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Actions and Solutions to Facilitate Women's Careers in Technology-Driven Work Environments

Expert paper prepared by:

Hilde G. Corneliussen[1]

Western Norway Research Institute (Vestlandsforsking)

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Invited expert paper for the CSW67

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Actions and solutions to facilitate women's careers in technology-driven work environments

Hilde G. Corneliussen
Research Professor, Leader for the Gender, Diversity and Technology research group, Head of Research for Technology and Society, Western Norway Research Institute (Vestlandsforsking)
hgc@vestforsk.no

Introduction: Challenges in the Nordic countries

The Nordic countries including Norway, are recognized for their gender egalitarian culture and gender equality policies. This is reflected in top positions, for instance in the World Economic Forum's Global Gender Gap Report, where Iceland, Finland, Norway, and Sweden are all ranked within the top-5 countries. Family-oriented national policies in Nordic countries have aimed to increase women's participation in paid work (Seierstad & Kirton 2015) and women makes up 47% of the workforce in Norway (Statistics Norway 2018). However, there is still a notable horizontal and vertical gender segregation in education and working life. This has been referred to as a *Nordic gender equality paradox*, due to the apparent mismatch between the widely accepted gender equality norms and regulations, and the continuous gender inequality in fields such as technology. Nordic Statistics recognised that the situation of the gender-segregated labour market has stagnated in the Nordic countries.[2] This is the background for many contradictions experienced by women in these countries, where on the one side there is a strong public gender equality rhetoric (Griffin 2022) emphasising that women are wanted and needed in fields of technology, while on the other side, women still constitute minorities in both traditional and the new emerging technologized work contexts, and they experience notable gender barriers on the pathways to technology.

This invited expert paper to CSW67 aims to give insights into the status and situation for women in technology, pointing to some of the recognized barriers as well as how women negotiate such barriers. The paper uses Norway as an example, and Part I contextualises Norway and the situation of women in technology. Part II provides insights into how girls and young women are met by and navigate the educational system. Part III discusses women's participation in technologized work contexts, highlighting how many women find alternative routes to new technologized workspaces. The final section draws up the two main challenges identified and points to actions and solutions that can support a development towards a more inclusive future for digitalized working life.

Knowledge and research sources for the paper

[2] https://indicators.nordicstatistics.org/ourvision2030 (accessed 16 Sept 2022)

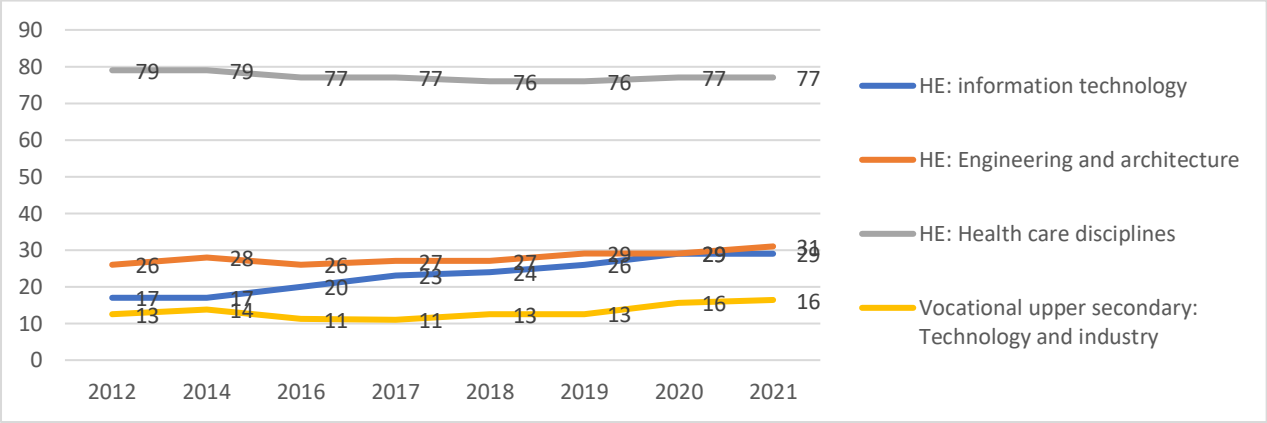
An important source of knowledge for this expert paper is the recent research in Nordwit, a Nordic Centre of Excellence focusing on women in tech-driven careers in working life in Norway, Sweden, and Finland (2017-2022, https://nordwit.com/). This research has been published in books and scientific journals and will be accordingly referred to when relevant. In addition, studies in Norway performed by the author and colleagues at Western Norway Research Institute give insight and empirical examples for discussing how women find their own solutions to enter and engage in fields of technology.

