Women in IT

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*The motto of **Strategy Alliance** is: sustainable digital transformation. We feel that organizations should strive towards sustainable solutions. This implies that people should play an important role: in an increasingly digital world, you have to put people first. This implies that we greatly value diversity in organizations. Our observation is that there is still a significant gap in gender equality in the IT sector. This motivated us to do a small research project to analyze the current state and make recommendations to improve the balance. This paper reports the findings of our study. We have found three main factors that hinder women to get started in IT: (1) its nerdy/beta reputation, (2) unawareness of the possibilities, and (3) unawareness of what it entails. We have found four factors that hinder women to stay in IT: (1) not feeling included in a male dominated environment, (2) inability to advance their career, (3) men are thinking in the wrong way, and (4) working conditions. Finally, we have found four options for removing the barriers: (1) more role models, (2) put more women in management positions, (3) change the working conditions, and (4) start young - at primary school.*

1. Introduction

You might expect that "gender in the workplace" is no longer an issue: it is 2023, and gender equality should be the status quo. If your stance is that gender is a non-issue, then we would argue that you are wrong: our observation is that (1) there is still a significant imbalance between women and men in IT – both at the workfloor and at the top of the organisation - and (2) that this is a problem. Thus, despite the IT sector making progress in recent years towards diversity and inclusion, there is still more work to be done.

The STEM (science, technology, engineering and mathematics) industry has historically been male-dominated and the IT sector is no exception. At the time of writing, only 22% of tech roles in Europe are occupied by women (McKinsey, 2023). In the Netherlands, less than 18% of IT employees are women (AG Connect, 2023).

We firmly believe that diversity and inclusiveness are important for organizations in all sectors, yet our primary interest lies in gender equality in the IT sector. A diverse staff with a wide range of skills, viewpoints, and experiences may result in a culture which is sustainable and yields better results. Important to note is that diversity and inclusion go beyond gender; it also covers race, ethnicity, sexual orientations, age, disabilities, education, neurodiversity and much more.

For purposes of this paper, we will use the terminology from the classic binary gender system (male/female) and refer to 'women' as all individuals who identify themselves as female regardless of their assigned sex at birth. We acknowledge that more genders exist and expressly state that we value people for who they are regardless of their sex. Choosing the traditional binary system helps to focus our research efforts more effectively.

Our goal with this whitepaper is to address the following questions:

· What are some barriers for women to get started/stay in IT?

· How can we overcome these barriers?

By answering these questions, we hope to offer recommendations for business who want to increase the number of women in their IT-domains, and what factors will let them stay.

Figure 1 shows our research approach for answering these questions. By combining selected papers from literature, interviews, a survey and an expert session, we hope to come to valid answers and recommendations for organizations in the IT sector.
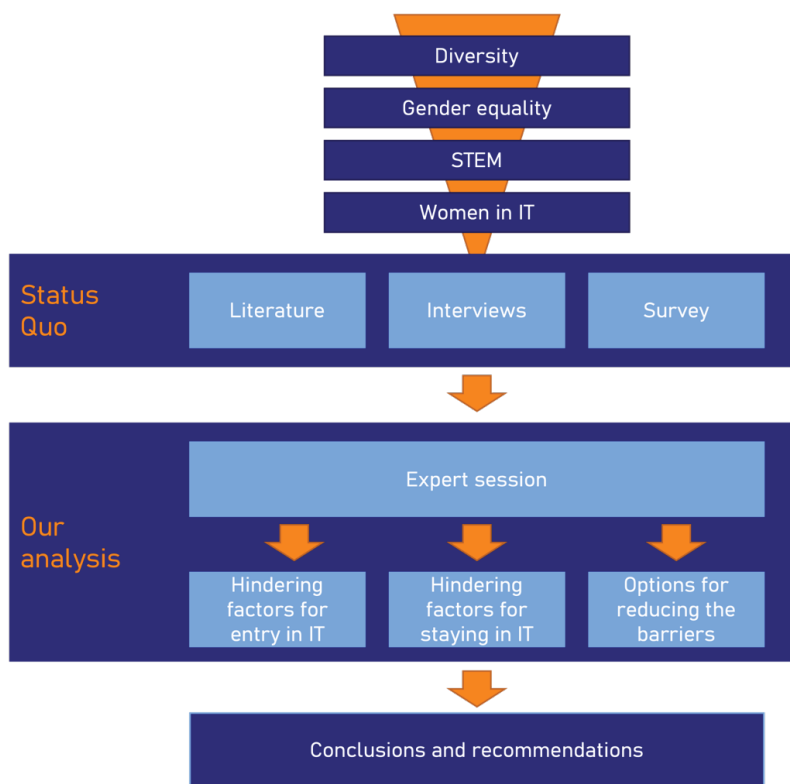

