1996- 2001 and 2011 – 2015), except for the US and UK, which saw a slight decrease in citations for women, and a stable FWCI for men. In the United States, the FWCI for women is higher than for men; in the United Kingdom and European Union, the FWCI is about equal. Knobloch - Westerwick et al (2013) described the "Matilda effect"—the perception that the scholarly work of women is lower quality than that of men—which leads to fewer citations or invitations to collaborate and has a negative effect on future scholarly output.

Figure 15: Scholarly Output per Researcher (among named and gendered author profile) by gender for each comparator, 1996-2000 vs. 2011-2015)

Citations only tell part of the story of the impact of a paper. Papers can also be used by students, companies, medical practitioners, engineers etc, when downloaded off the internet. Counting the number of downloads of a paper's PDF or the number of on-line views of the full-text of a paper on Elsevier's ScienceDirect platform (Field-Weighted Download Impact (FWDI) showed values slightly higher for women.

Patent applications

Patents can be used a proxy for innovation. Here women are generally underrepresented, but figures rose from 10% in 1996 – 2000 to 14% in 2011 – 2015, with the percentage of patent applications that include at least one woman among inventors also increasing, from 19% in 1996 – 2000 to 28% in 2011 – 2015.

Research funding

Gender disparities have also been noted in terms of research funding. This is a key benchmark of success for researchers which influence tenure and promotion decisions. As was seen in the previous section, more men apply for high risk, high value awards (Wadman, 2019; Oliveira et al, 2019). Additionally, top prizes in science are more often awarded to men, who then receive more money and prestige as a result. Women also have a lower patent counts than men (Whittington and Smith-Doerr, 2008; Charlesworth and Banaji, 2019).

Gender parity in authorship

The American Mathematical Society[48] stated that "joint research is a sharing of ideas and skills that cannot be attributed to the individuals separately". Different personal beliefs and disciplinary conventions make it difficult to reliably predict authorship or ownership of the work. Different conventions include, authorship by level of (reverse) seniority, contribution or alphabetical order, or a mixture. In some cultures, and disciplines, the (usually male) departmental head is included.

Using Scopus bibliometric data, the Elsevier report found that in engineering, women represent no more than 35% of authors in any of the 12 comparator countries (i.e. Argentina, Brazil, Mexico, Canada, USA, EU28, UK, Portugal, Spain, France, Italy, Netherlands, Germany, Denmark, Australia and Japan). When men did appear as authors they were more likely in first or corresponding author position than women publishing in the same field. For the EU, gender differences were less pronounced in Denmark, and Portugal, each with only nine percentage points between women and men. The average for the EU was 46% women and 68% men.

Mor positively, Elsevier noted an increase in the proportion of female researchers in all subject areas and geographies covered (i.e. Argentina, Brazil, Mexico, Canada, USA, EU28, UK, Portugal, Spain, France, Italy, Netherlands, Germany, Denmark, Australia and Japan) attributable to an increasing proportion of young authors. Among active authors during the period 2014–2018, the lowest ratio of women to men was observed in the physical sciences (median ratio among countries ranged from 20 women per 100 men in mathematics to 51 women per 100 men in environmental science). In many life sciences and health and social

[48] American Mathematical Society. The Culture of Research and Scholarship in Mathematics: Joint Research and Its Publication. 2004. http://www.ams.org/profession/leaders/culture/CultureStatement04.pdf

sciences subject areas, the median ratio among the countries analysed was close to parity. Transport was not pulled out as a specific area.

Men are more highly represented among authors with a long publication history while women are highly represented among authors with a short publication history. Additionally, more men were first or corresponding author, but there was a move to greater gender parity in the periods covered i.e. 1999–2003 and 2014–2018[49].

International collaboration and authorship

Using network analysis and interviews, the Elsevier report was able to conclude that:

- men tended to have more co-authors than women and this difference widened among authors with a longer publication history.
- In the EU28, where men authors had a slightly higher tendency to establish international collaborations than women authors
- women authors tended to collaborate more with women than men on average while men collaborated more with men than women across regions and subject areas

More detail is needed here, to understand the way in which EU funded projects, career trajectories and networks. This was outside the remit of the Elsevier report.

- In order to address some of these gaps a survey was conducted by the TInnGO project of female academics working at post grad level in transport related projects (Section 6)

Overall, Elsevier's analysis reveals incremental improvements in women's representation among researchers along three of the key core activities that they undertake: authoring publications, securing research funding and applying for patents. However, on average men are more dominant in all categories; they have a larger research footprint, gain more awards and apply for more patents. With a larger research footprint, they can dominate the research field, and lead to bias in approach and reporting.

5.3 Online survey of female researches in the transport sector

In order to understand more about the gender dynamics in research environments we need to know more about the lived experience of female academics in transport projects in order to identify main issues that create impediments to female career development and prevent women from equal participation in the field. Evidence-based findings are essential to address gender bias in academic outputs and inform strategies to reduce inequalities.

[49] First authorship does not necessarily denote who has made the greatest contribution to a paper. An issue we are trying to tease out in the online survey

This section reports on findings from a small research study of female researchers in the transport sector. The main objectives were to:

- Investigate bias against women in research environment in smart mobility
- Identify barriers to employment and career progression among female researchers
- Identify rationale for ordering of authorship on research papers
- Indicate which bias needs to be addressed in order to support women in research workforce
- Build on existing knowledge about gender disparity and inform further strategies and best practice to fight gender discrimination

5.3.1 Data Collection and Procedure

Data was collected via online survey from March to May 2020 across Europe. It was distributed via research networks, institutional platforms, social media, newsletters or personal contacts. Eligibility criteria for the Participants were: 1. researchers working in transport related field; 2. identifying as female. In total 31 complete surveys were returned. It had been hoped to conduct the survey face to face with participants in the workplace and at conferences. This would have provided much richer results. Unfortunately, this was not possible. Additionally, owing to the poor response rate, the field was widened from smart mobility to transport.

The survey (Appendix 2) comprised of 41 questions relating to general employment, research projects and funding bodies, recruitment procedure, pay gap, gender composition of the team, career aspiration and barriers to career development, bullying and sexual harassment and research footprint in the form of publications. Some of the questions were mandatory (e.g. general employment) other optional (sensitive question regarding bullying, sexual harassment or demographic question).

Respondent backgrounds

Almost all respondents had postgraduate qualifications with a doctoral degree (PhD) most frequent, followed by master's degree and professorship. The wide range of disciplines included engineering, psychology, ergonomics to management and cultural studies. 93.5% worked full time

With regards to job title the most common was Early Career Researcher and Associate Professor (**Error! Reference source not found.**). `Other' related to positions such as: project manager, private c ompany researcher, PhD student.

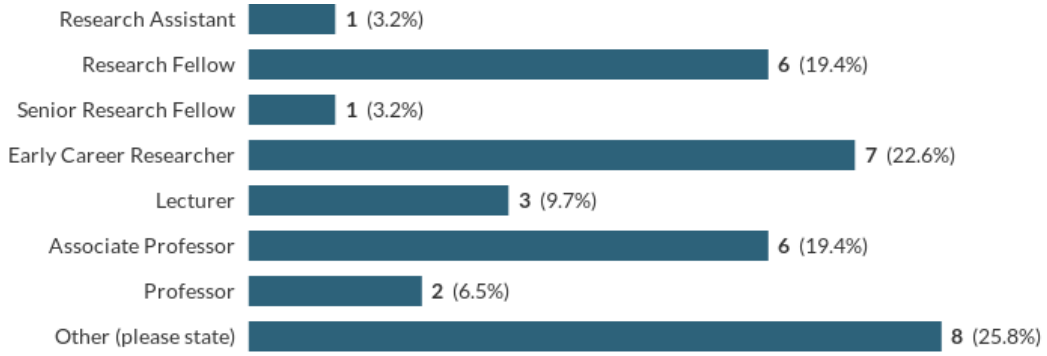


Figure 16: Job title Among Respondents (%)

Regarding age, the largest group of respondents was 26-33 years old (30%) and second largest (20%) group was between 41-50 years old. This profile accords well with those in research, and especially those engaged in EU funded activities. Ethnicity is shown in Figure 18.

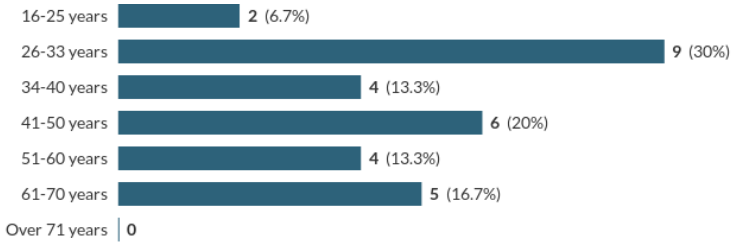


Figure 17: Age of Respondents (%)

Research area and role in the project

Research areas they worked in were varied. However, the most frequent focus was on sustainable urban transport development or human factors and social policy related to smart mobility planning.

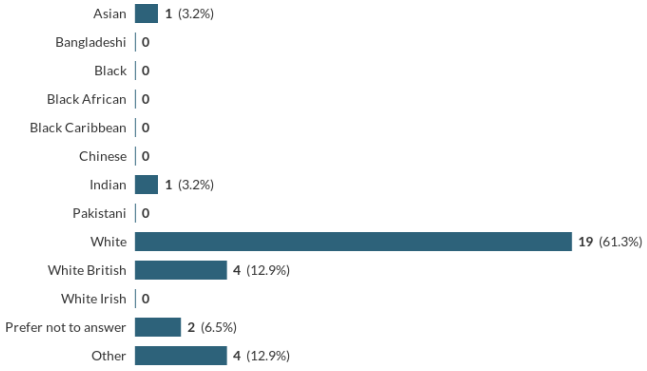


Figure 18: Ethnic background of respondents (%)

With regards their position: results show that Principal Investigator and Self Directed Researcher were the most frequent and placing at 35.5% respectively. Answers `Other' were explained in additional comments as: partner, task leader, support team or research fellow (**Error! Reference s ource not found.**).

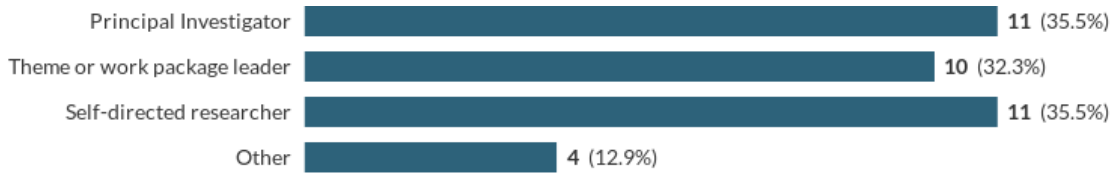


Figure 19: Role in Current Research Project (%)

Composition of research teams

Respondents were asked to estimate the makeup of their current (or recent) research teams. Gender composition of current research teams was well balanced including 59% females, and 41% males. Information about the gender of projects leaders showing majority of female leaders (66.6%) with an average age of 53. In the same projects female support staff constituted 42% with the rest being mixed gender groups. [50]

Gender and diversity in research

The majority of researchers answered that gender and diversity perspectives were applied to their research (**Error! Reference source not found.**). In many cases these were core project objectives. In o thers the gender dimension was used to build up the funding application and strengthen potential research impact:

> *I always at the beginning of each project ask in relation to the purpose, the question of power perspective/ gender. We often need to motivate our study from a gender perspective as we seek funding. I often go through my reference list with an equality eye.* (P9)

Responses varied from gender mainstreaming being the main project objective to good recruitment practices like involving representative from different groups (elderly, young, people with disabilities). Answers `Other' responses included being new to the project or objectives of the project not being fully scoped.

[50] This may reflect bias in sampling. It is likely that those who responded to the survey were in the same networks and worked on project with a gender focus

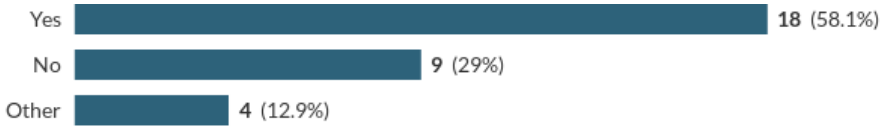


Figure 20: Incorporating gender and diversity dimension in research in percentage (%)

Wider career aspirations and mentoring

Question about career aspirations offered scope for a narrative description of professional goals. Answers included:

- a passion about mobility and knowledge sharing,
- pursuit of a reputable status,
- meaningful career that will be part of social change or contributing impactful research that will inform policies.

Inspirations included family members, teachers, tutors, lecturer or colleagues. Many highlighted the importance of having female colleagues or role models in the research environment. For example:

> *Female researchers [have been my inspiration] who possess deep knowledge and are prepared to share from their experiences and support others, in particular junior female researchers.* (P 3)

In other words, having a role model or relationship with female scholars brings a wide range of positive outcomes for protégés, especially in the early stages of an academic career. This echoes the approaches used to encourage women into STEM and the viewpoints of women in the industrial sector as well,

Gender and Equality Policy in organisation

A significant number of women (58.1%) had not heard about any gender and equality policy in their organisation. Those who answered positively (41.9%) commented on a broad coverage of polices including recruitment practices, responsibilities, remuneration and research opportunities. However, some comments were sceptical:

> *We have a law in Sweden that all organisation have to have an equality policy. Have never seen or heard of any action emerging from it within my organisation.* (P8)

Such critical comments suggest that having polices in place does not guarantee their active implementation and there is no tangible application of gender and equality legislation in the workplace.

Income and Pay Gap

24 Participants chose to share information about their income (**Error! Reference source not found.**) w hereas all 31 responded to the question about pay gap.

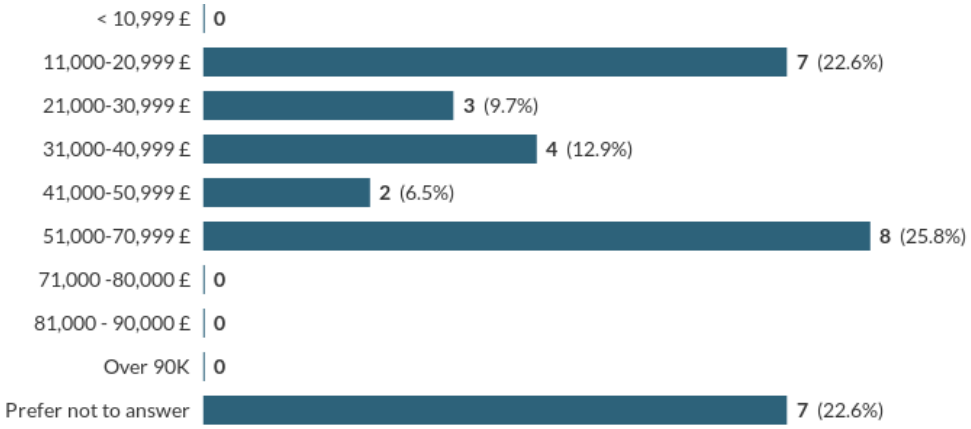


Figure 21: Annual income in percentage (%)

Approximately 25% of respondents were aware of a gender pay gap. There was option to reflect on given answers. Here respondents referred to their own observations, statistical data, salary investigations, systemic failures favouring men in male dominated disciplines. The role of unions was mentioned couple of times:

> *I have been working within the union for many years and know the salaries in the organization […] we do an investigation of salaries every other year looking at gender gaps* (P5)

The gender pay gap is common across Higher Education Institutions and transport sectors.

Glass Ceiling

Although 61.3% of researchers did not see any barriers or obstacles to their career development, they were aware of systemic gender biases, such as :

- female research/output associated with less value comparing to the male one (`Matilda effect`),
- disrespectful behaviours and hostile environments of `boys` club in male dominated field,
- systemic barriers to promotion of female researchers, lack of organisational support for mothers.

Examples of discrimination against women in research environment shows they can be very subtle and hidden in daily routines; as one respondent shared:

> *They are evidenced in an embodiment, in the daily lives of women. Sometimes just felt, mostly unnoticed and not always analysed as such*. (P15)

Many shared details on common and subtle practices of discrimination that became normalised by the system creating invisible barriers for female scholars. Full quotes are given in Appendix 3.

Gender Discrimination

Looking further into this, over a fifth of women reported (explicit or implicit) discriminatory practices during their academic careers (77.4% did not notice any gender-based favouritism). Some went back to their early careers in 80s or 90s. Most comments reported on systemic, organisational discrimination that becomes normalized and persistent. Comments included depriving women equal participation in activities, silencing of female colleagues who were underpaid.