Part I: Status for women in technology in Norway

An increasing number of people have been employed in various fields of IT in Europe during the last decade, a field growing notably faster than employment in general (Eurostat 2021b). The gender gap has remained notable across Europe, with the average participation of women in IT work on 18%, and with Czechia on the bottom of the scale with 10%, Bulgaria on top with 28%, and Norway in the middle with 19% in 2020 (Eurostat 2021a). Education in Norway is in general state supported, thus reducing inequality due to economic accessibility of education. Gender norms and stereotypes, however, still have a large effect on youths' educational choices (NOU 2019: 19), and women's participation in certain fields of technology education are lower in Norway than the OECD average (OECD 2021).

There has been a positive development for women's participation in some fields of technology in higher education. Figure 1 below shows the percentage of female applicants to higher education in technology and health care, illustrating the horizontal gender segregation, that has been remarkably stable during the last decade, though with a steady increase in fields of information technology (IT), from 17% in 2012 to around 30% in 2021/22. This is a notable increase over the last 10 years, however, still not at the target goal of gender balance, often interpreted as at least 40% of both men and women. The proportion of women in technology disciplines in vocational upper secondary education is even lower and have weaker signs of improvements. Furthermore, the increase in women's participating at university level has not yet caused any improvements in women's participating in IT jobs in Norway, which is different from some of the other European countries (Simonsen & Corneliussen 2020, Palmer 2021).

Figure 1. *Female applicants to higher education technology and health care, and vocational courses of technology and industry from 2012 to 2021*



Sources: For higher education (HE): The Norwegian Universities and Colleges Admission Service; for vocational education: The Norwegian Directorate for Education and Training.

Research analysing why the gender gap in technology continues have pointed to a male dominated culture of technology and gender stereotypes associated with technology as some of the main challenges for women's participation (OECD 2016, Chavatzia 2017, Frieze & Quesenberry 2019, NOU 2019: 19). This is also the case in Norway, documented in a recent governmental report showing that youth in Norway are highly affected by gender norms and stereotypes when choosing their education and career paths (NOU 2019: 19). Most fields of technology are still associated with boys and men, and gender stereotypes produce many barriers for girls' and women's participation in technology. Male dominance in contexts of technology affect girls' and women's choices in negative ways, making it more difficult for young women to see themselves as fitting in contexts of technology (Corneliussen 2020). Girls need support and encouragement to make gender-inauthentic educational choices, and family and school are central in this respect (Eccles 2015).

The same gender stereotypes also affect the "ecosystem" around girls and women (parents, school, employers etc.). A Danish study found that while 70% of parents assumed that boys were more interested in IT than girls, only 1% of the parents imagined girls to be more interested in technology than boys (Tænketanken DEA 2019). Such attitudes and stereotypes also affect to which degree girls are actively encouraged and motivated to participate in technology training and education. Seeing the gender imbalance in IT as the "normal state of affairs", results in less effort put into recruiting girls and young women to technology arenas (Corneliussen & Prøitz 2016). A study among IT employers and organizations found that gender stereotypes created assumptions about men and women having different ways of acquiring technology competence. This doubt combined with the "normal state of affairs" argument, resulted in weak or no strategies to increase women's participation in IT work (Corneliussen & Seddighi 2020). Corneliussen and Seddighi suggest that the "mechanism at play illustrates how gender imbalance in IT is simultaneously visible and invisible: it is indeed recognized, but as a result of cultural perceptions and gender stereotypes, it is not necessarily considered worthy of change" (Corneliussen & Seddighi 2020, p. 46).