Figure 1 – research design

2. Status quo

In this section, we unfold the "status quo" of women in IT. We do this by first covering some scientific literature, followed by perceptions of female interviewees who work in IT and finally some (mis)conceptions of a small group of women if it comes to the IT-field.

2.1 Literature

Prior to discovering some literature examples, the following questions can be answered about the minority of women in IT: (1) how has this issue established itself and (2) what we can do about it. We have selected three papers to explore these questions and will discuss each in turn.

Women at the top

According to research by Cohan and Ready (2019), "women at the top" are good for business. A McKinsey study that looked at the financial advantages of having women at the top supports

this. Unfortunately, only few businesses take adequate steps to promote women so they may enjoy these advantages. Furthermore, according to a US research, women make up 47% of the workforce. This proportion is substantially lower at the top (mainly C-level). Thus, demographic wise, it is noticeable that women in C-level positions are still a vast minority. According to the research, organisations can do the following:

· "Tone at the top"

· Adhere to recruiting practices that take real demographics into account

· Encourage women to pursue their careers

· Convert policy to KPIs, gather information, and make a change

Given these points, a growing body of data indicates that more women in leadership positions may be crucial to a company's long term success. Women who are willing to take on these tasks are either already in employment or available for recruitment. This matter does not limit itself to IT only, but as indicated, it is business wide.

Barriers and enablers in STEM

IT is, in our view, within the broader area of science, technology, engineering and mathematics (STEM). Prieto-Rodriguez et. al (2022) has studied barriers and enablers for women in STEM. Table 1 shows three common barriers and four common enablers that were found in this study.

The most common barrier is the gendered workplace. Women often feel they must tolerate or adjust to a work environment created by men, and are weary of complaining or reacting in ways that might be perceived as 'emotional'. The second suggested barrier is sexism and gender stereotypes within society. These barriers create doubts about whether a role in STEM is appropriate for women and can undermine their confidence in their own abilities. The last barrier relates to expectations of women's responsibilities. These subcategories relate to having children, work/family balances and traditional gender roles.

As for the enablers to STEM careers, the first enabler is aptitude. The interviewees believed in women's capability to do all things that men can do, but also bring a variety of other skills to the table. The second enabler relates to role model and mentor encouragement. This indicates the

people in our environment who have a supporting and positive influence. The third enabler is a supportive workplace. This category contains increased gender equity and positive discrimination. The final enabler is internal motivations, the inherent motivation to work in STEM.