> *Excluded from meetings; horizontal bullying by colleagues who effectively shut me out; have had to work harder than male colleagues; for many years my salary and position was below what it should have been.* (P 31)

Moreover, in many comments there is a shared notion of implicit discrimination internalised by the organisation described in one of the responses:

> *There are so many so it becomes normal. From not being listened to, being told to be silent or not invited to be part of a team or getting a pay raise or higher position.* (P 24)

Bullying and Sexual Harassment

Although optional, this question was answered by all respondents, with just over 25% affirming that they had been subjected to, or saw horizontal and hierarchical bullying and sexual harrassment

> *By my former head of the unit (man), never reported it. (P11)*

Other respondent shared experiences of bullying experienced by colleagues working at the same level:

> *Horizontal bullying I did not report it. […] I have sometimes not wanted to go into work because it is such an overtly male environment (P31)*

Lack of reporting was prevalent in many stories suggesting that these practices were not recorded by an organisation and perpetrators were not confronted or prosecuted.

29% had experienced sexual harassment or had known someone who had experienced gender-based harassment. Forms of misconduct varied from subtle insinuation or flirting to constant harassment by male colleagues or male line manager. Following quote illustrates one of the experiences:

> *In previous work I faced constant sexual and psychological harassment from my boss. He was a bit unstable mood and thought I belonged to him.* (P15)

Another quote below describes persistent gender-based harassment within educational organization coming in both forms: horizontal and hierarchical.

> *Over the years there have been several instances of males acting inappropriately towards female colleagues and students* (P31)

Similar to bullying, it seems that occurrence of harassment was regular and internalised by institutions. Lack of reporting or prosecuting perpetrators seems to be prevalent. Comments show that sexual harassment and misconduct issues are still being tolerated or accepted and that they are having a significant and lasting impact on some women's career. Again, these reflect the picture faced by women working in industry.

Transport related publications

Over 60% of the respondents provided full, annotated citations for publications and a commentary on how the order of authorship was determined. On the basis of submitted information it seems that in majority of cases order of authorship was decided according to level of contribution or the project leader was mentioned first, and the rest listed in alphabetical order.

5.3.2 Conclusions

Overall, the analysis indicates that gender disparities still exist, demonstrating that we have more work to do to address issues that cut across diversity as well.

- Gender makeup of the research team was well balanced showing almost 59% of projects being led by women. However, this may have been skewed by the sample, with those most likely to respond to the survey working in the fields of smart mobility in context of sustainability, social policies and social inequalities. Thus, results might not be generalizable to all transport research teams.
- Despite of gender equality policies being implemented in the majority of the referenced institution around 26% of the respondents reported a gender pay gap in their current organization providing evidence from own experiences and observations.
- 38.7% of female researchers felt there is a `glass ceiling`, a barrier to their career development resulting in many being in teaching roles or in lower paid support positions.
- 22.6% of respondents had experience gender-based discrimination evidencing it with examples from their professional life; discrimination was described as direct or indirect and deprived them opportunities
- Despite refined definition of what constituted bullying and sexual harassment, documenting these behaviors remains challenging. Our survey shows that bullying and gender targeted harassment are still prevalent in the academic settings (29% had experienced or knew someone who had experienced gender-based harassment). The underreporting of sexual harassment is well known, as is the use of power relations in academic institutions. Along with the data collection methods, this could be an underestimate.
- The need for female role models and mentoring was raised by many participants. Many were not able to provide any academic inspiration, mentor or a female academic role model. Studies have suggested that academic women are less likely to have mentors and the nature of women's mentoring differs from men's (Sands et al., 1991, Sambunjak et al., 2006, Eby et al., 2008, Kiopa et

al., 2009). Mentoring – especially at the early stage – can influence career choices, collaboration style which in result translated into number of publications.

- Despite all respondents having postgraduate qualification and working in research only 61% could reference their publications. This would support previous statement that women have a smaller footprint in the research landscape than their male counterparts.
- Demographic analysis showed lack of representation from Black or Chinese ethnicity questioning ethnic diversity with predominantly white ethnic background among respondents (in total almost 75%).

Study Limitations

Firstly, sample included 31 female researchers who volunteered to participate. Results may not generalizable to all women working in transport related research because

- Participants came from the EU and projects associated with TinnGO, which share a similar ethos
- In EU countries Gender Equality policies at research institutions are mandatory. This may not reflect the global research environment and situations from institutions where gender and diversity policies are not guided by the same practice.
- Due to Coronavirus pandemic initially, qualitative in-depth interviews had to be converted into online survey of a reductive nature. This is not appropriate to reporting subtle and sensitive matters such as micro-aggression or sexual harassment.

It is recognised that there is a need to broaden and deepen this study using one - to - one hermeneutic phenomenological interviews with those identified in Appendix 3 which not only examine their research careers, but the way their life experiences and diversity shape their research. As this has not been possible in the timeframe of this deliverable two extracts have been provided from Elsevier's expert interviews, along with a short transcript of reflections from the PI of TInnGO (and 2 other Eu funded projects) to indicate the future direction of this research (Appendix 1).

This section has clearly demonstrated when placed alongside the discussions of Section 4 is the remarkable similarities of women in different parts of the Transport Business Ecosystem, in terms of barriers, enablers and opportunities. These will be further discussed in the closing section.

5.4 Overview of Elsevier's expert interview with Charlina Vitcheva, Acting Director-General, Joint Research Centre (JRC)

Charlina confirmed that women in research in the EU are underrepresented (about a third are women) but that this was improving. 'The scientific quality and societal relevance of produced knowledge, technologies and innovation increases when they reflect the needs, behaviours and attitudes of both women and men'

p49. Gender disparity in STEM fields is high, but the 'EU is integrating the gender dimension in the content of scientific literature slightly better than the world average '.

She affirmed that 'Gender equality and the integration of a gender perspective in the preparation and evaluation of policies in academic research is a priority for the EU.' The Declaration on Women in Digital, will encourage women to play an active role in the digital and technology sectors. 'Concrete policy actions are thus necessary to support the full participation and inclusion of girls and women in the digital economy, while at the same time, addressing stereotypes and social norms that lead to discrimination.'

5.5 Overview of Elsevier's expert interview with Sarah Sharples, Pro-Vice-Chancellor for Equality, Diversity and Inclusion, University of Nottingham, UK

Sarah, who has a background in transport research, commented that

- The last five years has shown an increased awareness of gender diversity regarding leadership and in research teams, but no significant change in the makeup of research teams
- There is still a significant bias towards men in STEM research
- Best policy initiatives have included:
    - UKRI Future Leadership fellowship program, which considers all aspects of diversity,
    - Steps to address bias in promotion by emphasizing teaching, public engagement, and entrepreneurship as well as research activities and focusing on the quality of publications rather than quantity.
    - Support for a research leader (mentorship)
    - A network for women researchers interested in entrepreneurship and innovation.
    - Need to make sure that women are treated fairly, academically and professionally and that a fair pay structure is created to reduce gender pay gaps,
- Sexual harassment and misconduct are still tolerated and have a significant effect on women's research careers
- Reducing the gender gap in applying for research is key. If women apply they stand an equal chance of getting one. However, if women do not get the larger, more prestigious grants, 'there are fewer women in strategic policymaking discussions, presenting to parliamentary scientific committees, or engaging with government departments.' (Elsevier, p82)
- 'I think we are heading in the right direction, but it's going to take more than 10 years to achieve something that looks like gender equity. First, we need to address issues around gender disparity starting at primary and secondary school.'
- Significant progress has been made on the ability to discuss topics like gender, care responsibilities, and protected characteristics in research, but there needs to be a conversation about the

intersectionality of gender, disability, and ethnicity, and how these impact on successful progression through a research career.

- There is still resistance to gender diversity and equity, primarily because of a lack of knowledge.

5.6 Discussion in terms of Elsevier report and the gender toolkit

As part of its review Elsevier also conducted a global survey of researchers across all disciplines. Noteworthy results (taken from Appendix C of their gender report include) sample size was @ 1200, but number of responses varied per question[51]:

More women than men think:

- The workplace culture is gender biased (45% compared to 25%)
- Diverse representation in their field in off putting to potential recruits (24% compared to 18%)
- Insufficient inclusion and diversity plans (26% compared to 19%)
- There is bias or discrimination in hiring, recruitment and promotion (38% compared to 13% of men)
- The proportion of men to women has stayed the same (43% compared to 31%)
- The biggest barriers to career progression are discrimination, harassment, need to relocate, lack of sponsorship from senior colleagues, other commitments, and work life balance issues

More men than women think:

- There are more women in the profession now (66% compared to 52% of women)
- There are no barriers to career progression (11% compared to 8% of women)

In terms of gender differences

- Slightly more men than women have been asked to collaborate in the last year (mean 3.04 for women compared to 3.52 for men)
- Slightly more men than women have invited collaborators in the last year (mean 2.74 for women compared to 3.29 for men)
- Fewer women than men have contemplated a career change (47% compared to 52% for men)
- Where women do consider a career change, they are more likely than men to cite family commitments, job security, too demanding a career, experience of harassment and discrimination than men
- Men are more likely to know (e.g. easily start a conversation with) people in high prestige positions (such as members of parliament, heads of funding bodies, deans and chancellors)

[51] The interested reader is referred to the original report, which contains more details and a careful breakdown of figures

- Women are more likely to know (e.g. easily start a conversation with) people in moderate prestige positions (such as professors, lectures and postgraduates)

In terms of the gender toolkit, there is still some way to go. Taking each element in turn, bearing in mind the context and remit of this work, in terms of EU and nationally funded research in mobility

1. Research idea phase:
    a. Generate gender-sensitive ideas for research proposals. Not enough is known about this stage of the research lifecycle, but training material and guidelines do exist to help PIs and evaluators
    b. Make research hypotheses gender- sensitive. Not enough is known about this stage of the research lifecycle
2. Research proposal phase
    a. Formulate gender-sensitive research questions. Not enough is known about this stage of the research lifecycle, but training material and guidelines do exist to help PIs and evaluators
    b. Select a mixed team of men and women. Not enough is known about this stage of the research lifecycle, but there may be biases regarding who is invited to collaborate and the researcher pool
    c. Create gender-equal working conditions. More work is needed in STEM
    d. Choose a gender-sensitive methodology. More work and checks may be needed in STEM
    e. Collect gender -sensitive data. More work and checks are needed
3. Research phase
    a. Value women's and men's work equally. There is evidence that this not the case
    b. Manage and monitor equality. Equality is monitored, but guidance needed on how it can be managed (perhaps using Gender and Diversity Mainstreaming)
    c. Analyse data in a gender-sensitive way. More information /evidence is needed.
4. Dissemination phase
    a. Report data in a gender-sensitive way. More information /evidence is needed
    b. Use gender impartial language

In stages 1 and 2, the inclusion of gender and diversity issues in the call and evaluation against these criteria are key. For phase 4, please refer to Section 6 and 7 of this report

5.7 Conclusions

The results presented throughout this report, triangulate well, pointing to slight increases in gender and diversity across all fields. However, it does not look as if a turning point has yet been reached in education or employment. Where it has not been possibly to show figures specifically for smart mobility in a lot of cases

it may be predicted that these are similar to STEM related disciplines. A combination of initiatives may be responsible for this steady change, as the impact of the some have yet to be fully realised (e.g. encouraging young women into STEM and mentorship schemes, increased emphasis on gender and diversity in funding schemes).

Gender equality may be increasing but wider diversity issues have not received the same level of attention, and even bigger problems still exist.

A key issue is how can we optimise the efforts that are being made? This deliverable has included 3 cases of industries allied to smart mobility in which the business case has been made for embedding wider diversity in the workforce. The HEI sector, at least in the UK, in which R and I is located, has not experienced the same cultural shift.

Recommendations will be put forward in the last section of the deliverable.

6 Analysis of gender bias in research outputs using corpus linguistics

The aim of this study was to discover the ways in which gender is being portrayed in the Smart Mobility literature. Corpus linguistic techniques were used as a way of looking at this. It specifically addresses, in a quantitative way, the need to understand more about gender biases in the way research outputs are written, addressing the gap identified at the end of the last section.

Corpus linguistics enables large quantities of texts to be processed far more accurately and efficiently than by manual means. Overall it is concerned with the way in which language is used to convey information content, rather than the information content itself. The methodology is particularly useful as a means of revealing underlying biases that the producer of the text did not intend to be made overt and might even have been unaware of harbouring.

Corpus linguists generally approach their corpora with specific questions in mind, and although query software can automatically generate frequency lists and calculate degrees of lexicogrammatical co-occurrence, the human researcher must always decide which items to search for, how to formulate the queries, and the degree of significance to attach to the software output.

Two studies were undertaken of slightly different texts in the Smart Mobility domain. Study 1 referenced more engineering type articles from the Research and Innovation side of the field. Study 2 considered articles written from the social side, which focused more on the implications of sustainable transport for communities. In both cases a comparative analysis was made between the way in which male and female authors used gender terms in their research outputs.

6.1 Corpus linguistics study of the content of research papers in Smart Mobility/technically oriented papers

6.1.1. Data used for analysis of Smart Mobility technical papers

Many modern 'megacorpora' are created by trawling the internet for texts containing words of relevance to the topic under study. It is difficult to monitor the provenance of texts collected by this means, however, and it would be difficult, if not impossible, to automatically identify the gender of the authors. Human intervention is needed to select the contents of a corpus, so that they are a reasonably good representation of the population under study at a given moment in history.

The corpus used for this study was carefully compiled to represent research journal articles published since 2014 in the field of Smart Mobility. They were identified manually by searching scholarly archives using the key words and phrases, as shown in Table 3.

Table 3: Search Terms for the Corpus Linguistics Study on Smart Mobility Technical Papers

sustainable transport	environmentally friendly transport	intelligent mobility
intelligent transport system	mobility revolution	smart mobility

green mobility innovative transport

By this means 63 articles with a male first author were identified, and 35 articles with a female first author. The articles came from a range of engineering subfields, including conference proceedings and the following journals:

Table 4: Sources of Smart Mobility/Technical Articles

Ain Shams Engineering Journal	European Journal of Futures Research	International Journal of Research in Advent Technology	International Journal of Scientific & Engineering Research
Applied System Innovation	IEICE Transactions on Communications	International Journal of Sustainable Development & World Ecology	International Journal of Sustainable Transportation
Australian Planner	IEEE Transactions on Intelligent Transportation Systems	Journal of Cleaner Production	Journal of Engineering
Cities	IEEE Vehicular Technology Magazine	Journal of Modern Engineering Research	Journal of Traffic and Transportation Engineering
Ecological Economics	Infocommunications Journal	Journal of Transport Geography	Journal of Urban Technology
Engineering	Sustainable Cities and Society	Machines. Technologies. Materials	Research in Transportation Economics
Energies	Sensors	Technological Forecasting and Social Change	Telecommunications Policy
Energy Conversion and Management	Sustainability	TeMA	Journal of Land Use, Mobility and Environment
Energy Policy	Transport Policy	Transportation Cyber-Physical Systems	Transport Economics and Logistics
Urban Development	Urban Science	World Review of Intermodal Transportation Research	

In order to create two subcorpora of equal size, 35 articles with a male first author (M35) were selected from the larger pool to compare with the 35 articles with a female first author (F35).

The articles were converted from PDF to text format and uploaded in two subsets to the SketchEngine platform. This is a powerful online text analysis tool by Lexical Computing Ltd, founded by Adam Kilgarriff and Pavel Rychlý in 2003. It is widely used in the commercial sector, but its core features are freely available under the GNU General Public License. Under the ELEXIS scheme the query interface is currently freely available to educational institutions in the EU (see https://www.sketchengine.eu/).

According to SketchEngine calculations, M35 contained 285,015 words, and F35 contained 267,233 words. Results were normalized to frequency per million words to allow for this slight difference in size

6.1.2 Analytical procedure

- The two subcorpora were searched for male and female-specific pronouns (word = "he|his|him" and word = "she|her"), and “man”, “men”, “woman” and “women”.
- Cases where these words were used generically, with “he” standing in for both “he” and “she”, for example, were distinguished from cases referring to an individual with a specified gender.
- Cases where the male and female forms of the word were presented together, as in “he or she”, were noted.
- The two subcorpora were also searched for family-related words such as “mother”, “father”, “family”, “child”, “boy”, “girl” and “baby”, and their inflected forms. Instances of groupings relating to age, gender and/or ability were noted.