Actions to recruit girls and women to technology are few, mostly local, and have short lived effects (Lagesen, Pettersen et al. 2021). Few recruitment initiatives have been evaluated, thus it remains to identify precise effects (Reisel, Skorge et al. 2019). One exception to both, is the national campaign, Girls and Technology, which was evaluated by the author and colleagues in 2020 (Corneliussen, Seddighi et al. 2021a, Corneliussen, Seddighi et al. 2021b). This campaign invited girls from grade 9 to university to events across the country, aiming to encourage girls to choose technology and science educations by providing new insights about technology education and relevant professions, and promoting female role models. Although it is difficult to isolate and identify the precise reason for deciding to study technology, the evaluation showed that nearly all the women who participated in one or more events before choosing educational direction, had experienced that the campaign had an impact on their decision to study technology. The evaluation report points to two important effects of such recruitment initiatives: firstly, for girls who do not find support for learning about technology from family or school, the recruitment initiative compensates for this, and can have very dramatic effects such as making girls change study choice from more gender-traditional disciplines (e.g. health care) to IT. Secondly, for girls who already were interested, seeing female role models is vital in their ability to imaging themselves working with technology. This effect is less dramatic, but equally important for the final decision to study technology (Corneliussen, Seddighi et al. 2021a, p. 6). However, the same study showed a tendency for schools to only send girls they already considered to be interested in technology to such recruitment initiatives, thus, effectively undermining the first effect of the initiative (ibid.).

Part II: Girls and women navigating the educational system

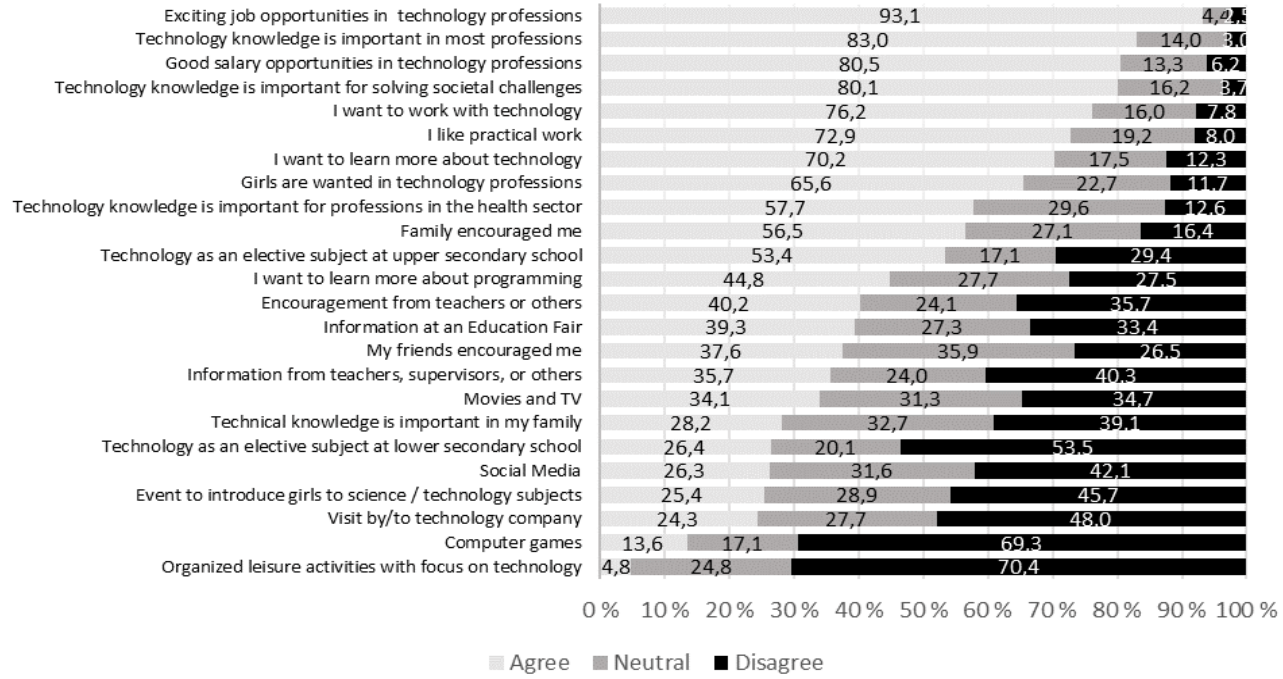
As shown above, the gendering of technology challenges girls and women's participation. This part will give examples of how girls and women navigate this gendered landscape, giving insights into motivational factors and illustrating how many women find alternative pathways to technology education.