Barriers	Enablers
Gendered workplace	**Aptitude**
• "Old boys club" mentality • Lack of confidence to report discrimination • Isolation in the workplace • Difficulties gaining promotion • Sexual harassment or verbal abuse	• Possessing a competitive, determined or resilient nature • Bringing a broad skill base • Belief in equal ability to men • Natural aptitude to STEM
Sexism and gender stereotypes	**Role model & mentor encouragement**
• Perceptions of gendered ability • Lack of role models • Childhood conditioning • Being uninformed about STEM • Negative perceptions of positive discrimination	• Teachers • Mentors (all genders) • Female role models • Supportive family environment
Expectations of responsibilities	**Supportive workplace**
• Being discriminated against having children • Taking maternity leave perceived as detrimental for their career • Difficult to balance work/family life • Traditional gender roles for women in families – contradicting progressiveness	• Gender equity • Positive discrimination
	Internal motivations
	• STEM aspirations from a younger age • Own curiosities • General interest in STEM-related fields throughout their lifetime • Desiring to do purposeful work by STEM helping society or the environment

Table 1 - barriers and enablers

Women's experiences in IT

We still wonder how these results translate to the field of IT since these barriers and enablers are present in STEM at large. Starting off with the question "how do male employee dominant structures affect women's gender identity in IT?" According to Kenny & Donnelly (2020), this is due to several reasons. First, male dominant culture has particular geek or nerd characteristics that are male-centric and seem to exclude femininity. Participants of this study indicated that male coworkers thought it was unusual for women to be technical. Beyond that, a shared view of a lot of men is that women only excel in "soft skills" which encourages them to take on "housekeeping roles". Due to male dominance, women are frequently excluded from activities and events, which reduce their ability to influence decisions.

So how do women navigate this environment and use their agency to challenge the features of this structure and uphold their fit in IT? In Kenny & Donnelly (2020), a few respondents felt under pressure to downplay their sexuality and gender difference and that they could not take their position for granted – including the display of emotion. A sizable portion of the respondents in that study said it was difficult to work well in a setting where males were expected to know a lot about and be obsessed with IT (Kenny & Donnelly, 2020).

Based on this exploration, we conclude that (1) the challenges in IT are similar to the challenges in STEM as a whole and (2) more women are needed in the STEM sectors. All the barriers can be matched with overarching issues such as sexism, dominant masculine culture in work settings and gender biases. Needless to say, this is a problem in an era where progressiveness and inclusiveness ought to be the norm.

2.2 Interviews

In this section, we explore the situation of women in IT through interviews with questions such as "what are the opinions on diversity & inclusion and personal experiences of women who work in IT?" and "what are the perceptions of IT of women who are not affiliated or do not work in IT?"

Our two interviewees work in IT consultancy and cybersecurity. For both, diversity and inclusion is highly important. The reasons given why diversity and inclusion are crucial also relate to some of the mentioned enablers to STEM and that the barriers can be broken. Having more women in IT can establish role models and bring more awareness to possibly unexplored career paths for girls and women. A lot of women are not yet fully aware of career opportunities in IT because it is still marketed as a one-sided and technical field. This apparent singular focus on tech-skills withholds women from pursuing a career in IT. The masculine culture is dominant which strengthens this point further: many women shy away from a career in IT when realizing that not everyone fits in masculine cultures and that in such a culture men are often favored over women.

Improving the gender balance can be a first step to increase diversity and inclusion. The visible effect of such a move would be a more effective balance between masculine and feminine qualities in business. In addition, women get a prominent voice and different ways of thinking are valued. As for the current status, the interviewees perceive that the number of women

in IT is still being underestimated by many men. They acknowledge that the degree in which this is understimated depends on where someone is in his diversity and inclusion journey. There is still a lot of improvement needed in management and senior roles, which was already indicated earlier in this paper. Fortunately, gender distributions are considered more and more nowadays, and women perceive more IT-environments as pleasant.

2.3 Survey

Another interesting angle is the root of the barrier why women and young girls are so misinformed about IT, given that the "nerdy" stereotype remains to have such a strong presence in society. Therefore we conducted a small survey to investigate this further. With questions such as "how do you perceive IT?" and "why is IT not appealing to you?", we hope to find underlying principles such that stereotypes and misconceptions can be reduced. The target group for this survey consisted of 17 women, from ages 16 to 53, young adults being the largest group (21-25).