6.1.3 Findings from the analysis of Smart Mobility/technical papers

Articles with the male as first author (M35)

In M35, male-specific pronouns occurred 33 times (95.5 per million words), and female-specific pronouns occurred 15 times (43.4 per million words). The female-specific pronoun was only used by itself in four of these 15 occurrences; in other cases, male and female-specific pronouns were used in combination, in 12 instances with the male-specific pronoun placed first, e.g.

- The modern traveler has more choices to optimize **his/her** travel activity according to **his/ her** preferences due to the progress in technological development.
- the application notifies the driver whether **he /she** can maintain the same speed

and in only one instance with the female pronoun placed first:

- Every actor's power–hence **her /his** ability to influence the dynamics of ST systems–is a function of the above vector.

In five contexts he|his|him was used generically:

- identifying transportation vehicles in order to decide whether or not to enter a vehicle; this must be done in a way so that **the traveler** is sure that **he** enters the right bus or tram
- Design defines the relationship between supervision and actual intervention in an emergency, whereby it should, in principle, support **the individual** in **his** ability to act.
- There is no way to use classic stock and of course **the costumer** expect **his** granola for the breakfast next morning.
- The user experience while using smart city service has to be designed in a way **user** gets a better service respective **his** needs
- Regional transport authorities considered traffic management as their joint public task, reconfigured the collaborative settings and established a joint business case in which **each partner** knew **his** role, contribution and benefits

In these cases the male pronoun is used to refer back to a gender-neutral noun: “traveller”, “individual”, “costumer” [sic], “user” and “partner”.

The identification of a male traveller as ‘typical’ in one further case may have been justifiable on the basis of research evidence:

- The typical Norwegian electric car user is **a middle-aged family father** with higher education and income, who owns a Nissan LEAF as one of two cars, drives **his** electric car on a daily

basis because this saves **him** money and time and although satisfied with **his** choice highlights longer range and predictable EV policy as two areas for improvement

The remaining 16 uses of "he|his|him" in M35 refer to specific male individuals, e.g.

- In **his** study, Buckingham [52] depicts that involving women in sustainable development is one of the key elements that can help change the world
- Burns [89] ends **his** praise for the driverless cars by saying: BWe must bring together technology, systems design methods and business models to supply better mobility at low cost to consumers and to societies

Apart from one instance of “father”, in the Norwegian example above, and two references to “baby boomers”, there were no instances of “mother”, “mum”, “father”, “dad”, “husband”, “wife” or “baby” (or their plural forms) in M35. There were 38 (98.4 per million) instances of “family” or “families”. A few of these were figurative, as in

- A taxonomy of bioinspired computational intelligence, comprising 4 major **families**

but most of them referred to family transport needs; for example:

- Daily life revolves around friends, **family**, work, school, and shopping.
- Newly urbanized **families** in emerging economies contributes to support the demand side of these rising markets
- In general, most African **families** do not allow the girls to even learn how to ride.

In M35 “man” or “men” occurred 34 times (98.4 per million) and “woman” or “women” 145 times (419.5 per million). “Man” was used in the generic sense three times in just one article (from *Sustainable Cities and Society* 51):

- For a long time, **man** has long dreamed of autonomous "thinking" machines that are free of human interference
- The relationship between **man** and machine has changed massively in the last 20 years
- it makes sense for us to divide the collaboration between **man** and machine into different types.
-

“Woman” was never used in this generic sense.

Many of the studies in this subcorpus focused on the transport needs of women, and in most cases where the word “men” occurred in M35, the word “women” occurred too, either to emphasize inclusivity or to compare the status or travel needs of men and women. For example:

- the United Nations Global Sustainable Transport Conference [1] highlighted that sustainable transport must be a teamwork project that includes both **men** and **women**
- Finally, **men** have reduced their automobile travel more significantly than **women**
- Further studies revealed that despite the improvements in travel patterns and the role of **women** in sustainable transport, their contribution is still less compared to **men**.

There were no instances of “boy” or “boys” in M35, but 10 instances of “girl” or “girls”; all of these came from a single article pertaining to women’s participation in bicycle transport.

Children, but not women, were sometimes included within target categories of vulnerable people in M35. For example:

- Greater freedom of mobility for the **disabled, tired, drunk, inattentive, very old, or children**
- combined informative actions for **children** and **the elderly** (emphasis on target groups: **children, elderly people, people with disabilities**, etc.) on issues of mobility choices and road safety.

- Fully automated driving is of course highly desirable for specific groups such as **children , senior citizens, and people with severe medical handicaps**.

Articles with the female as first author (F35)

In F35, male-specific pronouns occurred 45 times (138.3 per million words), and female-specific pronouns occurred 66 times (202.8 per million words). In 10 of these cases the male- and female-specific pronouns were used in combination, as in “he or she”, “him or her”, or “he/she”. The male-specific pronoun was always placed first. Otherwise uses of "she” or “her" in M35 refer to specific female individual study participants, e.g.

- **Anna** uses **her** mobile phone to text, call, take and store photos and as a diary.
- **Ingrid** talked about 'being a student' at university, at **her** home during term time and at home with **her** parents.

There were a few references to specific male individuals, for example:

- **Litman** (2014) also factors policy instruments into **his** discussion of various paths with regard to market penetration
- **Debbie's son** was in a football team that required **his** parents to spend their Sundays driving to different fixtures across Bristol and South Gloucestershire
- in hindsight, one could wonder whether **Henry Ford** should have foreseen the drastic consequences for the climate and society now associated with **his** creation of the mass-produced automobile. After all, **his** intentions were to unlock immense possibilities for all social classes.

However almost half the occurrences of “he/his/him” in F35 (21, 64.5 per million) were generic, as in:

- The second criterion is related to the human **driver** and whether **he** is allowed to dedicate **his** attention partially or completely to other activities except driving
- A **person** cannot be assigned more than one time to a several vehicles and cannot be assigned to a vehicle if **his** preferences or constraints exile this assignment.
- the **manufacturer** will be interested in creating a branded service network that will provide **him** with implementation of the principle of responsibility 0

As in M35, "she”, “her" and “woman” or “women” were not used generically in F35.

In F35 “man” or “men” occurred 9 times (27.7 per million) and “women” (always in the plural) occurred 6 times (18.4 per million). In three of these occurrences men and women were referred to together:

- The car is the most important travel mode for **men** (71.9%) and **women** (68.6%).
- the distribution of private cars among **men** and **women** remains almost the same when regarding changes in first-choice preferences
- **Men** shift their preferences much more from PT to carsharing when automation becomes available than do **women**.

Three occurrences of “man” were figurative (in the phrase “middle man”), and three were generic, as in:

- further digitisation and digital networking between **man** and infrastructure
- Mobility researchers, traffic planners, and business **men** should take the opportunity to re-think mobility from scratch.
- social efficiency and optimal interaction between **man** and technology.

There were no references to the singular or plural forms of “boy”, “girl”, “father”, “dad” or “wife” in F35. There were two references to “husband”:

- She commutes to work by bicycle and occasionally by car and **her husband** commutes by bicycle.
- I'm going to work late I have to ask **my husband** to leave work early to collect the children

and two refences to “mother(s)”, one of them figurative:

- the **"mother"** of the other initiatives to be settled down locally.

However one article (from the *Journal of Transport Geography*) contained 29 references to “mum(s)”. This study explored the use of ICTs by part-time working mothers.

“Family” occurred 21 times (64.5 times per million). Three of these were figurative, as in “IEEE 802.11 **family** of specifications” but most referred to family life and relationships.

On two occasions in F35 children are grouped with other categories of disadvantaged or vulnerable people:

- At the same time, automobile manufacturers face new customer groups such as **disabled** or **older people**, or maybe even **children**
- the opportunity to provide new user groups with individual motorised mobility, in particular **pensioners, children** or **physically disabled people**.

And on one occasion women are one of the target categories:

- **Women, poorer, and lower educated adults** are more likely to be unbanked.

6.1.4 Conclusions from the analysis of Smart Mobility/technical papers

Table 5 summarises some of the uses of gender-specific language in the selected texts and compares usage in articles first-authored by a man and articles first authored by a woman.

Table 5: Summary of the Use of Gender-specific Language in Smart Mobility Technical Papers

	M35	**F35**
male-specific pronouns	95.5 per million	138.3 per million
female-specific pronouns	43.4 per million	202.8 per million
generic he|his|him	14.5 per million	64.5 per million
generic she|her	0	0
he|him / she|her	34.7 per million	30.7 per million
she|her / he|him	2.9 per million	0
“man/men”	98.4 per million	27.7 per million
“woman/women”	419.5 per million	18.4 per million
“men” and “women” in same sentence	81 per million	9.2 per million
generic “man/men”	8.7 per million	9.2 per million
generic “woman/women”	0	0

The articles tended to focus on the need for inclusivity, and the analysis did not reveal much underlying gender bias.

- However, it was notable that the word “man” or a male pronoun was used on a number of occasions in both subcorpora when referring to humankind in general, rather than an individual male. The word “woman” or a female pronoun was never used in this way.
- We should bear in mind that the first author is not necessarily the main author of an article, and it is quite possible that some articles first authored by males were largely written by females, and vice versa.
- However it was perhaps surprising that
  - the articles in F35 did not seem to be less gender-biased than those in M35.
  - articles first-authored by men were far more likely to mention men and women together in the same sentence,
  - although there was some provision of alternative male and female pronoun forms in both subcorpora (“he/she”, “him or her” etc), the only instance of the female pronoun being placed before the male pronoun was in an article with a male first author.

6.2 Corpus linguistics study of the content of research papers in the field of Smart Mobility/social equity

In comparison to the previous study, the articles used for this analysis were written by those active in the field of transport equity and sustainable transport, such as social scientists and geographers who are generally more concerned with planning and public health rather than technical innovation. Their research engages with smart mobility specifically in the relation to planning and evaluation of new transport measures e.g. in terms of gender equity and social impact assessment.

6.2.1 Data used for analysis of Smart Mobility Smart Mobility/social equity

Articles were identified manually by searching scholarly archives using key words and phrases, such as those shown in table 6.

Table 6: Search Terms used for the Smart Mobility/Social Equity Study

accessibility	equity	gender
social inclusion	assessment	smart mobility
green mobility	innovative transport	global south

Articles were selected from journals such as those shown in Table 7.

Table 7: Sources of Smart Mobility/Social Equity Articles

Journal of Transport Geography	Transport Policy	Research in Transportation Economics	Travel Behaviour and Society
Journal of Transport and Health	Transportation Research Part F	Travel Behavior and Society	Transportation Research Part A
NBER Working Paper	Environment and Urbanisation		

In order to create two subcorpora of equal size, 21 articles with a male first author (M21) were selected from the larger pool to compare with the 21 articles with a female first author (F21).

The articles were converted from PDF to text format, and uploaded in two subsets to the SketchEngine platform. According to SketchEngine calculations, M21 contained 168,392 words, and F21 contained 170,403 words. Results were normalised to frequency per million words to allow for this slight difference in size. The analytical procedure was the same as that used in the previous study (Section 6.1.2)

6.2.2 Findings from the analysis of Smart Mobility/Social equity papers

Articles with the male as first author (M21)

In M21, male-specific pronouns occurred 33 times (146.9 per million words), and female-specific pronouns occurred 24 times (106.8 per million words). In 21 of these occurrences the male and female-specific pronouns were used in combination, in 16 instances with the male-specific pronoun placed first, e.g.

- Parents might also suffer stress and anxiety related to a child's desire to express his/ her independence through mobility during school travel.
- the physical representations of every point in space he or she could reach at a certain time.

and in four instances with the female pronoun placed first:

- The driven child is likely more aware of, and interested in learning about, her/his travel environment
- This approach is arguably more reflective of what a child might actually observe along her or his trip to/from school.
- Another measure for car availability is the amount of time a person uses the car plus the time she or he has it available at the destination.
- 'PT poor' means that there is a slow direct connection, a connection where (s)he has to change.

In one further instance the references to ‘her’ and ‘his’ were balanced:

- They find that the likelihood for a woman to make a trip as a car driver increases with the number of her children, while the equivalent likelihood for men decreases with the number of his children.

In the 12 instances where he|his|him was not used in conjunction with a female-specific pronoun, only four were used generically. Three of these appeared in one sentence, a quotation from an earlier source:

''[W]e believe that an individual wishing to satisfy his desire to play a [Video Lottery Terminal] will tend to go to the establishment closest to *his* place of residence, above all when he is walking'' (Robitaille and Herjean, 2008, p. 5).

There were 132 uses of the word ‘man’ (587.5 per million) and 180 uses of the word ‘woman’ (801.2 per million) in M21. In many pf the articles the attitudes and behaviour of men and women were compared, and in 100 cases (445.1 per million) men and women were mentioned in the same sentence.

Of these cases, 67 referred to men before women, even though women's travel needs were often the focus of the article, e.g.

- Men have larger values than women for duration of car use in virtually all sub-groups
- ….similar travel times for each gender, but with higher commuting times for men compared to women within each occupation.
- Men's preference for powerful cars may also serve as an explanation for car use being more important to them psychologically, as men are more motivated to car use than women

Women were mentioned first only one third of the time, e.g.

- contributing to breadwinning increases women's chances of accessing the car more than men's
- For younger age groups, women's and men's commuting times have been converging.

The words "man" and "men" were always used with specific reference to subgroups, such as white men or men who are working full-time, or to contrast men's circumstances, attitudes and behaviour to those of women.

Family behaviour patterns are discussed, and mothers' and fathers' roles compared in M21, as in

- Paull (2008) identified that the birth of a child had little effect on a father's work time, but considerable effect on the mother's (reducing their work time), and indeed father's work hours might rise.
- For the trip home from school, the presence of a stay-at-home father correlated with escorted travel, which is not to say that mothers are not more likely to be involved in the unpaid work of school travel and broader institutional communications about their children's lives

However there is no indication of gender bias in the assessment of capability.

Articles with the female as first author (F21)

In F21, male-specific pronouns occurred 106 times (478.6 per million words), and female-specific pronouns occurred 167 times (754 per million words). The words "man" or "men" occurred 296 times (1336.5 times per million) and "woman" or "women" occurred 799 times (3607.5 times per million). "Man" or "men" frequently co-occurred alongside the words "woman" or "women", but male- and female-specific pronouns were only used three times in combination, the male-specific pronoun always coming first:

- both the respondent and his/her partner
- a person's ''functionings'' are not just achievements (such as achieved education); they also become part of his or her capabilities
- participation results from a person's needs and desires to participate in activities in other places, his or her resources and characteristics

Gender-specific words were not used generically to refer to both genders. However "she", "her", "women" and "woman" were used when discussing the female condition in general, e.g.

- The more a woman is allowed to travel and experiences problems with transport, the more she will appreciate having her vehicle. Where this is not practicable owing to social taboos or lack of financial resources, her safe independence comes at a cost; she is forced to either continue to put herself at risk and suffer harassment, or to use ride-sharing or on-demand services with unregulated fares or depend on male family members. She is trapped in a circle of gender transport poverty where life chances slowly erode. She has to spend more effort in

planning journeys, negotiating her mobility, paying more for transport, and being constantly vigilant on arduous journeys to and from employment. On top of this, she will also be responsible for household duties. In the case of 'can drive' (d) cycle, a female driver faces misogyny and hostility from other drivers, congestion, and poor driving of other motorists....

Otherwise uses of "she" or "her" in F21 refer to specific female individual study participants, e.g.

- Caroline does not have a driver's licence, and when explaining why not, she says: "We would need two cars then, and I DON'T want to put money into that.
- Johanna's household has a more unusual time-use strategy, because her husband does fulltime shift work though with fewer than usual hours; she says that her husband's schedule allows them to cope with their long commuting distances.

Similarly, he|his|him always referred to specific male individuals, for example:

- To Sen, wellbeing is the freedom to choose to live one kind of life or another: as he puts it, ''to achieve various valuable functionings'' (Sen, 1993, p. 30).
- Hans argues that the car is his and not his wife's also because she does not like to drive a car with a manual transmission.
- According to her, he thinks that she uses the car very often, although she only uses it when she works the night shift
- Because it also fits into that, that he stops working at five and isn't at home before six, and day-care closes at that time.

The words "man" and "men" were always used with specific reference to subgroups, such as working men or unemployed men, or to contrast men's circumstances, attitudes and behaviour to those of women, e.g.