What motivates women to study technology?

In a survey with nearly 700 young women (age 16 to 36+) explored what had motivated them to consider or deciding to study technology at upper secondary or higher education (ISCED 3-6) (Corneliussen, Seddighi et al. 2021a, Corneliussen, Seddighi et al. 2021b). Most of the young women agreed that exciting job opportunities were important, closely followed by the importance of technology knowledge, good salary, and technology as important for solving societal challenges. These numbers point to how many positive drivers are similar between men and women, however, it also identifies the emphasise that women put on societal aspects when choosing technology.

The least important motivational factors were related to leisure activities and computer games, documenting that some of the triggers for choosing a technology career associated with boys (Sevin & Decamp 2016, Yates & Plagnol 2022) are of little importance as a motivational factor for most girls and young women.

Figure 2. *Motivational factors for choosing technology among women (N689)*



Source: Corneliussen, Seddighi et al. 2021b

Furthermore, the figure illustrates that both school and family are relevant supporters, however, there is a large gap between these and the top motivational factors for women. Only 37-40% of the women had been encouraged or motivated by information from teachers or other representatives

from schools, and only 1 in 4 had been motivated by recruitment initiatives. This illustrates that a minority of women who decide to study technology have been motivated through the school system.

Women's pathways to technology education

The findings above, in particular the low importance of leisure activities and of encouragement at school, were also recognized in qualitative research project exploring women's chronological pathways from childhood to the decision to study information technology (IT) at STEM faculties at university level (Corneliussen 2020). The qualitative data provides an in-depth understanding of how women navigated the gendered landscape of technology, and what finally made them decide to study IT. The analysis of the women's chronological narratives showed that women take different routes to IT, involving different motivations and reasons for choosing IT education:

- *Early interest (and lack of insight):* Only a handful of women recognized an early teenage interest that had developed into a wish to study technology; out of these, only one referred to computer games and leisure activities. Two of these women ended up choosing the "wrong" IT program due to lack of knowledge about different fields of IT.
- *Alternative platform:* a large group of women had been motivated to study IT due to their interest or strength in a *different* discipline such as mathematics, sciences, language or writing. This illustrates that IT can be perceived as relevant and interesting for nearly any fields and occupations, but also that the women avoided "competing" with men's interest in IT/programming.
- *Random:* Nearly one in four of the women interviewed had ended up in an IT program for completely random reasons such as making a (literally) blind choice between study programs.
- *Late "discovery":* 5 women had started on a different study program, before "discovering" that IT was interesting and relevant, whereupon they changed direction/started over in an IT program. Their discovery happened outside the "conventional" route to higher education and was dependent on some kind of input. Many expressed regrets that they hadn't been involved/recruited earlier.
- *Encouraged:* 3 women told a story of having been encouraged because *technology was a suitable education for girls.* None of these were from a Nordic country, thus they illustrate the cultural construction of technology as a gendered field.

Educational choices are often assumed to rely on rational choices (Reisel, Skorge et al. 2019), assumptions about own abilities or – in particular when talking about technology – related to interest (Sáinz & Eccles 2012), often developed in spaces and places of leisure time (Sevin & Decamp 2016). The pathways described above illustrate that these were not the main factors that had made women consider to study technology. The different pathways to IT education described by the women are not reserved for women, however, the women's chronological narratives described how they navigated the educational landscape as *gendered*, in particular regarding *not* being recruited through the educational system when moving from lower to higher secondary and to university. Few of the women had received adequate information about what technology education and work entailed at school. For most of the Norwegian women, this meant that gender stereotypes including assumptions of IT as a field dominated by male "hooded gamers" who were already skilled programmers before university, dominated their understanding and thus represented a notable barrier for choosing IT. The important turning point for deciding to study IT was for most women related to some kind of input: they heard, saw, or learnt about technology. Furthermore, the three

women who described IT as a suitable field for women highlights the cultural construction of IT as a masculine field in Norway.