When asked what comes to mind when you think of IT, the term 'computers' was given the most. We found that the respondents perceive IT to be about IT-systems, data, computers, software engineering and cyber security. Other areas of IT such as risk management, processes, governance, architecture and compliance were picked the least since the respondents believe that these are no part of IT at all. This could mean that "harder" and more technical sides of the IT-world are much more prominent to women than the "softer" sides which relate to various disciplines, e.g. business (processes), law, ethics and communications. Besides the given opinions for IT to be interesting (innovation and good salaries), much more opinions were given on why there are so few women in IT according to the respondents. Interestingly, all the given answers could be related to earlier mentioned problems: lack of role models, sexism and gender biases.

3. Analysis

Based on the insights from literature, the interviews, and our survey, we designed an expert session in order to understand (1) the factors that are a barrier for women to start in IT, (2) the factors that are a barrier for women to stay in IT, and (3) options for reducing those barriers.

3.1 Research setup

The expert session took place online in a Teams environment and was hosted by Strategy Alliance. The session lasted three hours. To set the stage, we presented our understanding of the status quo. We then used a group support system (Meetingwizard) for the interactive part of the session. We asked three specific questions, notably:

1. What are hindering factors for women to get started in IT?

2. What are hindering factors for women to stay in IT?

3. What are options to overcome the barriers?

For each of these questions we asked the participants to brainstorm two factors (we used a limited number to "force" them to capture the most important points first). The results were discussed and deduplicated. Finally we asked participants to rank the results by distributing 100 points over the clustered factors/options.

3.2 Participants

We asked 19 people to join in our expert session. We ended up with a group of 11 participants (excluding ourselves). Of these 11 participants, 6 were female and 5 were male. We had 1 participant from the US, the other participants were from the Netherlands. In terms of occupation, 1 participant had a purely academic background, 2 had a mixed academic/industry background, and 8 participants were mainly active in industry. The participants from industry were active in different branches (e.g. education, consultancy, and government) and in different roles (e.g. architect, information manager, program manager).

3.3 Results

Hindering factors to get started in IT

With regard to the question "What are hindering factors for women to get started in IT?" we brainstormed a total of 19 potential factors. After clustering, these were reduced to 10 factors. The voting results are are shown in table 2 (the score is an average; the variability is an indication of the degree to which participants are in agreement – which we normalized to low/ medium/ high).

Factor	Score	Variability
1. Nerdy/beta topic	18.8	M
2. Unaware of the possibilities	17,1	M
3. Abracadabra: we don't know what it is	12.5	H
4. Not exposed to IT often	10.0	M
5. Bias: technical subjects/topics are for men	9.2	M
6. Not fashionable for women	7.9	M
7. Already male-dominanted, don't want to be a minority	6.3	M
8. Active recommendations for girls not to study IT	6.3	L
9. Less opportunities for part-time work	5.8	M
10. Few students and therefore smaller resource pool	5.8	M

Table 2 – hindering factors to get started in IT

Even though the top two factors clearly stand out from the rest (with a significant gap in score to the third factor), it appears that there is limited consensus (medium to high variability) among the participants around the factors that are the biggest barrier for women to get into IT. Several important points were raised during the discussion. With regard to factor 1, 4, and 6 it was remarked that IT is increasingly important in many industries – so women will be exposed to IT whether they like it or not. With regard to factors 2 and 3, it was remarked that IT has invaded almost all aspects of our lives, so general knowledge of IT is likely to grow rapidly. We also noticed that further research (in the form of a root-cause analysis of these factors) is required. We consider this part of our future research. Our tentative conclusion is that the top factors that hinder women to get into IT are (1) the nerdy reputation of IT and (2) unawareness of what the field IT is and what its opportunities are.

Hindering factors to stay in IT

With regard to the question "What are hindering factors for women to stay in IT?" we brainstormed a total of 16 potential factors. After clustering, this was reduced to 8 factors. The result from voting are shown in the table 3.