- Four focus groups were conducted in each area between October and November 2011 one with housewives with childcare responsibilities, one with employed women, one with unemployed men and one with students between the ages of 14 and 15 years.
- Working men can use a bus, car, or motorbike. Women are socially forbidden to use motorbikes – a mode of transport favoured by men (Hoodbhoy, 2013) as wind through clothing may lead to female body shapes being revealed.

6.2.3 Conclusions from the analysis of Smart Mobility/Social equity papers

The following table summarises some of the uses of gender-specific language in the selected texts and compares usage in articles first-authored by a man and articles first authored by a woman.

Table 8: Summary of the Use of Gender-specific Language in Smart Mobility /Social Equity papers

	M21	F21
male-specific pronouns	146.9 per million	478.6 per million
female-specific pronouns	106.8 per million	754 per million
generic he|his|him	0	0
generic she|her	0	0
he|him / she|her	71.2 per million	13.5 per million
she|her / he|him	17.8 per million	0
"man/men"	587.5 per million	1336.5 per million
"woman/women"	801.2 per million	3607.5 per million

"men" and "women" in same sentence	445.1 per million	Very frequent
generic "man/men"	0 per million	0
generic "woman/women"	0	0

- There was very little evidence of underlying gender bias in these articles. They were concerned with the transport rights and needs of women in particular and did not use male pronouns or the word 'man' generically, to refer to both men and women.
- Female first-authored articles made many more references to people, particularly women, but when referring to both genders together the female first-authored articles always placed the masculine pronoun 'he' or 'him' before the feminine pronoun 'she' or 'her'. In this respect they displayed slightly more gender bias than the male first-authored articles where there were four instances of the female pronoun being placed first.

6.3 A comparison of results from the two corpus linguistic studies.

Most of the articles in both areas manifest concerns about the rights and needs of female travelers, and supported initiatives which would result in greater gender equality.

The division into male first-authored and female first-authored texts was a fairly crude distinction in these two studies, as many of the articles were produced by mixed-gender teams, and first authors may have played a bigger part in data collection and analysis than in the final reporting of findings.

Although there were differences between male and female first-authored articles' use of gendered language (with male first-authored articles displaying slightly less bias), there was a more marked difference between the two disciplinary areas, smart mobility and gender and transportation.

Authors of the more technical papers in the first study seemed to be more unthinking in their use of gendered language; some used "man" or "men" and "he/his/him" to refer to humans in general, but this did not occur in the articles from gender and transportation, where males and females were routinely mentioned together, and there were many more references to women, particularly in the female-first-authored texts.

Across both datasets it was still the norm to place the male pronoun before the female pronoun ("he or she" and "him or her"), although some of the male first-authored gender and transportation articles did reverse this order ("she or he" and "her or him"). Offering gender alternatives in any order does of course indicate less bias than the generic use of the male pronoun, which was particularly common in female first-authored smart mobility articles.

7. Investigation of the use of intersectionality in papers related to Smart Mobility

This study uses a quantitative approach to address the gap in knowledge regarding the use of gender diversity in research papers related to Smart Mobility. Here the emphasis has been on the coverage of intersectionality.

Research in transport through a feminist lens has shown that the interplay between socially constructed mobility and unequal position of women as transport users, can take the form of social exclusion (Levy 2013). However, simply stating that women are suffering because of gender is not enough since gender interacts with other categories, including race and class, that co-exist and interact with each other. A major criticism levelled at working with gender issues is the potential disregard for an inclusive approach and the risk of assuming that all women are suffering equally and comparatively more than men.

To avoid this, the concept of intersectionality coined by Kimberlé Williams Crenshaw (1989), an American civil rights advocate (Guittar and Guittar 2015: 659) can be useful. It holds that women experience marginalisation in multiple ways and display complexities of discrimination that can be faced by others (Patton, 2002). Lockhart and Danis (2010) maintain that women must be considered as having multi-layered, socio-political identities which stem from race, social class, employment, education, ethnicity, physical characteristics and geographical location. They take complicated journeys, because of the nature of their responsibilities, and, 'gender-blind transport planning exacerbates these challenges, resulting in women requiring making multiple stops for a range of different reasons' (Pozarny 2016: 7).

Apart from questioning the polarity of genders and its fixity, a social constructionist view also supports intersectionality, by identifying how gendered experiences are also shaped by age, sexuality, class, and ability of individuals (Kang et al. 2017). This view is also aligned with an ergonomic approach centred on the needs of the people who face most challenges so that everyone can benefit from them (Woodcock, 2015). Thus, such an approach can help in embracing the constructivist approach to mobility, underscoring not only its social dimension but also helping to conceptualize it as a subjective or disproportionally distributed resource.

The complex relationship between gender and transport has not received sufficient attention until this century, when there has been a shift in focus away from transport to mobility (Creswell, 2010). This ideological change or 'mobility turn' (Sheller and Urry, 2006) is now seen at policy and operational levels in developed countries, e.g. in the development of Sustainable Urban Mobility Plans (Sitányiová and Masarovicová, 2017). However, taking into account the value of understanding the lived experience of transport users, and the need to pay attention to the wider socio-cultural context of travel as opposed to transport performance metrics is still rudimentary. These traditional measures 'are useful indicators as a first approximation, but they are not sensitive enough to capture the nuances of gender power relations' (Pradhan 2003). Also, social and individual factors may impact an individual's mobility which thus cannot be confined to measuring trip generation (Jennings, 2016).

Many cities have not yet embraced this paradigm shift towards socially inclusive accessibility. In such contexts, technocratic approaches to mobilities still dominate the practices of urban development authorities (Uteng and Lucas 2018: 12) and social issues acting upon an individual's movement are not yet integrated into transport planning (Lucas et al. 2016). This is the reason why one can observe that the mobility issues are often dealt with using 'technical rationality in justifying decisions to support and promote a car-based culture (Uteng and Lucas 2018:13).

In this section, an experimental search methodology (NVivo) was used to analyze two sets of papers to understand the extent to which intersectionality featured in their outputs.

7.1 Methodology

The following three papers were selected to guide the construction of the search methods and analysis based on the relevance of their authors, work and discussion to intersectional studies.

- Cho, S., Crenshaw, K. W. and McCall, L. (2013).Toward a Field of Intersectionality Studies: Theory, Applications, and Praxis', Signs: *Journal of Women in Culture and Society*, 38, 4, pp 785-810, Available at https://www.journals.uchicago.edu/doi/abs/10.1086/669608
- Carbado, D., and Crenshaw, K.W., Mays, V.M. and Tomlinson, B. (2013). INTERSECTIONALITY: Mapping the Movements of a Theory, Du Bois Review: *Social Science Research on Race*, 10, 2, 2013, pp. 303-312, Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4181947/
- Moradi, B., Parent, M.C. and Weiss, A.S. (2020). Mapping the Travels of Intersectionality Scholarship: A Citation Network Analysis, *Psychology of Women Quarterly*, 19, 1, pp.1-19, Available at: https://journals.sagepub.com/doi/pdf/10.1177/0361684320902408

They inform the variables and social markers employed in NVivo's mechanism. The word search was based on the social markers/concepts employed in the 3 papers. The concepts here are gender[52], race, ethnicity, class, disability, sexual orientation, sexuality, age, nationality and religion[53]. The queries were based in doubles for the concepts presented, where the search mechanism will only find papers presenting a minimum of two concepts. The arbitrary decision of labeling 'intersectional' any paper presenting and discussing at least two concepts does not exclude papers presenting more than two, as they would also appear in the search. In order to distinguish such papers, the Reference tool[54] are used for further verification (such as false positives/negatives) among the triaged papers.

Each query set gathers all the combinations between two concepts - gender AND race; gender AND ethnicity; gender AND sexual orientation and so on). There are 10 pairings and 5 query sets. The first 4 sets are gender, race, ethnicity and class. The last set collates all combinations between disability, sexual orientation, sexuality, age, nationality and religion. Such definition of query and subqueries allows NVivo to run all the possible combinations between all the sets concomitantly, reducing the

[52] 'Sex' as a category have consciously been left out of this set. As shown in the works of authors such as contemporary gender studies have criticised and resignified the division between sex and gender as unintelligible. In a lot of works they can be interpreted as synonymous, saved a deeper analysis. Although recognising such discussion, this will not be accounted for in our development.

[53] We intentionally left 'belief' out of the set as well, as the word can be misleading in the search for intersectional elements, appearing just in its semantic use.

[54] Such tool flags all the results found through NVivo's customised mechanism and codes them into documents for further analysis. In our case, such documents presents highlighted textual parts of the papers analysed where the concepts were flagged, for further processing and analysis, allowing to find positive and false negatives.

chances of false/positive negatives, as the next query excludes previous concepts that might have been combined.

7.2 First cluster analysis – Word frequency and Reference results for papers concerned with Social Equity theme

Our first preliminary analysis discusses results for 58 papers put through NVivo's mechanism using the above-mentioned method. The papers were, those used in section 6.2 and had a 'social equity' theme. The results from may be summarized as follows:

- 'intersectionality' and stemmed words (intersectional; intersect, etc.) as a concept appears in one paper only[55], where an intersectional approach is included in the discussion. This specific paper discusses how to go beyond disaggregation of transport users by social relations such as class, gender, age and ethnicity.
- Another 3 papers mentioned 'intersection', but were false positives, with the term being used to refer to roads or points of discussion, unrelated to social identities.
- Generally, gender as concept was employed more than other concepts, as detailed below
- Papers employing the concepts of age or gender with other concepts mainly used them as variables or sociodemographic values.
- The papers did not develop the combination of concepts intersectionally, reaffirming trends in research where one concept is privileged and others are marginalized, showing how intersectionality is important to understand social identities and research practices.

Word frequency and summary of sets of cluster 1 papers

- Gender and age accounted for most of the results, totaling 74.17% of the word frequency found in all 58 papers.
- 'Age' featured as the second most common concept but was mainly used as a demographic value.

Figure 22 shows the gap in gender and age as privileged concepts, compared to the others. Race, for instance, has only 2.98%, a worrying figure, considering the historical political struggles of feminism, gender and race[56].

Table 9 shows the combined References and Coverage for the nodes found in all possible search combinations (45 concepts in total). Reference numbers are the total of selections within NVivo's sources (in our case, all the papers in PDF) that have been coded through the designed queries (any combination of at least two elected concepts). The percentage shown in the Coverage section relates to the percentage of textual results at the nodes that have been coded.

[55] Travel choice.pdf
[56] As shown by Kimberlé Crenshaw's already mentioned seminal work on the intersections of gender and race.

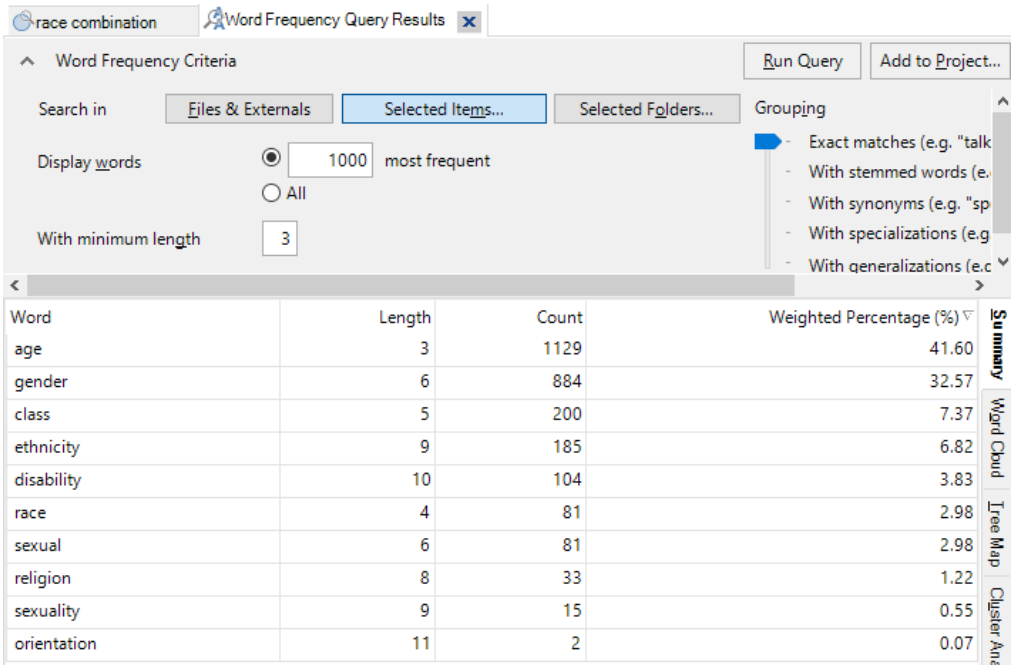


Figure 22: Word frequency – cluster 1

The set query results once show the prevalence of gender employed in most papers, combined with the frequency it is used, as shown in the last section Word frequency. By checking all the results coded in the References, our analysis shows that ethnicity and age figure highly in their results but are mainly used as a demographic value and not as a social category employed analytically.

Table 9:Reference and Coverage results – cluster 1

Race combinations		Class combinations		Disab+Sex+Age+Nat+Religion co.	
References	Coverage	References	Coverage	References	Coverage
289	1.21%	317	1.10%	249	1.04%

Ethnicity combinations		Gender combinations	
References	Coverage	References	Coverage
371	1.57%	1.488	6.77%

NVivo's coded Reference results

More than 200 pages of results were generated from this analysis, presenting the textual results of all combinations for the selected papers. Although such results provide an idea of its content and positive correlations between the concepts searched, this still requires reading the papers to eliminate false positives and negatives. For large datasets this is not always possible. NVivo does however provide a short extract from the paper in which the result was found. This can be used to reduce errors

Only four papers from the 58 sampled presented elements of intersectional analysis. Of these:

- One paper was coded in all 5 query sets (as defined in the methodology section).
- Only one paper was coded in the set of Disab+sex+etc. and ethnicity, but also gender, which was common to all.

- One paper combined exclusively two concepts (class and gender).
- Lastly, all possible combinations between class, gender and race were found in one paper.

All four papers were coded in the Gender set, presenting once again its prevalence as a concept employed in all papers Lastly, 3 out of the 4 papers had female authors. Reference analysis pointed to concepts being used to reinforce the one employed in the paper, which is mainly gender.

The use of important concepts such as ethnicity and disability as an appendix to gender analysis shows how intersectional research is still needed to encourage a better understanding on society's identarian interplay. As Crenshaw (1989) teaches us, equality and identity politics can only fail if they crystallise certain categories as being more descriptive of one's experience. This also goes for gender, taken as a traditional and important concept, but that rarely describes people's experiences by itself. The lack of results presenting racial analysis combined with other variables is worrying, as race is such an important concept, historically and contemporarily, and one of the main catalysts of Crenshaw's intersectional contribution on identity politics.

7.3 Second cluster analysis for papers dealing Social Mobility/Technical aspects

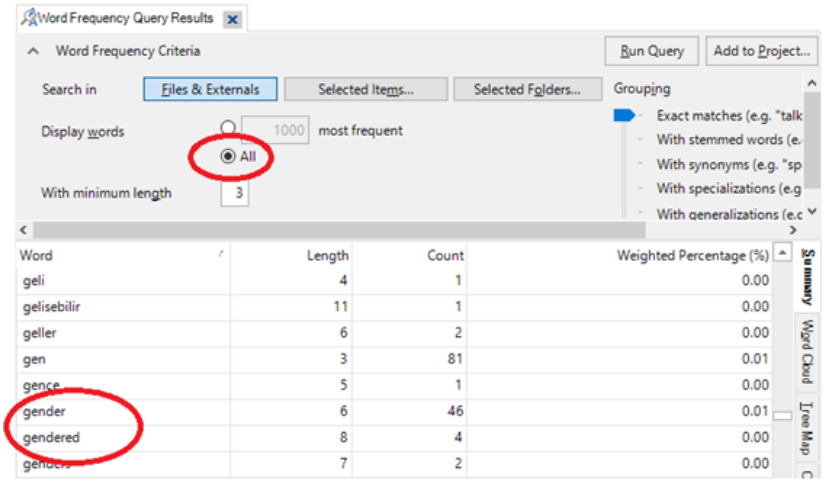


Figure 23: Word Frequency for Gender in Cluster 2

The second cluster analysis considered a list of 104 papers and was used by the corpus linguistic study in Section 6.1. These papers are related to Smart Mobility but have a more technical focus. It presented similar results to the previous section and cluster of papers, including no coded results for 'intersectionality' as a concept in any paper. The word 'intersection' was found in 18 papers, all referring to graphs and technical discussions unrelated to the concept as a research method. Gender and class were employed more than other concepts, as well as race, yet no intersectional analysis was conducted between these concepts.