Part III: Women navigating technologized work contexts

A similar pattern of women finding unconventional routes to technologized work were found in the Nordwit project. Less than half the women interviewed for this project had pursued a "conventional" route to IT by choosing sciences at upper secondary school (a requirement for most IT programs at university level), and then moving directly to an IT program at university. However, most of the women had also here found alternative routes to technologized workspaces. In this project we started with a wider understanding of technology work, and therefore refer to ICT – information and communication technology, rather than the narrow focus on STEM-related IT education in the previous part. In the chapter "Unconventional routes into ICT work" (Corneliussen & Seddighi 2022), we analyse three "unconventional" routes that brought women to IT work in new technologized workspaces.

First, a delayed entry into ICT education (cf. the late "discovery" above) was characterized by women first choosing a non-technological education, then realizing their interest in working with technology, whereupon they started over in an IT education to pursue a traditional technology career.

Second, many women who started out in a non-technological discipline experienced that digitalization made technology competence increasingly important. This had made the women acquire technology competence by returning to university or through work-based upskilling. For some this transition into technology work was by choice, while for others it was by necessity.

Third, digitalization requires competence from a wide set of disciplines, and many of the women in this study had been recruited or found opportunities in working with digitalization because their non-tech profession was needed. They mainly developed their technology competence through work. One of these women had been recognized as one of the most important people in technology development in Norway.

As the table below shows, route one and two led women to work closely with technology, including designing, programming, implementing new technology, and management, while the third group were more focused on implementation and management. Many of these women will remain invisible in statistics identifying, for instance, students or even IT workers, they had clearly developed a high degree of involvement and central positions in technologized work, and they contributed to processes of digitalization that had vital importance for society.

Table 1. *Women's unconventional entry routes into ICT work*

	Route 1: Delayed entry into ICT education	**Route 2: Digitalization of (non-technical) disciplines**	**Route 3: Non-technological professions engaged in ICT research and innovation**
Education	First degree in a non-technical discipline Second degree in ICT	Education in disciplines traditionally not recognized as technical	Education in non-technical discipline

Reason for choosing ICT	Support for future work	Necessary or natural change due to digitalization of chosen discipline	New opportunities in digitalization of non-tech profession
Way of acquiring ICT competence	Degree in higher ICT education	Development in original discipline with higher ICT education or workplace-based upskilling of ICT competence	Formal ICT courses and workplace-based upskilling of ICT competence
Current position	ICT expert	ICT as expert area within original (non-tech) profession	Occupied in original profession in area of digitalization
Current work tasks	Designing, programming, implementing new technology, management	Designing, programming, implementing new technology, management	Designing, implementing new technology, management

Source: Corneliussen & Seddighi 2022

Part IV: Policy recommendations: Actions and solutions for a more inclusive future for technologized work

The continuous underrepresentation of girls and women in technology have resulted in many suggestions for how to change this. The main tools engaged in the Norwegian context do not differ much from solutions recommended internationally, such as motivating girls through female role models, providing insights into technology education and tech-driven occupations, to invite girls to visit and get to know IT departments at university campuses, and in many other ways supporting girls to experience and become interested in technology (Arnold, Dee et al. 2021, Corneliussen, Seddighi et al. 2021a, Lagesen, Pettersen et al. 2021).

Critical voices suggest that we lack knowledge about the effects of initiatives to encourage girls and women to choose technology, since few of them have been thoroughly evaluated, in particular not with statistical methods aiming to isolate motivational factors (Reisel, Skorge et al. 2019). The evaluation mentioned above identifies the challenge of isolating factors, however, it also points to the importance of recruitment initiatives, not the least for girls who do not have other sources for building interest for technology. Reflecting this and the continuous underrepresentation of women in fields of technology, the first recommendation is therefore:

Recommendation 1: Traditional tools for recruiting and encouraging girls and women to consider a career in technology are vital for a more inclusive tech sector.