There is more to be said about these factors. First, factor 2 is about both the perception that there is an inability to advance the career but also the reality of a proverbial glass ceiling: men are picked over women when it comes to

Factor	Score	Variability
1. Not feeling included in male-dominated environment	25.7	H
2. Inability to advance the career	16.6	H
3. Men are thinking in the wrong way	16.4	H
4. Working conditions	15.0	H
5. One-side mono-culture (male, nerdy)	9.1	M
6. Exhaustion from being the only woman in the room	8.5	L
7. Less attention to skills/factors	7.7	M
8. Move to non-IT function within the company	0.9	L

Table 3 – hindering factors to stay in IT

Factor	Score	Variability
1. More role models nearby	21.8	M
2. Put more women in management positions	17.3	H
3. Change working conditions	11.8	H
4. Start young, at primary school	10.5	M
5. Enforce equality in salary, promotions etc.	8.6	L
6. Encourage male/female dialogue about these topics	8.6	L
7. Set up a 'women in tech' community	6.4	L
8. Demystify the many forms of a career in IT	5.5	L
9. Value 'feminine' traits on the workfloor	4.1	L
10. Favor women in cases of equal m/f qualification	3.2	L
11. Use KPIs to stimulate "the right behavior"	1.4	L
12. Create more openness in job selection processes	0.9	L

Table 4 – options to overcome barriers

promotion. With regards to factor 3, one respondent remarked that many men want to do the right thing but because they think in the wrong way, they still end up doing the wrong things instead. The example that was given was the situation where a woman had recently given birth. One of her male team-members, trying to be considerate, suggested she work from home because "the drive would be tiresome in her condition". Factors 1 and 5 appear similar yet factor 1 is more about the feeling whereas factor

5 is mostly about the fact that there is a nerdy mono-culture. We hypothesize that factor 1 is caused by factor 5.

The first factor is a clear winner in the sense that it has an overwhelmingly high score when compared to the rest. Yet, it has a high variability. This is caused by the fact that two respondents gave a score of 0 points to this factor (they thought other factors were more important) whereas all the other participants gave a very high score for this factor. To a lesser extent, this also holds for factors 2, 3 and 4 which also received relatively high scores with relatively high variability.

Our tentative conclusion with regard to this question is that the male-dominated, geeky environment is the root cause for the fact that relatively few women stay in IT. The (perceived and actual) inability to advance the career may be caused by this. Even more, the working conditions (i.e. no 32-hour work-week etc) may also partially result from this. Last but not least, men thinking in the wrong way may be a result of years and years of conditioning. We sincerely hope that the good intentions will eventually pay off.

Options to overcome barriers

With regard to the question "What are options to overcome the barriers?" we brainstormed a total of 19 potential factors. After clustering, this was reduced to 12 factors. The result from voting are shown in table 4. Several interesting points were raised during the discussion. We extensively discussed factor 1 about role models. It was first suggested that the ideal situation is that women within the organization would function best as role models. After another participant remarked that not every organization is lucky enough to have such role models, it was suggested that female guest speakers from other organizations are a good "second best" option.

There was also a firm debate on factor 2. The end result was that we should not "hire women just to hire women". Instead, we should hire the best people for C-level positions yet try as hard as possible to choose female candidates. With regards to factors 6, 7, and 9 the participants heavily favored a productive dialogue: the best improvements can be found through dialogue and collaboration.