Figure 23 shows that gender presented at a very low word count and length, only being able to be detected by expanding the search. Mainly, the words employed referred to transport and mobility/technology, as presented in figure 24.

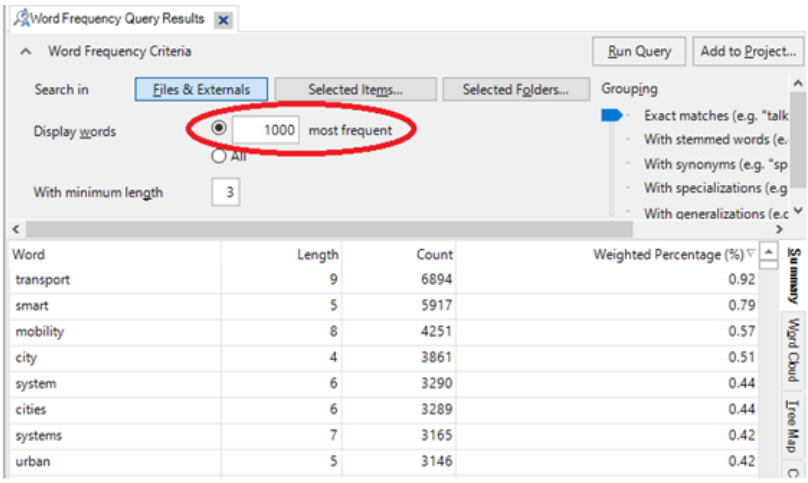


Figure 24: Word Frequency for Transport Related Terms in Cluster 2

Table 10 shows the Reference and Coverage percentage of the set queries between concepts, as presented in our manual. It features all the possible 45 combinations between the selected concepts (gender, race, ethnicity, class, disability, sexual orientation, sexuality, age, nationality and religion).

Table 10: Reference and Coverage results – cluster 2

Race combinations	
References	Coverage
321	0.40%

Class combinations	
References	Coverage
322	0.43%

Disab+Sex+Age+Nat+Religion co.	
References	Coverage
164	0.27%

Ethnicity combinations	
References	Coverage
280	0.32%

Gender combinations	
References	Coverage
343	0.51%

The set query results are well-balanced between gender, class and race as individual concepts employed in the papers. No hierarchy of analysis is present, meaning that concepts are well distributed between all papers through their different subjects. Yet, gender as a concept is still the major concept, by a smaller margin than the last cluster. The use of different social identities as demographic values, with little to no development, has also been a trend in this cluster.

Reference examples and discussion

The Reference results generated more than 150 pages of coded searches. No papers presented any intersectional discussion, which was verified through the coded Reference results and confirmed by analysing their positive and negative results. One paper presented intersectional elements of analysis, but a further investigation showed no development of the concepts and mainly their use as demographic values.

Age is a concept that crossed all papers, as happened with the previous cluster analysis, connected only to demographic variables (like gender and income) or to reinforce other arguments without developing an age-approach to the research. Class appeared in the results in a semantic term, dividing

groups/traits of objects and/or car models. Disability was coded in two papers, also as a demographic value or an undeveloped reference/example. 'Race' presented a false positive as the word referred to competitive races and in relation to cars, not as a social variable.

7.4 Conclusions

With only 2.47% of all papers showed intersectional elements of analysis, it is noticeable, in both clusters, a tendency to privilege one specific concept in their discussion. When other concepts are mentioned, they are not developed and are used generically. Age and gender were favoured in most papers. Yet, they were mainly used as added demographic value to the privileged concept or mentioned as potentialising gendered dynamics, peripheral to it.

The analytical importance given to gender in most papers is shown through NVivo's Reference results in a quantitative way, aside from the phrasal analysis we presented in the sections above. For instance, one paper discussing mobility patterns amongst millennials presented 84, out of which 80 corresponded to age, the defining concept of the authors' generational classification. In doing so, it is expected that age is the main influencer of one's experience, an expectation criticised by intersectional theorists as problematic. Carbado et al (2013) believe that an intersectional analysis is possible even when data appears as non-intersectional. Empirical data can be pointing out to one specific concept, which is not an impediment to understanding its origin and development intersectionally.

That is essential to understand the problems presented in our results, where one concept stands out in comparison to others. No data is intersectional in itself, especially as intersectionality is an area still not in the academic mainstream and it can be affected by research biases, which is the case of defining 'millennial' through age as a defining identity concept. In other cases, more than four concepts were mobilised but not analysed intersectionally, presented as an undeveloped demographic aspect or its scope of influence. Not only research bias and privileged concept data are impediments to an intersectional analysis, but the scope of its proposition.

Many important contributions to intersectional studies are from works focusing on two concepts, allowing for better distribution of time, resources and a focused dynamical insight. Two papers in our analysis presented this, one seeking to understand class and gender and the other gender and age. Although all papers presenting positive results are also analysing gender, they contribute to developing methodologies and frameworks for intersectional studies (Cho et al 2013) and insights into age and class as well. Works like these helps to expose specialism bias in research dating back to colonial roots and the illuminist science still influencing knowledge production to this day (Scott, 1998).

In conclusion, the results display the predominance of gender and age as privileged individual concepts and how intersectional studies need incentive in order to grasp the complex reality of people's identities. Papers which included intersectional elements in their analysis did so by focusing on two concepts, but an intersectional approach is possible in researches where one concept might be prevalent in their data. It also helps to evidence and change specialism bias in research and contribute to understanding how social injustices affects people's lives, identities and inclusion possibilities.

8. Overall conclusions and recommendations

8.1 Summary

Reiterating the contemporary feminist approach of TInnGO, using gender diversity provides a broader approach that enables us to better conceptualise and fight for progressive change. Intersectionality (including class, race, ethnic, age, gender and sexual orientation) emphasizes that things do not exist separately from each other but are complexly interwoven (Finlayson 2016). In such a world, it is not just women that are more capable of reaching full potential, it is everyone. Following from this argument, this deliverable has situated women's R and I outputs in the context of women's career pathways in the Higher Education and Transport Business Ecoystems. This approach has identified key similarities in the position of women. Key points may summarised:

1. Case studies of industry have shown:
    a. Women and those from diverse backgrounds are not given equal opportunities and their working lives are reduced in quality. This significantly effects their leadership opportunities,
    b. Belittling is a subtle form of everyday harassment. This has not been widely recognized in the literature,
    c. Paradigm shifts towards greater diversity in the organization can be created where CEOSs recognize that diversity will lead to competitive advantage,
    d. Sponsorship and mentorship are important for women's career progression and job satisfaction,
    e. Women's networks may fail to deliver,
    f. Managing (gender) diverse teams is difficult,
    g. Gender pay gaps are still an issue,
    h. urgent need to address ethnic diversity,
2. Analysis of UK HEI sector has highlighted:
    a. Slight positive movements towards gender equality as measured by R and I outputs,
    b. failure to embrace and embed diversity in staffing of HEIs,
    c. urgent need to address ethnic diversity.
3. Women's research journeys (Elsevier and TinnGo study):
    a. Women have smaller footprints due to sex related issues such as Matilda effect, motherhood penalty and expectations /culture of care,
    b. Harassment and discrimination is ongoing,
    c. Women need stronger and more effective networks,
    d. Zones of influence for women are significantly smaller.
4. Study of gender and diversity in EU funded projects (especially in transport):
    a. Fewer women as PIs,
    b. Good practices for FP7 and horizon projects,
    c. Lack of detail in how diversity shapes and is embedded into proposals,

d. Lack of available, detailed data regarding gender and ethnicity of teams.

5. Analysis of dissemination outputs of Smart mobility texts:
    a. Little evidence of bias in scripts,
    b. Little evidence of use of intersectionality.

In 2009, based on her work on the development of polysensory environments for autistic children, Woodcock adapted the traditional, user centred, concentric rings models used in ergonomics to a generic one for educational environments. Such a model can be used to systematically identify issues which can impede learning. One innovation of the model was its recognition that 'learning' occurs in a variety of different contexts, and that the learning environment needs to be optimized for each situation. If there are unsurmountable barriers in one of the contexts, the learner will 'opt out' or change strategy to avoid it. In Figure 25, the model has been used to map out the factors which may impede the progress of female researchers.

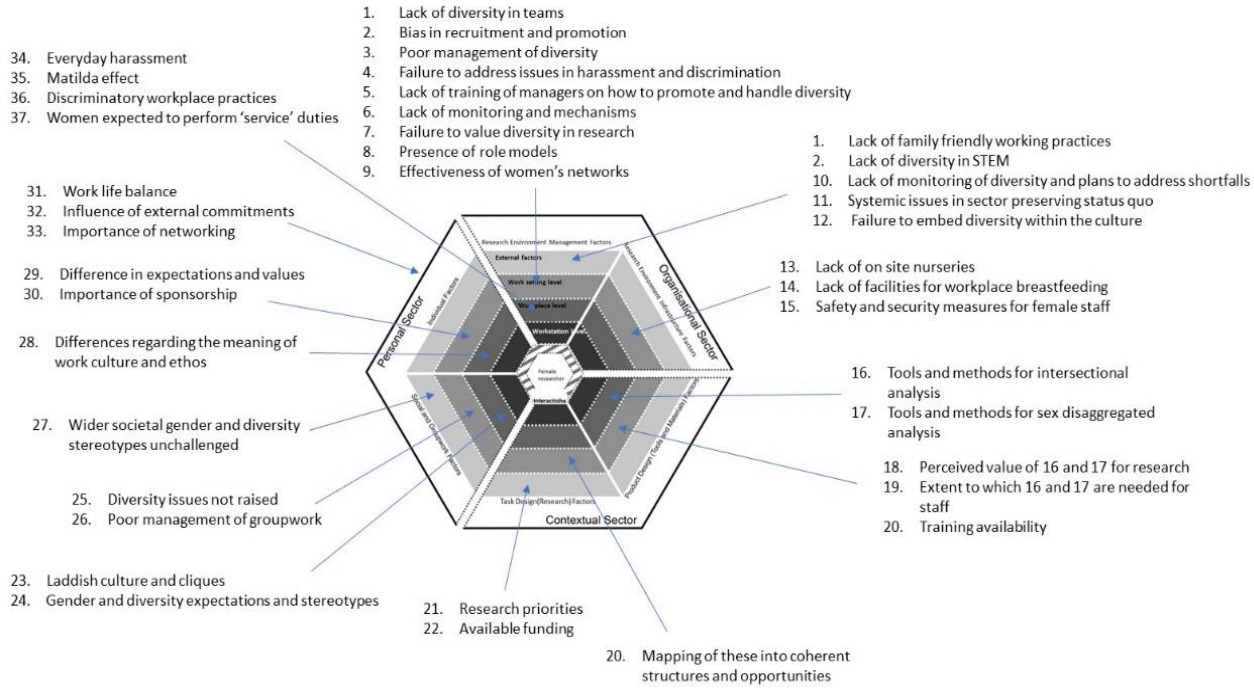


Figure 25: Example of Factors which Impeded Women's Research Careers Mapped on to the H-S Model

Significantly this shows clusters of issues around the outer rings (external and work place setting), in the organizational sector, relating to the management of the research environment, the personal sector, and the design task, which is interpreted here as relating to a sectorial lack of knowledge and methods to support intersectional and sex disaggregated data analysis.

These findings accord with the EC (2012) document on structural change in research institutions which focused on opaqueness in decision-making processes, institutional practices inhibiting career opportunities, unconscious bias in assessing excellence, wasted opportunities and cognitive errors in knowledge, technology and innovation, and employment practices and policies. They proposed solutions as shown in Table 11 and a series of activities focused at EC level, European wide

organizations, member states and gatekeepers of scientific excellence, universities and scientific institutions.

Area of focus	Proposed solutions	D9.4 would stress the need to
Making decision-making transparent	Making in-house women more visible	
	Gender-balancing committees	
	Making nomination and election to committees and boards more transparent	
Removing unconscious bias from institutional practices	Training (up-skilling) the decision makers	x
	Funding comprehensive structural change efforts designed to create models for effective practice	
	Rewarding effective practices and providing recognition,	
	Creating accountability measures such as periodic reporting on key indicators	x
Promoting excellence through diversity	Enhanced cognitive creativity and more effective capacity in collaborative working and problem-solving in research teams and project consortia	x
	Enhanced scientific human capital for knowledge production and utilization	
	Improved scientific cultures (by diversifying the values of the participants in scientific discourse and diluting prevailing implicit stereotypes)	x
Improving research by integrating a gender perspective	Developing, communicating and implementing standards for the incorporation of sex and gender analysis into basic and applied sciences	x
	Integrating gender into the whole process of knowledge transfer, thereby introducing different perspectives for more innovation potential	x
	Supporting specific research on gender and women to feed into all disciplines and research subjects	x
Modernising human resources management and the working environment	Through legislation relating to the pay gap, parental leave, societal structures of inequality, monitoring, enabling mobility, reconciling the quality of work and family life	x

Table 11: Structural Changes in HEI revisited

The key takeaways are

- The promotion by the EU of the need to include gender in transport related work,
- The slowness of the rate of change across the TBE,
- The need for recommendations and guidance to consolidate and solidify the progress made to date,
- Lack of wider diversity (e.g. ethnicity, ability)

The need to address wider diversity issues in the Transport Business Ecosystem (including HEI) at this time is especially relevant given the remit of Smart Mobility within the wider context of urban development and inclusivity/social equity.

8.2 Recommendations

Using authorship of a paper or leadership of a project/department can serve as a proxy measure for the level of influence a woman can have. Women face more barriers to achieving such a position, as such the first set of recommendation relates to the need to embed diversity in organizational structures following Mor Barak's (2000) definition of the 'inclusive workplaces'. The deliverable shows that some industries and HEIs do not support diversity in their workforce, i.e. they do not integrate and use a heterogeneous work force at all levels of the organization. Changes may be made to internal processes

without an expanded notion of incorporating diversity into the ethos of the company or looking at it in relation to wider society.

8.2.1 Organisational change; creating learning organisations

Key issues have been identified across the TBE (including HEIs), which point for the need for organisational change to widen diversity. The H2020 CiviTAS SUITS project addresses capacity building in another part of the TBE, namely small to medium local authorities (LAs). LAs need to transform their organisations if they are to develop effective sustainable mobility solutions as part of the Smart City of the future. To assist them in this SUITS' developed and successfully implemented an organisational change programme (based on Kotter's (1996) process for creating charge) in 9 LAs (Kalamaria (Greece), Valencia (Spain), Alba Iulia (Romania), Rome and Turin (Italy) and West Midlands (UK), Palanga (Romania), Stuttgart and Dachau (Germany)) to assist their transition to becoming learning organisations (Budhdeo et al., 2019; Woodcock et al., 2019; Nienaber et al (submitted). The 8 transferable steps include:

1. Form of a powerful coalition within the organisation,
2. Jointly develop a change vision,
3. Identify the correct change agent as a driver responsible for making change happen,
4. Communicate the vision widely and involve colleagues in defining concrete goals and activities to achieve the vision,
5. Let the change happen in small increments and keep up the momentum over the long term,
6. Celebrate quick wins and keep reinforcing the vision,
7. Learn from the process and the results - adapt goals and activities if necessary,
8. Anchor the changes and the change process in corporate culture, e.g. written guidelines, new forms of communication or planning inside the local authority.

Having been proven to work in 'traditional' organisations within the TBE across Europe, it is suggested that such an approach is used in conjunction with Gender and Diversity mainstreaming to develop workplace diversity to develop learning organisations which are responsive and responsible to diversity issues.

8.2.2 For the TBE

Recommendations address the needs to take a holistic approach to understanding diversity within the organization and its fit with changing society and the wider demographics in which it sits. Top level buy in is needed to develop a business cases and objectives for diversity within the organization (as was exemplified in the industry case studies for cybersecurity, finance and automotive design) using a more holistic approach to addressing gender diversity (see Figure 4) and Gender and Diversity Mainstreaming. Starting point for this could include:

- The creation of affinity and diversity task forces,
- Using a diversity index to develop gender and diversity action plans,

- Cultural and diversity competence training,
- Audit of human resources procedures for recruitment, promotion and appraisal.
- Creation of task forces to implement organizational change.