However, based on the above reviewed research there are two main challenges that urgently need to be addressed, the first regarding a distrust of girls' and women's interest in technology, and second, the gender equality norm working as a shield against change. Both issues point to a *different set of actions and solutions* needed to increase women's participation in technology: a focus on changes in the "ecosystem", as elaborated below.

First, there is a widespread assumption that girls and women are not interested in technology, which enters a self-reinforcing circle in which girls lack knowledge about technology, therefore they do not express interest, therefore they are to a less degree invited/encouraged to tech-arenas, thus they continue to lack knowledge etc. The effect is, paradoxically, that the biggest chance for girls to

experience active recruitment or encouragement to participate in technology arenas, is if they were already interested (recruited). This misses the point that interest in technology is a cultural construct and for young women it might not be enough (Corneliussen & Seddighi 2022): women still might doubt that they fit in a masculine space of technology; nor is it a requirement: women identify many other fields of interest as motivational for studying technology. Thus, by recognizing this diversity in backgrounds and interests, fields of technology can appear more open for a diverse set of people, including girls and women (Corneliussen, forthcoming 2023). This opportunity is vital to recognize, for instance, for the future work in fields such as the green transition, e-health, and artificial intelligence, which are all fields in need of cross-disciplinary knowledge not only in teams, but also in each individual contributor – which is a characteristic result of many women's delayed entry into technology (BCS 2019).

Second, the strong public discourse of gender equality in the Nordic countries has created a myth about gender equality already being achieved (Martinsson & Griffin 2016), which makes the continuous gender imbalance in fields of technology appear to be a result of women's free choices (Corneliussen 2021). As shown above, this relies on a misunderstanding and ignorance of the continuous gender stereotypes in this field, also in Norway, that leads many women to ask whether they belong if they "only see men" (Corneliussen 2020). This post-feminist (Budgeon 2015) assumption that women do not want to study technology, gives the impressions that lack of gender equality actions are not in breach with the gender equality norm; rather they are only reflecting the nature of things. As an effect, the responsibility for the gender imbalance is moved from the educational structures and working life organizations, and to the individual women, contributing to "a perception of gender-typical career choices as a legitimate result of free choices and therefore as something that needs to be supported" (Corneliussen 2021, p. 4, cf. Ellingsæter 2014).

The research revisited here as well as the first challenge above, highlights that under the current situation, girls and women need support to choose and enter fields of technology that are associated with men. However, the second challenge above calls for strategies and actions to not only focus on changing girls and women's perceptions of technology, but rather to target a wider "ecosystem" that constitute and are part of the situation for girls studying technology and for women entering tech-driven workspaces. Thus, it is not only girls and women that needs to recognize that women belong in fields of technology, but also the supporters: the women's family, friends, fellow students, and co-workers also need to recognize this if we are to make technology appear as an equally natural choice for girls and women as it is for boys and men. The next recommendations reflect the ecosystem's role and responsibility in contributing to a more inclusive tech sector and technologized work and highlights the gap between policy and action:

Recommendation 2: Gender stereotypes need to be tackled to develop a more inclusive tech sector; however, it is vital to target the wider "ecosystem" and not only girls and women.

Recommendation 3: Strategies for developing a more gender inclusive tech sector should require concrete and local/contextualised actions and activities to avoid non-performative policies.

Current knowledge gaps

While several decades of research into the underrepresentation of girls and women in fields of technology have created important knowledge about what the challenges are as well as producing suggestions for how to make changes, the gender equality actions – putting such solutions to work – is a critically understudied field. Many of the examples above illustrate how the widely accepted

gender equality norm itself can be interpreted as the actual solution (Corneliussen & Seddighi 2020). Thus, vague guidelines and lack of follow-up strategies increases the risk of the gender equality norm and policies becoming non-performatives (Ahmed 2012), "meaning that the changes these measures and policies are meant to bring about are assumed to have been effected by the very fact of having a policy. In other words: nothing is done because a policy is in place" (Griffin & Vehviläinen 2021, p. 7). This effect is recognized in the educational system, in working life, and in academia (Corneliussen 2021) and Griffin and Vehviläinen identifies this as one of the reasons that gender inequalities persist in the Nordic countries (Griffin & Vehviläinen 2021).

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