With regards to the scores, factor 1 again stands out as a clear "winner". Factors 2-4 also receive high scores after which the averages trail off to

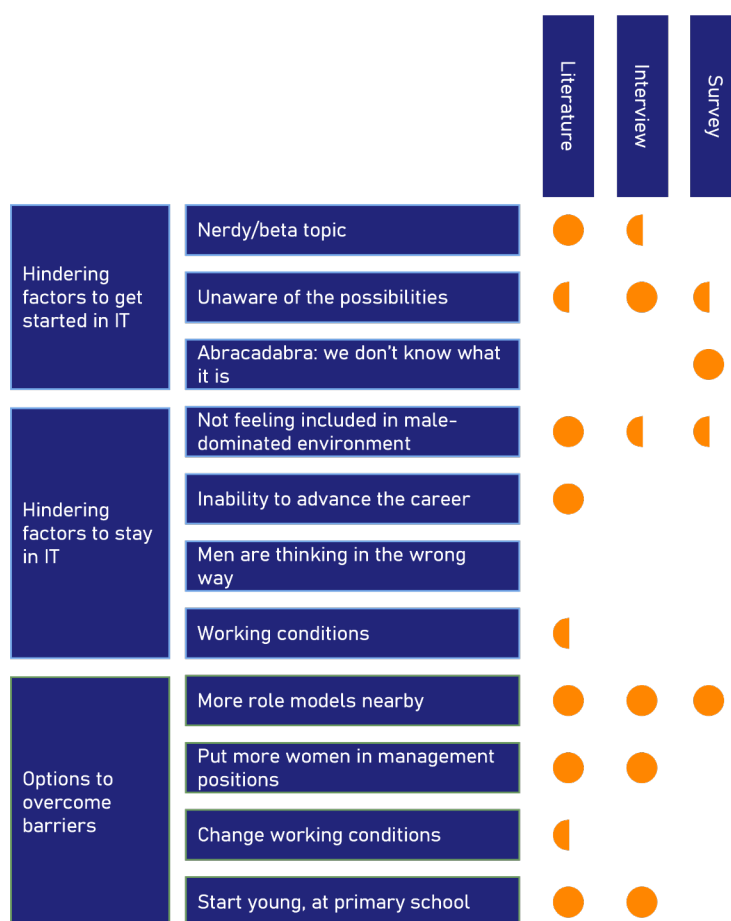|	Literature	Interview	Survey
Hindering factors to get started in IT			
Nerdy/beta topic	●	◐	
Unaware of the possibilities	◐	●	◐
Abracadabra: we don't know what it is			●
Hindering factors to stay in IT			
Not feeling included in male-dominated environment	●	◐	●
Inability to advance the career	●		
Men are thinking in the wrong way			
Working conditions	◐		
Options to overcome barriers			
More role models nearby	●	●	●
Put more women in management positions	●	●	
Change working conditions	◐		
Start young, at primary school	●	●	

Figure 2 - validation of our results

a 0.9 score for factor 12. The variability is medium to high. We interpret this as follows: role models are a key factor for helping women to overcome barriers, closely followed by a combination of putting women in management positions, creating suitable working conditions, and exposing women to IT from an early age on.

Our results in light of the status quo

In order to analyze how significant our results are, we performed a cross-check with our description of the status quo. That is, for each factor (of the three questions) we analyzed whether it was also present in the literature, the interviews, or the survey. The results are presented in Figure 2. A "full circle" is intended to mean: the factor is present. A "half circle" is intended to mean: the factor is somewhat present/suggested.

Our observation is that all factors except one were indeed present in the description of the status quo. The literature in particular confirms the results of our expert session.