8.2.3 For Higher Education Institutions

Figure 25 and Table 11 stresses the importance of change within HEIs in the 'research environment management sector'. It is common for researchers and other members of staff to rise to managerial level because of their performance/expertise in a very narrow domain. This does not mean they automatically become good managers on promotion. While they are learning this additional craft, they make mistakes, which may lead to resignations, favoritism, cronyism etc. The deliverable has shown the benefits of, along with the difficulties of, managing diverse teams. Therefore, a key recommendation of this deliverable is for training to be developed to fill this gap. This could be applied at national or institutional level, but it could form an essential element in mandatory training provided to prospective or new PIs.

8.2.3.1. Reducing lack of diversity in the HEI

1. Realign core objectives to develop a holistic approach to cultural diversity,
2. Set Key Performance Indicators for gender and diversity, and measure progress towards these,
3. Develop of Gender and Diversity Action Plans e.g. task forces,
4. Use gender and diversity mainstreaming approaches throughout the university to address organizational norms,
5. Use current or develop new mechanisms to promote greater diversity and support staff from more diverse groups,
6. Transfer knowledge from industry with respect to, for example:
    - creating inclusive workplaces and support advancement of women,
    - removing bias in recruitment,
    - understanding female pipeline and progression,
    - tying diversity to business goals throughout the organisation (not just for student numbers),
    - increase satisfaction and succession through mentorship,
    - spotting high-performance women, and enabling them to rise to senior levels eg through training, mentorship and sponsorship
    - gap analysis to make sure events are accessible to women,
7. End gender pay inequity using appraisal systems which are based on competence,
8. Value all educational backgrounds,
9. Create an unbiased and nonprejudicial complaints systm
10. Reduce disproportionate gaps in service duties . Guarino and Borden (2017) suggest:
    - monitoring of service requests and allocations,

- mentoring female faculty to be more selective in their service-related choices and cultivate their ability to say no,
- increase overall awareness of this issue to improve overall attitudes toward service loads,
- remove traces of gender bias from service expectations and enable both women and men to accept or decline service requests with equal ease and impunity,
- Internal auditing.

8.2.3.2 For research centres

1. Reduce the motherhood penalty by:
   - paid maternity leave for graduate students,
   - faculty family friendly program for families with small children, including modified duties and tenure clock stoppage following birth or adoption and part-time options,
   - child and infant care options, reentry services for postdocs and relocation services,
   - postponement and suspension of grants for childbirth, adoption and family leave,
   - providing supplements to cover research technicians to maintain labs while principal investigators are on leave,
   - publication and promotion of entitlements,
   - better support for home working.
2. Increase the research footprint of women
   - Eliminating the Matilda effect,
   - Increasing sponsorship (internally),
   - Increasing external mentorship opportunities,
   - Analysis of/enabling of more successful networks e.g. using communities of practice,
   - Fairer allocation of service duties,
   - Equal and fairer treatment, publicity and promotion of research led by women,
   - Gender actions plan and gender mainstreaming processes in research centres,
   - Understanding the research case for gender diversity and more creative thinking in research,
3. Better management of research staff e.g. look at the roles played by men and women in research teams, in leadership and authorship, create a zero-tolerance environment in relation to bullying, harassment and other forms of discrimination, reduce male-oriented language and media which promotes a “boy’s club” , create an inclusive social calendar,
4. Inclusivity and diversity should be intrinsically written into research priorities,
5. Research managers should receive training on the creation and management of diverse research teams which will enable them to get the most out of their teams,
6. Demonstrate and publicise good practice regarding use of sex disaggregated data and intersectional analysis,

7. Conduct a capability audit on research staff regarding their familiarization with sex disaggregated data and intersectional analysis and develop training material specific research priorities of the centre.

8.2.4. For funding bodies

This should include additional training to supplement the recommendations from, for example, the GenderedInnovations project, the existing Gender Toolkit and H2020 guidelines, relating to

- Understanding the effects of diversity on research questions, methods, analysis and impact
- Reporting of intersectional activities
- Use of gender and diversity mainstreaming and using gender and diversity action plans to guide the research and staff development
- Team management

Along with this are recommendations that:

1. a named section on gender and intersectionality be included in proposals, and in all reports (interim and final), showing how research questions and methods have been used to assess the degree to which the differences between male, female and other gender identities might shape research outcomes,
2. advocating for policies that link the diversity of teams and research questions to funding success,
3. guides be produced for evaluators on how to mark this section, and it is weighted in evaluation.

This happens in some cases, and on some calls, and transport/mobility is exemplary in this. However, anecdotal evidence collected during the course of this deliverable suggests this does not happen for other domains or with other research funding at national or international level. If it is not a compulsory/mandatory element, it will simply be ignored.

4. Project information should include not only information about the gender of the PI and project staff but also other characteristics (such as ethnicity) and that this information should be available for analysis
5. Previous proposals are subject to meta-analysis using quantitative and qualitative analysis to produce recommendations and guidelines on diversity

Funding bodies possess a wealth of knowledge embedded in the form of proposals. Some of this is quantifiable and available for inspection and analysis, but deeper insights can be achieved from closer inspection of material. Diversity and intersectionality are relatively new cross cutting themes (embracing issues such as impact, inclusivity and user centred design). Their importance will not lessen, and they will be extended into other areas. Further clarity/permissions/calls are needed to enable the research community to access these with a view to improving practice.

5. Gender-equitable research consortia should be actively incentivised in European transport research.

6. Develop a gender action plan for equality, diversity and inclusion (for example, Research Councils UK (RCUK) action plan[57] which focuses on Leading by example:
    - through achieving improved diversity in the membership of RCUK Councils, advisory and peer review bodies[58];
    - ensuring that RCUK has a diverse workforce equipped to act as ambassadors for equality, diversity and inclusion in all that they do.
    - Challenging bias and ensuring fair and inclusive funding processes:
    - raise awareness of and take steps to remove the impact of unintentional bias in RCUK systems, processes, behaviours and cultures;
    - ensure RCUK funding is not influenced by the gender of the applicant or by any other protected characteristics;
    - Leading and supporting change in the research community: Show strong leadership to change the culture, practices and makeup of the research community
7. Provide greater transparency in relation to the gender and ethnicity of award applicants, holders and research teams. Such data is gathered by projects as part of the required reporting process. Yet it is not publicly available.

8.2.5 Training opportunities

Sex, gender and intersectional analysis

The GenderInnovations project advocate for greater use of and proficiency in sex and gender analysis and argue that university selection panels should also ask applicants about their experience with this form of analysis and its effects) and that peer reviewers should look for this in applications. However, little information is available on how to undertake this. Some online resources gender and intersectional analysis are included in Appendix 6.

Managing diverse teams

As mentioned previously, research managers may not have the skill set needed to equip them to manage and create diverse teams. Continuous in house or external training, supported by networks and action learning sets are needed for all research managers. This is especially needed to encourage contributions of women and those from diverse backgrounds and other disciplines.

PI management skills in EU funded projects

Given the EU's commitment to gender equality and diversity it is also recommended that PIs, or even prospective PIs undertake project management training as part of the application process, in order for them to address equality and diversity issues during the course of the project, and promote the career trajectories of staff on the project. Currently, there is simply a requirement to report gender of makeup

[57] https://www.ukri.org/files/legacy/skills/action-plan-edi-2016/

[58] From RCUK annual report (the https://www.ukri.org/files/about/ukri-annual-report-and-accounts-2018-2019-pdf/RCUK) gender split is 43% female and 57%, but within science teams female representation drops to 35 %. only 6% of staff belong to the Black, Asian, Mixed or other Ethnic group which is below the national UK figure (13%) and 2% declare themselves disabled. Greater gender disparities are found at higher levels within the organisation

of the project as part of CP. This could be further enhanced by more information and a clearer role with the project management work package to take responsibility for staff development. This would strengthen the research base of the EU if it was accepted across all projects.

Continual Professional Development

This and previous sections point to the need for a new qualification/level of competence for those wishing to lead research teams and projects after their PhD. Gaining a postgraduate qualification indicates that the holder may have identified and have expertise in an innovative/interesting area. Research management skills are 'picked up along the way' e.g. through mirroring the behaviour of supervisors, departmental heads, attending ad hoc courses and learning by trial and error.

Given the amount of investment in research, the need for impact, wider diversity and, and the barriers (female) research staff face in fulfilling their potential, the final recommendation of this deliverable is:

- the development of an EU wide research competency framework,
- leading to a named qualification (based on a portfolio of practice)
- which is built on the 3-fold relationship between women and research (European Commission, 2014) and
- provides training and mentorship for those wishing to be research leaders.

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APPENDICES

Appendix 1: A personal statement

The above documents show a concerted effort by the EU to address gender equality within research environments and how women and other groups are considered in research. Having been part of this movement from an early career researcher (ECR) to leader of international projects the primary author of this deliverable and PI of TInnGO has witnessed and benefitted from these changes. As an ECR on national and FP5 and FP6 projects in the ICT domain, I was in a substantial minority. Identifying with end users, my work was side-lined as not important and an unnecessary add in. User centred design approaches were not adhered to, and end user evaluation was squeezed into a short window of opportunity at the end of the project, as IT systems invariably failed to deliver on time. I was given tasks related to dissemination and communication, formatting of documents, photocopying reports and worked longer hours, on less pay than many of the project partners. My work has been plagiarised; I have been removed from authorship of publications.

As a woman, advocating user centred design (not seen as core to IT or engineering), I have been marginalised throughout my career. Promotion has come, but I have been given the impression that 'a woman' was needed to improve the gender balance. Salaries have never been openly disclosed, but at one period my own was substantially lower than that of my male colleagues.

Good mentors have helped (as confirmed in studies cited later in this report) and inspired me with a 'go for it' attitude, along with support from my host institution and EU calls in which I see that there is scope to address gender and diversity in transport. After a career break to raise a young family I was fortunate enough to be awarded a Daphne Jackson Fellowship working with a female transport professor. This gave rise to my first national research award, back in 1999, looking at the safety and security of women drivers and passengers in the UK. During a keynote in the WiiT conference (2019) it was mentioned that women researching women's issues in transport was highly criticised and seen as detrimental to one's career. I did not realise this at the time, but I remember a critique of my research replete with phrases such as 'witches of the highway' which left me guilty that the funding body had been called into disrepute for raising the issue. In this 1999 project we dealt with gender inequalities in accident severity, road rage incidents faced by women, gender bias in academic reports on transport and the focus of research (e.g. at the time the emphasis was on reducing traffic incidents of boy racers) and gender bias in transport design. 20 years later the same problems remain.

Over the course of three projects FP7 METPEX, H2020 CIVITAS SUITS and H2020 TInnGO), the gender and diversity of my research teams has shifted from 70% male to almost all women, both as RAs and WP leaders, so more women are coming through the system. All projects combine a strong technological innovation part with a need to develop transport that is sustainable and inclusive.

Across the EU there has also been a paradigm shift away from transport per se, to transport and mobility as an enabler – a difference which is sometimes lacking in the work of my more engineering-oriented colleagues. That transport provision needs to be inclusive and consider wider issues of society is one which resonates deeply with the inclusive workplace (Mor Barak, 2000), leading me to wonder if

transport organisations which display a lack of diversity within themselves are capable of relating to and designing for wider society.

In terms of my career path, I have always been an outlier as an ergonomist, not fitting easily within engineering or design. In my former transport research centre, despite holding more awards than many of my more senior male colleagues my stream of activity is not seen as especially relevant to the key concerns of smart transport. It is marginally more acceptance in transport design, but sustainable transport is viewed as a poor relation compared to high performance vehicles.

In both engineering and design, there are very few women, In industrial design just one female of staff. I have known female members of staff routinely ghost write publications for senior male colleagues, and be so overburdened with service work that they have abandoned their research careers and become little more than administrators.

Appendix 2: On line survey

Survey Questions

1. What is your degree (year and subject)
2. What are your Postgrad qualifications (year and subject)?
3. Please describe your research area in a couple of sentences
5. What is your current position (please tick all that apply)?
5.b. Please provide the website for your project: Optional
5.c. Please provide the funder of your project:
6. Please provide a brief description of the project:
7. What role do you have in your current project?

Overview of your career

8. What are your career aspirations and main motivations?
9. Who or what has been your inspiration?

In relation to your current role

Considering up to three recent research projects you were involved, focus on the most significant ones on the development of your professional skills and/or the most demanding/time consuming. First section refers to your current role.

10. How were you recruited to the team/group and was this decided?
11. If you know the gender composition of your team, please provide it here
12. What is the age and gender of the Project Leader? □ Required
13. What is the age and gender of the management team? □ Required
14. What is the age and gender of the support staff? □ Required
15. What is the age and gender of the work package or theme leaders? □ Required

Please think about a second research project in which you were involved. You can skip this page if not appropriate (optional)

16. Please provide a brief description of the project and its website.
17. What is/was your role?
18. How were you recruited to the team/group and how was this decided?
19. If you know the gender composition of your team, please provide it here (in percentage, if possible):
20. What is the age and gender of the Project Leader?
21. What is the age and gender of the management team?
22. What is the age and gender of the support staff?
23. What is the age and gender of the work package or theme leaders?

Project 3 (optional)

Please think about a third research project in which you were involved. You can skip this page if not appropriate.

24. Please provide a brief description of the project and its website.
25. What is/was your role?
26. How were you recruited to the team/group and how was it decided?
27. If you know the gender composition of your team, please provide it here (in percentage, if possible):
28. What is the age and gender of the Project Leader?
29. What is the age and gender of the management team?
30. What is the age and gender of support staff?
31. What is the age and gender of work package or theme leaders?
Thank you for sharing your experiences so far. We have a few more questions:
32. Do you apply gender and diversity perspective to your research?
32.a. Can you please tell us more?
32.b. How are they dealt with e.g. in terms of analysis, documents, publications?
32.c. Who is responsible for them?
Questions 36, 37, 38 and especially 39, might be triggering due to the nature of their content. Please consider if this might be an issue to you before proceeding.
33. Are you aware of any gender related pay gaps in your organization?
33.a. Please tell us the reasons for your answer:
34. Are you aware of any gender equality policies in your organisation?
34.a. If yes, what do they cover?
35. Are you aware of any glass ceilings (an invisible obstacle/barrier) or other barriers to your career?
35.a. Please comment:
35.b. How are these evidenced and how have they affected you?
36. Have you ever been denied or given opportunities based on your gender?
36.a. Please give details:
37. Have you ever felt there are certain things expected of you because of your gender? (e.g. taking the meeting minutes, keeping the kitchen clean)
37.a. If you chose Yes, please tell us more
38. Have you or your colleagues ever been subject to bullying? (Optional)
38.a. If appropriate, please tell us more: (Optional)
39. Have you or your colleagues ever been subjected to sexual harassment at work?
39.a. If appropriate, please tell us more: (Optional)
40. Have you received any mentorship of gender-based training? □ Required
40.a. Please give more details:
Transport related publications
This section of the questionnaire will be handled separately to ensure your anonymity. It is very difficult to find information relating to gender of authors on academic publications as this is not routinely collected. Once we have a list of the publications we will put them together as a corpus for further linguistic evaluation.
41. Do you have any publications?

41.a. List up to five of your latest publications below. Please provide the full citation for each reference as it appears in the publication. Label the gender of each author. Provide a brief commentary for each publication on how the order of authorship was determined e.g. by level of contribution, alphabetical, seniority.

Standard Demographic Information as per Diamond socio-demographic questionnaire

All questions are optional. The socio demographic questions have been provided by our sister EU project, DIAMOND, to help to collect 'background data' on respondents in the same way, allowing for data to be more easily compared.