The factor that was not found in the description of the status quo is about the way men think: even though their intentions may be good, it appears that they still show "the wrong behavior". Given the limited scope and focus on
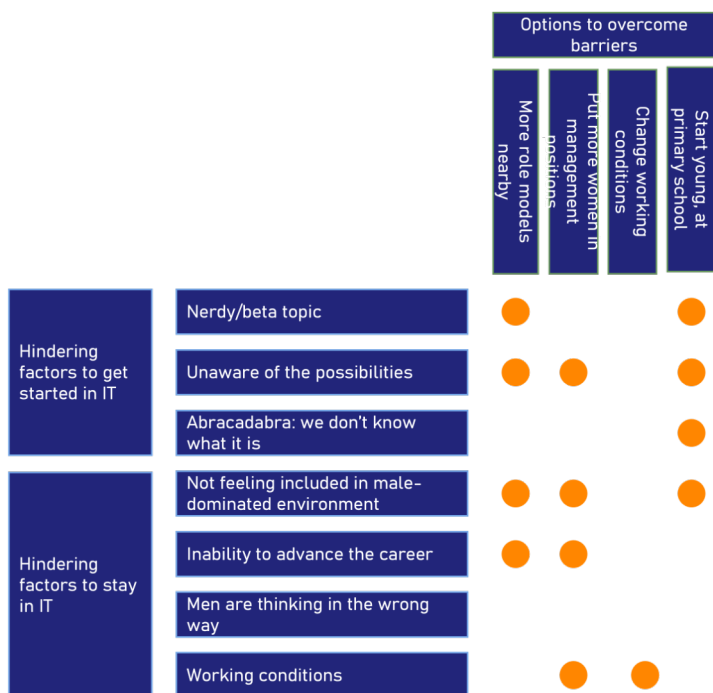
Figure 3 – solving the right problem

Hindering factors	Options to overcome barriers	More role models nearby	Put more women in management positions	Change working conditions	Start young, at primary school
Hindering factors to get started in IT	Nerdy/beta topic	●			●
	Unaware of the possibilities	●	●		●
	Abracadabra: we don't know what it is				●
Hindering factors to stay in IT	Not feeling included in male-dominated environment	●	●		●
	Inability to advance the career	●	●		
	Men are thinking in the wrong way				
	Working conditions		●	●	

women in IT in our literature review, interviews, and survey this is perhaps not surprising. This analysis contributes to the validity of our work.

Resolving the real issue

We also investigated whether the options to overcome barriers indeed address the barriers that were raised by our participants. This confrontation between options and barriers is shown in Figure 3

Based on this data alone, we cannot justify a prioritization of the options for overcoming the barriers, nor can we claim which barriers are easiest to overcome. Our gut feeling is that there is definitely some low hanging fruit the organizations can address themselves such as addressing the working conditions and the ability for women to advance their careers in IT. Other factors (mostly outside the direct area of influence of a single organization) are more difficult to address, such as the perception that IT is a nerdy/beta topic or even worse: that it is abracadabra. Last but not least, the fact that men are – in this context – thinking in the wong way may be deeply ingrained in our culture. Only significant and long lasting initiatives to changes this aspect of our culture are likely to yield results for these factors.

4. Conclusion

This paper is based on the premise that in an increasingly digital world, you have to put the people first. We strongly feel that people should

be valued for who they are. We are aware that diversity is a big topic, and have focused only on gender equality in this research. Our observation is that there is an inequality between men and women in IT. Our ambition is to investigate what factors hinder women to get/stay in IT and also to explore which options we have to overcome these obstacles.

We described the status quo based on (a) literature, (b) interviews, and (c) a short survey. Our analysis is based on an expert session that resulted in three hindering barriers to get started in IT (nerdy culture, unawareness of the possibilities, and uncertainty about what IT looks like). We found four hindering barriers to stay in IT (not feeling included in a male culture, inability to advance the career, men thinking in the wrong way, and the working conditions). Last but not least, we found four options for overcoming the barriers (role models, more women in management positions, improving working conditions, starting young).

A cross-check of our findings with the description of the status quo shows the validity of our results with the exception of one factor, notably the way men think – even though we are aware that our research is somewhat limited in scope and depth. Investigating this factor further is part of future research.

Our overall recommendation to companies, education institutions and perhaps even society at large is to invest in the four recommendations that result from our work, notably:

· More role models nearby

· Put more women in management positions

· Change working conditions

· Start young, at primary school

We are aware that this is a big topic to ask. However, in light of our fundamental belief that people – men and women alike – should be valued for who they are, we do believe that this is worth the investment.

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