Appendix II

Research areas described by Participants

Quotes from Participants:

P_1	Environmental aspects of street design and regulations.
P_3	Travel satisfaction, service quality, wellbeing.
P_4	I do research on urban and regional governance, urban and regional planning and transport policy and planning, mainly departing in urban political economy.
P_5	Understanding travel behavior and people's preconditions for transport mode choices, especially vulnerable people such as older, rural citizens, poor and young unemployed.
P_6	Individual dimension and perspectives in travel e.g. Perceptions, accessibility and wellbeing.
P_7	Mobility and accessibility for older people and people with disabilities.
P_8	Mobility. Older people as actors and travelers. Gender and diversity in the transport sector. Interaction between actors in traffic environments and transport planning. Social impact assessment and Gender impact assessment in transport planning. Qualitative research methods.
P_9	I'm working on planning logistics facilities and urban freight in metro areas, on "productive metro areas", goods mobility (freight flows).
P_10	Children's and families' geographies/nobilities, interested in intersectional inequalities related to mobilities and transport.
P_11	Optimization of Hybrid Powertrain.
P_12	My research area involves energy and resources efficiency in manufacturing processes; industry 4 technologies to enhance processes and workforce capabilities; modelling and optimization algorithms.
P_13	Sustainable Urban Transport with focus on micro mobility and active travel modes.
P_14	Mobility management and transport operations.
P_15	User orientation; usability of provided tools, information and devices.
P_16	Public transport policy and strategy formation and social impact assessment. Strategies of transport business and its social impact assessment.
P_17	My research areas are within the transport sector and in social psychology and pedagogy. More specified I study driver education, drivers mental model of new technology, safety culture etc.
P_18	Sustainable mobility; Planning for bicycle and pedestrian traffic; Gender Planning; Moderation.
P_19	Knowledge management and e-Learning in the sector of public transport.
P_20	Currently Transport Strategy.
P_21	Research area is regional sustainable development and European integration.

P_22 Increasing the ability and capacity of small to medium sized cities to implement sustainable future mobility. A H2020 Civitas project including 8 cities in 7 EU countries including the UK.

P_23 Smart and Sustainable Mobility, Cycling, E-Mobility, Digital Cultures, Sound Studies, Creative Economy.

P_24 Information and human resources.

P_25 My research regards the interaction between automated vehicles and vulnerable road users.

P_26 Safety of vulnerable road users in mixed traffic environments (with manually driven and autonomous vehicles).

P_27 Business modeling and technology transfer.

P_28 I am architect, Ph.D. in Urban planning (PhD thesis: "Mobility and Urban Form"), Associate Professor, founder and coordinator of the "Urban Mobility" Master Program at "Ion Mincu" (UMM) University of Architecture and Urban Planning – Bucharest, Romania. During my activity I wrote 2 books and 24 articles, I have been co-author at 9 other books, 11 national research studies, 21 planning studies, in urban mobility and urban planning fields. I deeply investigated the urban planning insight on urban mobility issues.

P_29 Transport, logistics and urban mobility.

P_30 Working in transport, users' perception, freight movement.

P_31 Experience and knowledge to mainstream Gender in different sectors: public admin-situation; energy, health, transport, urbanism, agriculture, water and sanitation, connection with Climate Change, Disaster Risk Reduction (DRR); Nationally Determined Contribution etc.

Appendix III

Glass Ceiling and barriers to career development

Quotes from Participants

P_1 It has been obvious many times that women are treated with less respect. On the other hand I have from the start of my career been offered different kinds of positions as soon as they have understood my competence and work capacity.

P_2 My research is considered less important and I have received no support for career development.

P_3 Yes. In the Swedish academy there are still just 29 percent female professors. A development is going on but on a snail's pace. The proportion of female professors increased from 19 percent in 2008 to 29 percent in 2019 (Swedish Higher Education Authority: https://english.uka.se/).

P_4 Becoming a professor or get a management position is more difficult for young women who have a family (young children)

P_5 Professors are mostly male, teaching staff predominantly female. Other more subtle barriers exist, but are for the most part seen as something else (individualized, i.e. seen as non-structural and non-gendered).

P_6 In the engineering environment, women are still seen as fragile and not able to perform some hands-on tasks.

P_7 Age and years in the organization

P_8 Women in my organization have much less opportunity to advance to managers

P_9 in the early days of employment but this has improved over time

P_10 Step to Professor is challenging

P_11 Numbers in my organization shows that women are in a low number in high job position

P_12 Transport remains a 'boys club'. lots of networking, lots of interest in technology not so much on people also classism is rife within the sector and the EU, 'they can tell by looking at a woman whether she went to a public school'

How are these evidenced and how have they affected you?

Quotes from Participants

P_1 The way I have been addressed by primarily older men when I was younger - it doesn't happen much anymore (but there are two kinds - those trying to diminish me and those who have supported me).

P_2 It is unclear if this is due to my gender, I believe this is a major contributing factor. I am very much behind in my career development considering where I ought to be.

P_3 The gender distribution in working life is reflected to a relatively high extent in the education programs at the university, where a relatively equal gender distribution prevails, or where women are in the majority, in most of the programs. However, one area, the field of technology, is still clearly dominated by men and by the students of Swedish engineering programs (college engineer and civil engineer), women make up only about 30 percent of students. Note that engineering education and officer training are now the only vocational programs in the university where men are in the majority and where the gender balance is outside the 60 percent - 40 percent criterion.
I did my university educations in the 1980s and 1990s and then the proportion of women was even lower, thus I did not choose STEM but I successively moved into the area of humans in Technology-Design-Communication from my profession first as journalist and master student in communication studies and then as doctoral student and finally as Ph.D. and senior researcher.

P_4 I won't be replace during my maternity leave, so either I will have to assume my responsibilities while I'll be away, either I leave things unmanaged (mostly my teaching responsibilities)

P_5 They are evidenced in an embodiment, in the daily lives of women. Sometimes just felt, mostly unnoticed and not always analyzed as such.

P_6 In my daily routine, also validated when I attend Women in STEM events.

P_7 Not evidenced, impose higher work load

P_8 More male leader coming from outside. It affects my trust in the leadership

P_9 In the mid-90s, application for departmental positions - at that time such positions were not considered suitable for women (with children)

P_10 E.g. difficulty in acquiring PhD students, when completions are key to career progress

P_11 Statistics show this.

P_12 I was pushed forward into a leadership role because of my gender, I was asked to remain in a center because my leaving would upset the balance gender

Appendix IV

Gender Discrimination

Have you ever been denied or given opportunities based on your gender?

Quotes from Participants

P_1	I was questioned by a colleague when applying for professor. I'm not sure if this was because of gender.
P_2	It is not clear if the opportunities I have been given and denied are due to gender, but I cannot rule it out.
P_3	I have not been given opportunities based on my skills.
P_4	Not that I am aware of
P_5	Not that I have understood
P_6	Not very clear in working life, but implicitly. As a student with male teachers, I found difficulties, and as a young woman who wanted to make progress in working life (in the 1980s). But not now 2020, I am established myself in a research area. However young women still feel these sort of difficulties.
P_7	I got my position while I was competing with other male candidates.
P_8	Of course, given that we live in the gender order, this is self-evident. It happens all the time, what and how it is done depends on the way you want to interpret/analyze it.
P_10	I don't think so.
P_11	I'm not aware of any situations in which this might have been the case.
P_12	none
P_13	Not that I know of; in any case not obvious There is a requirement that women should be given preferential employment if they are equally qualified. One never knows whether this regulation was applied at the time of recruitment.
P_14	Never
P_15	There are so many so it becomes normal. From not being listened to, being told to be silent or not invited to be part of a team or getting a pay raise or higher position
P_16	Denied: In the mid-90s, application for departmental positions - at that time such positions were not considered suitable for women (with children)
P_18	In this organization, I can't say at this moment in time as am relatively new in post.
P_19	I have never been denied or given opportunities based on my gender.
P_20	A very long time ago in the 80's I was denied a job as a local authority researcher because the interviewers thought combining a part- time job with childcare would be too hard to do, and told me that is why they gave the job to a man.
P_21	Always difficult to tell, but I think no.
P_22	no problems
P_23	I have not had much experience yet. Although, I do remember that during my undergraduate final project I had some issues pursuing it because it related to feminine hygiene products and my supervisor (I only had male lecturers back then) did not feel comfortable with the research area.
P_24	Not that I am aware of
P_26	I haven't been denied or given opportunities based on my gender.

P_27 1. Excluded from meetings
2. Horizontal bullying by colleagues who effectively shut me out
3. Have had to work harder than make colleagues. For many years my salary and position was below what it should have been.

Have you ever felt there are certain things expected of you because of your gender? (e.g. taking the meeting minutes, keeping the kitchen clean). If yes, please comment.

Quotes from Participants

P_1 In my early career that was obvious (notes, coffee etc) but I simply refused by claiming I was a bad choice taking bad notes and making terrible coffee. Worked fairly well.
P_2 It happens. I always oppose and/or ignore.
P_3 Taking a large load of teaching. Never say not to extra work tasks.
P_4 I have not noticed it for myself but for others around me in the same position as me.
P_5 I am blue eyed, but this probably happens sometimes.
P_6 Yes, more when I was younger and less experienced.
P_7 Mostly organizational/administrative responsibilities (meetings, graduation, etc.)
P_8 Providing care and being caregiving to students and colleagues among many other things.
P_9 It is mostly the women (and I) who take social responsibility and create well-being at work and in the industry
P_10 Taking meeting minutes!
P_12 Sometimes there is this perception, but I am not sure if it is related to the gender or to the job position.
P_13 Yes to all.

Appendix V

Bullying and sexual harassment

Have you or your colleagues ever been subject to bullying?

Quotes from Participants

P_1 Ostracism and stigmatization, mainly.
P_2 I don´t know any details but I am sure that someone has experienced it. One has experienced that she has a lower salary than men in the same age.
P_3 I have heard of incidents, such as bullying or harassments, but I am not aware of any such things at my workplace.
P_4 I only speak for myself
P_5 This occurred some years ago. Not at my present position and organization.
P_6 By my former head of the unit (man), never reported it

P_8	Horizontal bullying (by those at the same level of the organization). I did not report it. I have sometimes not wanted to go into work because it is such an overtly male environment

Have you or your colleagues ever been subjected to sexual harassment at work

If appropriate, please tell us more:

Quotes from Participants

P_1	Intense flirting, subtle sexual invitations.
P_2	I am not aware of any.
P_3	See previous answer
P_4	I only speak for myself.
P_5	This occurred some years ago. Not at my present position and organization.
P_6	I am previous work I faced constant sexual and psychological harassment from my boss. He was a bit unstable mood and thought I belong to him.
P_7	Verbal pick-up lines; insinuations.
P_8	A very long time ago in the 70's and 80's it was commonplace in industry but I have never had this experience as an academic.
P_10	Over the years there have been several instances of males acting inappropriately towards female colleagues and students,

Appendix 3: Dataset of PIs by Gender

ID	Acronym	Coordinator	PI Gender	Organisation Code	Topics	Start Data	Total Cost	Call	Funding Scheme	Coordin. country	#organisations
688900	ADASANDME	Anna Anund	F	HES	MG-3.6a-2015	01/09/2016	9,609,700.00 €	H2020-MG-2015_TwoStages	RIA	SE	10
690705	AutoMate	Andreas Luedtke	M	HES	MG-3.6a-2015	01/09/2016	4,918,426.25 €	H2020-MG-2015_TwoStages	RIA	DE	4
769033	AVENUE	Dimitri KONSTANTAS	M	HES	ART-07-2017	01/05/2018	20,031,244.50 €	H2020-ART-2017-Two-Stages	IA	CH	7
636412	CIPTEC	Aristotelis Naniopoulos	M	HES	MG-5.3-2014	01/05/2015	3,498,350.00 €	H2020-MG-2014_TwoStages	RIA	EL	7
723194	Cities-4-People	Julie Jo Nygaard	F	HES	MG-4.5-2016	01/06/2017	3,999,937.50 €	H2020-MG-2016-Two-Stages	RIA	DK	7
769086	CityChangerCargoBik	Susanne Wrighton	F	REC	MG-4.1-2017	01/09/2018	3,920,712.50 €	H2020-MG-2017-Two-Stages	IA	AT	15
690699	CIVITAS ECCENTRIC	Francisco José López Carmona	M	HES	MG-5.5a-2015	01/09/2016	19,307,702.27 €	H2020-MG-2015_TwoStages	IA	ES	7
723201	CoEXist	Bernard Gyergyay	M	PRC	ART-05-2016	01/05/2017	3,474,067.50 €	H2020-ART-2016-Two-Stages	RIA	DE	7
636573	CREATE	Peter Jones	M	HES	MG-5.3-2014	01/06/2015	3,981,461.25 €	H2020-MG-2014_TwoStages	RIA	UK	11
689031	DESTINATIONS	Claudio Mantero	M	OTH	MG-5.5a-2015	01/09/2016	20,082,574.32 €	H2020-MG-2015_TwoStages	IA	PT	11
824326	DIAMOND	Francisco Santarremigia	M	HES	MG-4-3-2018	01/11/2018	2,628,408.75 €	H2020-MG-2018-SingleStage-INEA	RIA	ES	8
815001	DriveToTheFuture	Evangelia Gaitanidou	F	HES	MG-3-3-2018	01/05/2019	3,998,612.50 €	H2020-MG-2018-TwoStages	RIA	EL	13
636012	ELIPTIC	Hendrik Koch	M	HES	MG-5.1-2014	01/06/2015	5,988,745.35 €	H2020-MG-2014_TwoStages	RIA	DE	8
769926	ELVITEN	Angelos Amditis	M	HES	GV-10-2017	01/11/2017	9,633,126.79 €	H2020-GV-2017	IA	EL	9
636249	EMPOWER	Claire Pickerden	F	HES	MG-5.1-2014	01/05/2015	4,898,621.00 €	H2020-MG-2014_TwoStages	RIA	UK	6
635998	FLOW	Bonnie Fenton	F	OTH	MG-5.3-2014	01/05/2015	3,781,697.38 €	H2020-MG-2014_TwoStages	RIA	DE	8
824273	GECKO	Yannick Bousse	M	OTH	MG-4-1-2018	01/12/2018	1,996,781.25 €	H2020-MG-2018-SingleStage-INEA	CSA	BE	6
769016	GreenCharge	Joe Gorman	M	HES	MG-4.2-2017	01/09/2018	5,722,980.00 €	H2020-MG-2017-Two-Stages	IA	NO	6
769177	Handshake	Mario Gualdi	M	OTH	MG-4.1-2017	01/09/2018	4,998,593.75 €	H2020-MG-2017-Two-Stages	IA	IT	12
815269	HARMONY	Maria Kamargianni	F	HES	LC-MG-1-2-2018	01/06/2019	7,649,645.25 €	H2020-MG-2018-TwoStages	RIA	UK	9
636537	HIGHTS	Stefano Severi	M	HES	MG-3.5a-2014	01/05/2015	5,999,616.25 €	H2020-MG-2014_TwoStages	RIA	DE	5
769819	HiReach	stefano borgato	M	OTH	MG-8-4-2017	01/10/2017	2,024,875.00 €	H2020-MG-2017-SingleStage-INEA	RIA	IT	5
770115	INCLUSION	Marco Boero	M	OTH	MG-8-4-2017	01/10/2017	2,969,007.50 €	H2020-MG-2017-SingleStage-INEA	RIA	IT	7
769638	INTEND	Eleni Anoyrkati	F	PRC	MG-8-7-2017	01/10/2017	499,968.75 €	H2020-MG-2017-SingleStage-RTD-MOV	CSA	UK	4
774199	IRIS	Haye Folkertsma	M	HES	SCC-1-2016-2017	01/10/2017	20,769,279.77 €	H2020-SCC-2017	IA	NL	9
770038	LeMO	Rajendra Akerkar	M	HES	MG-8-2-2017	01/11/2017	1,492,627.50 €	H2020-MG-2017-SingleStage-INEA	CSA	NO	4
690727	MAVEN	robbin.blokpoel	M	HES	MG-3.6a-2015	01/09/2016	3,149,661.25 €	H2020-MG-2015_TwoStages	RIA	DE	5
723430	MeBeSafe	Stefan Ladwig	M	HES	MG-3.5-2016	01/05/2017	7,136,979.00 €	H2020-MG-2016-Two-Stages	RIA	DE	6
723375	Metamorphosis	Karl Reite	M	HES	MG-4.5-2016	01/06/2017	3,413,922.50 €	H2020-MG-2016-Two-Stages	RIA	AT	7
640401	MIND-SETS	Silvia Gaggi	F	HES	MG-9.2-2014	01/12/2014	1,755,558.75 €	H2020-MG-2014_SingleStage_A	CSA	IT	6
815069	MOMENTUM	Irene Blazquez	F	PRC	LC-MG-1-3-2018	01/05/2019	2,928,125.00 €	H2020-MG-2018-TwoStages	RIA	ES	4
769276	MORE	Peter Jones	M	HES	MG-7-2-2017	01/09/2018	5,537,113.75 €	H2020-MG-2017-Two-Stages	RIA	UK	10
770145	MoTiV	Ghadir Pourhashem	M	HES	MG-8-5-2017	01/11/2017	1,930,838.75 €	H2020-MG-2017-SingleStage-INEA	RIA	SK	5
723521	MUV	Salvatore Di Dio	M	HES	MG-4.5-2016	01/06/2017	3,992,625.00 €	H2020-MG-2016-Two-Stages	RIA	IT	8
769980	NOESIS	Stratos Arampatzis	M	OTH	MG-8-2-2017	01/11/2017	1,197,831.25 €	H2020-MG-2017-SingleStage-INEA	CSA	UK	6
636160	OPTIMUM	Konstantinos Thivaios	M	PRC	MG-7.1-2014	01/05/2015	5,966,186.25 €	H2020-MG-2014_TwoStages	RIA	BE	8
768947	OSCCAR	Werner Leitgeb	M	REC	MG-3.2-2017	01/06/2018	7,688,334.50 €	H2020-MG-2017-Two-Stages	RIA	AT	8
769072	Park4SUMP	Patrick Auwerx	M	OTH	MG-4.1-2017	01/09/2018	3,576,253.75 €	H2020-MG-2017-Two-Stages	IA	BE	17
815098	PAsCAL	Guillaume Gronier	M	HES	MG-3-3-2018	01/06/2019	3,974,041.25 €	H2020-MG-2018-TwoStages	RIA	LU	7
690713	PORTIS	Marijke De Roeck	F	HES	MG-5.5a-2015	01/09/2016	17,678,400.00 €	H2020-MG-2015_TwoStages	IA	BE	7
690636	Prosperity	Robert PRESSL	M	HES	MG-5.4-2015	01/09/2016	3,188,049.00 €	H2020-MG-2015_TwoStages	RIA	AT	15
646511	REMOURBAN	Miguel Ángel García Fuentes	M	REC	SCC-01-2014	01/01/2015	24,754,878.10 €	H2020-SCC-2014	IA	ES	7
815008	ReVeAL	Olaf Lewald	M	HES	LC-MG-1-3-2018	01/06/2019	3,942,067.50 €	H2020-MG-2018-TwoStages	RIA	DE	8
723989	SKILLFUL	Thierry Goger	M	REC	MG-8.3-2016	01/10/2016	2,991,672.20 €	H2020-MG-2016-SingleStage-INEA	RIA	BE	12
636427	SocialCar	Paola Cossu	F	PRC	MG-7.1-2014	01/06/2015	5,953,083.00 €	H2020-MG-2014_TwoStages	RIA	IT	13
723994	SPICE	Jos van Vlerken	M	HES	MG-4.4-2016	01/09/2016	827,500.00 €	H2020-MG-2016-SingleStage-RTD-MOV	CSA	DK	7
814910	SPROUT	Maria Teresa de la Cruz	F	HES	LC-MG-1-3-2018	01/09/2019	4,412,553.75 €	H2020-MG-2018-TwoStages	RIA	ES	15
769513	STARS	Marco Diana	M	HES	MG-8-5-2017	01/10/2017	1,805,665.00 €	H2020-MG-2017-SingleStage-INEA	RIA	IT	6
769944	STEVE	Marco Ottella	M	OTH	GV-10-2017	01/11/2017	9,517,870.18 €	H2020-GV-2017	IA	AT	7
814999	SUaaVE	Nicolás Palomares	M	REC	MG-3-3-2018	01/05/2019	3,894,782.50 €	H2020-MG-2018-TwoStages	RIA	ES	5
690650	SUITS	Andree Woodcock	F	HES	MG-5.4-2015	01/12/2016	4,111,361.26 €	H2020-MG-2015_TwoStages	RIA	UK	11
690669	SUMPs-Up	Ana Dragutescu	F	HES	MG-5.4-2015	01/09/2016	3,999,921.25 €	H2020-MG-2015_TwoStages	RIA	DE	11
723365	SUNRISE	Ralf Brand	M	OTH	MG-4.5-2016	01/05/2017	4,081,481.25 €	H2020-MG-2016-Two-Stages	RIA	DE	9
636220	TIMON	Leire Serrano	F	HES	MG-3.5a-2014	01/06/2015	5,605,213.00 €	H2020-MG-2014_TwoStages	RIA	ES	8
824349	TInnGO	Andree Woodcock	F	HES	MG-4-3-2018	01/12/2018	3,979,502.50 €	H2020-MG-2018-SingleStage-INEA	RIA	UK	13
635266	TRACE	Paulo Ferreira	M	REC	MG-5.3-2014	01/06/2015	2,896,984.75 €	H2020-MG-2014_TwoStages	RIA	PT	8
690772	VI-DAS	Martina Baumann	F	HES	MG-3.6a-2015	01/09/2016	6,225,246.25 €	H2020-MG-2015_TwoStages	RIA	ES	5
768960	VIRTUAL	Astrid Linder	F	REC	MG-3.2-2017	01/06/2018	6,997,943.75 €	H2020-MG-2017-Two-Stages	RIA	SE	8
635975	XCYCLE	Luca Pietrantoni	M	HES	MG-3.4-2014	01/06/2015	5,009,332.50 €	H2020-MG-2014_TwoStages	RIA	IT	5

Appendix 4: Dataset used in first NVivo analysis

Authors	Title	Gender	Full Citation
Guzman, L.A et al	Assessing equity in transport accessibility to work and study: The Bogotá region	M	Journal of Transport Geography 58 (2017) 236-245
	How to get there? A critical assessment of accessibility objectives and	F	
Geneviève Boisjoly1, Ahmed M. El-Geneidy1	indicators in metropolitan transportation plans	F	Transport Policy,55 (2017),38-50
Giulia Melis, Matteo Tabasso, Morena Stroscia,	Assessing health inequalities related to urban and transport determinants of mental health		Measuring Transport Equity. https://doi.org/10.1016/B978-0-12-814818-1.00009-3
Paez, et al	Measuring accessibility: positive and normative implementations of various Measuring	M	Journal of Transport Geography 25 (2012) 141–153
Koos Fransen, Steven Farber	Using person-based accessibility measures to assess the equity of transport systems71		Measuring Transport Equity
S. Kiavash Fayyaz et al	Dynamic transit accessibility and transit gap causality analysis		Journal of Transport Geography 59 (2017) 27–39
Geneviève Boisjoly, Ahmed El-Geneidy⁎	Daily fluctuations in transit and job availability: A comparative assessment of time-sensitive	F	Journal of Transport Geography 52 (2016) 73–81
Yavuz Duvarci et al	Transportation disadvantage impedance indexing: A methodological approach to reduce		Journal of Transport Geography 48 (2015) 61–75
Floridea Di Ciommo, Francesc Magrinya`, Gianni	A behavioral framework for needs-based transport assessment		Measuring Transport Equity. https://doi.org/10.1016/B978-0-12-814818-1.00017-2
Karel Martens	Transport justice .Designing fair transportation systems	m	This is a pre-publication draft version of a chapter from the following book:
A. Gil et al.	Public participation in municipal transport planning processes – the case of the sustainable	m	Journal of Transport Geography 19 (2011) 1309–1319
Kovács, Gyöngyi, Tatham, Peter	Humanitarian logistics performance in Humanitarian logistics performance in		International Journal of Productivity and Performance Management, 2009
Alex Karner, Aaron Golub	Assessing the equity impacts of a transportation investment progam	m	measuring transport equity, 2019
Karel Martens, Jeroen Bastiaanssen, Karen Lucas	Measuring transport equity: Key components, framings and metrics	m	measuring transport equity, 2019
karen lucas and peter jones	Social impacts and equity issues in transport: an introduction	f	Journal of Transport Geography 21 (2012) 1–3
Barbara Schmucki	"If I Walked on my Own at Night I Stuck to Well Lit Areas." Gendered spaces and urban	f	Research in Transportation Economics 34 (2012) 74-85
Joachim Scheiner*, Christian Holz-Rau	Gender structures in car availability in car deficient households	m	Research in Transportation Economics 34 (2012) 16-26
Anna Alberts⁎, Karin Pfeffer, Isa Baud	Rebuilding women's livelihoods strategies at the city fringe: Agency, spatial practices, and	f	Journal of Transport Geography 55 (2016) 142–151
Wafa Elias et al	Gender differences in activity and travel behavior in the Arab world	f	Transport policy, 44 (2015) 19-27
Gina Porter*, Kathrin Blaufuss, Frank Owusu	Gendered patterns of IMT adoption and use: Learning from action researchG. Porter et al. /	f	Research in Transportation Economics 34 (2012) 11-15
Maria Leonor Maia et al	Access to the Brazilian City—From the perspectives of low-income residents in Recife	f	Journal of Transport Geography 55 (2016) 132–141
Karen Lucasﬂ	Making the connections between transport disadvantage and the social exclusion of low	f	Journal of Transport Geography 19 (2011) 1320–1334
Lourdes Diaz Olvera, Didier Plat, Pascal Poche	The puzzle of mobility and access to the city in Sub-Saharan Africa		Journal of Transport Geography 32 (2013) 56–64
Ron N. Buliung et al	Children's independent mobility in the City of Toronto, Canada	m	Travel Behaviour and Society 9 (2017) 58–69
transport: Linkages, tools and	The health impacts of urban transport: Linkages, tools and transport: Linkages, tools and		Measuring Transport Equity, 2019
Louise Reardon, Lucy Mahoney, Wenbo Guo	Applying a subjective well-being lens to transport equity	f	Measuring Transport Equity, 2019
Kieran Broome et al	Evaluation of flexible route bus transport for older people	m	Transport Policy 21 (2012) 85–91
Fengming Su	Travel differences by gender for older people in London		Research in Transportation Economics 34 (2012) 35-38
charles musselthwaite	Further examinations of mobility in later life and improving health and wellbeing§	m	Journal of Transport & Health 2 (2015) 99–100
Sungyop Kimﬂ	Assessing mobility in an aging society: Personal and built environment factors associated		Transportation Research Part F 14 (2011) 422–429
Alexa Delbosc et al	Exploring the relative influences of transport disadvantage and social exclusion on well-	f	Transport Policy 18 (2011) 555–562
Susanne Nordbakkeﬂ	Capabilities for mobility among urban older women: barriers, strategies and options	f	Journal of Transport Geography 26 (2013) 166–1741
Md Moniruzzaman, a, Antonio Páezb,⁎	An investigation of the attributes of walkable environments from the perspective of seniors	m	Journal of Transport Geography 51 (2016) 85–96
Susan Gallagher and Stephen Albert	Cultivating a rural lens: successful approaches to developing regional transportation corridors through professional capacity building	f	Empowering the New Mobility Workforce, 2019
Aoife Ahern et al	Rural transport e-Valuing the mobility of older people	f	Reseacrh in transport economics, 34 (2017) 27-34
Adrian Davis, Paul Pilkington	A public health approach to assessing road safety equity—The RoSE cycle	m	Measuring Transport Equity. https://doi.org/10.1016/B978-0-12-814818-1.00017-2
Tanu Priya Uteng, Yamini Jain Singh, Tiffany Lam	Safety and daily mobilities of urban women—Methodolgies to confront the policy of "invisibility"		Measuring Transport Equity. https://doi.org/10.1016/B978-0-12-814818-1.00017-2
	Transportation Security Issues and Transportation Security Issues and Regulation		Introduction to Security. DOI: https://doi.org/10.1016/B978-0-12-805310-2.00018-4
Lotta Frändbergﬂ, Bertil Vilhelmson	More or less travel: personal mobility trends in the Swedish population focusing gender and cohort	f	Journal of Transport Geography 19 (2011) 135-1244
Anne Bastiana,⁎, Maria Börjessonb	The city as a driver of new mobility patterns, cycling and gender equality:Travel behaviour trends in Stockholm 1985–2015	f	Travel Behaviour and Society 13 (2018) 71–87
Tierra S. Billsa,⁎,1, Joan L. Walkerb,2	Looking beyond the mean for equity analysis: Examining distributional impacts of transportation improvements	f	Transport Policy 54 (2017) 61–69
Juan Antonio Carrasco, Karen Lucas	Measuring the influence of social capital and personal networks on transport disadvantage	m	Measuring Transport Equity. https://doi.org/10.1016/B978-0-12-814818-1.00017-2
Daniel Oviedo Hernandez et al	Mobilities of the periphery: Informality, access and social exclusion in the urban fringe in Colombia	m	Journal of Transport Geography 55 (2016) 152–164
K. Lucas et al	Modelling the relationship between travel behaviours and social disadvantage	f	Transportation Research Part A 85 (2016) 157–173
Yanbo Ge et al	RACIAL AND GENDER DISCRIMINATION IN TRANSPORTATION NETWORK companies		Working Paper 22776,http://www.nber.org/papers/w22776
CAREN LEVY	Travel choice reframed: "deep distribution" and gender in urban distribution" and gender in urban	f	Environment & Urbanization,Vol 25(1): 47–63.
Ana Gil Solá	Constructing work travel inequalities: The role of household gender contracts	f	Journal of Transport Geography 53 (2016) 32–40
Chang-Hyeon Joh et al	Exploring the use of travel information – identifying contextual market segmentation in Seoul, Korea		Journal of Transport Geography 19 (2011) 1245–1251
Ronald W. McQuaid*, Tao Chen	Commuting times e The role of gender, children and part-time work	m	Research in Transportation Economics 34 (2012) 66-73
Jillian Frater⁎, Simon Kingham	Gender equity in health and the influence of intrapersonal factors on adolescent girls' decisions to bicycle to school	f	Journal of Transport Geography 71 (2018) 130–138
E.O.D. Waygood et al	Transport and child well-being: An integrative review		Travel Behaviour and Society 9 (2017) 32–49
Juliet Jainﬂ, Tilly Line, Glenn Lyons	A troublesome transport challenge? Working round the school run	f	Journal of Transport Geography 19 (2011) 1608–1615

Appendix 5: Dataset used in second NVivo analysis

Full Citation
M. Lom, O. Pribyl and M. Svitek, "Industry 4.0 as a part of smart cities," 2016 Smart Cities Symposium Prague (SCSP), Prague, 2016, pp. 1-6. doi: 10.1109/SCSP.2016.7501015
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Appendix 6: Online resources to guide Sex, Gender and Intersectional Analysis

A6.1 For Sex and Gender Analysis:

- EIGE, Gender Analysis, https://eige.europa.eu/gender-mainstreaming/methods-tools/gender-analysis
- GenderedInnovations, *Methods of Sex and Gender Analysis* https://genderedinnovations.stanford.edu/methods-sex-and-gender-analysis.html
- Gender H2020 Online Manual , https://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/gender_en.htm
- Gender Statistics Wiki, What are gender statistics, https://unstats.un.org/unsd/genderstatmanual/What-are-gender-stats.ashx
- Heidari, S., Babor, T.F., De Castro, P. *et al.* Sex and Gender Equity in Research: rationale for the SAGER guidelines and recommended use. *Res Integr Peer Rev* **1,** 2 (2016). https://doi.org/10.1186/s41073-016-0007-6
- John Hopkins University Affiliate (2020). Seven steps to a gender analysis https://gender.jhpiego.org/analysistoolkit/seven-steps-to-a-gender-analysis/
- Runnels, V., Tudiver, S., Doull, M. and Bosoe, M. (2014). The challenges including sex/gender analysis in systematic reviews: a qualitative survey, *Systematic Reviews*, 3, 33. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3990268/
- Treasury Board of Canada (2019). Integrating Gender-Based Analysis Plus into Evaluation: A Primer, https://www.canada.ca/en/treasury-board-secretariat/services/audit-evaluation/evaluation-government-canada/gba-primer.html

A6.2 For Intersectional Analysis:

- Atewologun, D. (2018), Intersectionality Theory and Practice, https://oxfordre.com/business/view/10.1093/acrefore/9780190224851.001.0001/acrefore-9780190224851-e-48
- Christensen, A-D. and Jensen, S.Q. (2012) Doing Intersectional Analysis: Methodological Implications for Qualitative Research, NORA - Nordic Journal of Feminist and Gender Research, 20:2, 109-125, DOI: 10.1080/08038740.2012.673505
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- Krausse, H. (2019), How to model data with intersectionality, https://weallcount.com/2019/06/21/intersectionality-data-2/
- Windsong, E.A. (2018) Incorporating intersectionality into research design: an example using qualitative interviews, International Journal of Social Research Methodology, 21:2, 135-147, DOI: 10.1080/13645579.2016.1268361

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