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WOMEN IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS: EVIDENCE FROM TWO ESTONIA BASED COMPANIES

Master's thesis

Supervisor: Professor Elina Kallas, PhD

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Name and signature of supervisor…….

Allowed for defence on.....

(date)

We have written this master's thesis independently. All viewpoints of other authors, literary sources and data from elsewhere used for writing this paper have been referenced.

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(signatures of authors)

Abstract:

The aim of the Master's thesis is to find the factors positively and negatively affecting the Science, Technology, Engineering and Mathematics (STEM) study and career choices of Estonian women on an example of local females working in the engineering and technology divisions of two Nordic and Baltic financial institutions. The study engaged 10 participants employed at Business Intelligence, Software Engineering and Product Development departments of the companies mentioned above with the overall experience of three and more years in the STEM field and investigated females common experiences and perceptions. The results revealed that educational background, early adoption of technology, close associates, and the list of personal traits positively affected females and their decisions, while the lack of the same sex role models, gender preferences from the employers, family responsibilities and the masculinity of the STEM jobs were identified as hindering factors. The findings also exposed that women employed by the Nordic company less likely experienced the gender[1] disbalance compared to females working in the Estonian organization.

Keywords:

Estonia, Science, Technology, Engineering and Mathematics, Women

[1] Gender in this MA thesis represents two sexes, male and female. It doesn't focus on other identities.

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Introduction

It is historically well known that women are underrepresented in the science, technology, engineering, and maths (STEM), and numerous young females remain to bypass academic, professional or entrepreneurial opportunities in these fields.

Notwithstanding the global incentives and promotional programs of STEM courses at schools and universities, and the fact that the gender achievement gap between males and females has significantly narrowed down (NCER, 2018), the low-level involvement of women in technological fields is salient - statistically not only STEM degrees but also the jobs are consequently dominated by men (Osikominu and Pfeifer, 2018).

The labor market of the STEM sector, worldwide and particularly in Estonia, begets a constant demand for employment but females represent only a small group of professionals. The Estonian tech-ecosystem is rapidly evolving and is highly competitive but despite this, the 2017 OSKA report states that only 29 per cent of the country's tech specialists are women and the same number appears while revealing the percentage of female undergraduate and graduate students of the STEM degrees. Meanwhile, approximately 5.1 % of Estonian females are unemployed (ILO, 2018) and this estimate can be significantly lessened by increasing the number of female tech workers.

The identification of the factors, influencing Estonian female educational and career choices in STEM, can contribute to increasing the number of women entering this employment area and can benefit diminishing the existing employment gap which is significantly high, 6.5% (Eurostat, 2018)

The comprehensive literature has recorded the reasons behind female under-representation in the STEM sector, which is a rapid developing industry and the employment opportunities, offered by this area, have a high demand for the professionals. Meanwhile, it's indispensable that women have admittance to the variety of coaching possibilities to meet the particular demands of the field and use their knowledge efficiently (Shaw, 1999). Ramirez and Wotipka (2001) mentioned that the mediocre number of females in the fields of science and engineering in higher education globally

has more than tripled over 20 years (Ramirez and Wotipka, 2001) and unquestionably, women career choices have changed in recent times. However, still the number of women engaged in the STEM is alarming, and it's crucial to understand what affects female career aspirations. Schuster and Martiny (2016) argue that the tech field is stereotypically masculine and existing stereotypes become a persuasive hindrance for women to enter the so-known male field. The circumstances mentioned above can influence women's motivation and suspect their competence to succeed in maths, engineering, and programming (Schuster and Martiny, 2016).

This study was implemented in Business Intelligence, Software Engineering, and Product Development Departments of two Nordic and Baltic financial institutions, whose offices are located in Tartu and Tallinn, Estonia. Both companies employee highly qualified specialists of different ethnicities with diverse social-cultural and educational experiences. At the same time, the gender disbalance in the tech departments of Company 1 is 8:1, dominated by men, and 6:1 in Company 2, similarly.

Under this explanatory study, ten Estonian female tech specialists were interviewed, with the working experience of longer than 3 years in the STEM field. The aim of the study is to uncover the factors which affect women's STEM educational and career choices to suggest actionable approaches in increasing the female representation in this field.
The research questions are as follows:

1. Which internal and external, supporting and hampering factors influence Estonian female's study and profession choices in STEM?
2. What actionable solutions can be proposed to promote STEM in local women?

The thesis is divided into six major parts followed by the bibliography and appendix. The first part gives a concise introduction to the research and outlines the importance of the topic. The second part reviews the pertinent literature on the under-representation of females in the STEM sector globally. The third part discusses the study methodology and the method used to examine the research data.

The fourth and fifth parts define the primary outcomes of 10 in-depth interviews handled with women working in the Software Engineering, Business Intelligence and Product

Development Departments of two financial institutions. The sixth part compiles the findings of the research and urges artifices to promote women engagement into the STEM careers in the future in Estonia. In the closing, the limitations of this thesis are listed, and a concise summary of the additional study on this issue is rendered.

Literature Review

Science, Technology, Engineering, and Mathematics (STEM) have become prevalent in the modern world. The acronym STEM, formulated by Judith Ramaley, unites disciplines important for the economic advancement of communities and assurance of life conditions (Petroski, 2010). According to Lacey and Wright (2009) STEM plays an indispensable part in industrial growth and improvements.

Notwithstanding the market demand for specialists who can make breakthroughs in these areas, the number of females studying and working in STEM is surprisingly low. This part of the thesis explains the reasons behind the under-representation of women at school, university and employment levels based on the scientific literature, as well as common factors affecting their choices to be engaged in the STEM fields.

Researchers have been conducting studies to reveal the possible reasons influencing the choice of STEM-related disciplines among school girls and boys. Stanley and Benbow (1980) suggested that the cause for differences could be the genetic nature of the gender, while Maccoby and Jacklin (1974) proposed that the primary determinant was the development of the individual skills mainly focused on STEM subjects and the readiness to participate in experiments in these domains (Hyde, Fennema and Lamon, 1990). Over the past decades, the scientific literature has increasingly incorporated a gender approach to explain the study and career-related differences.

Fang and Schaumann's (2015) gender asymmetry discusses and summarizes the causes of this diversity. Gabei-Egozi, Sheyvit, and Yaish (2015) talk about the role of gender stereotypes and role of expectations: girls consider themselves to be different from those who study or work in the STEM-areas, while boys do not see themselves in the place of those who would choose the humanities. This exerts females and males to evaluate their abilities in humanitarian and technical disciplines in different ways. Shelley (2001) concludes that gender beliefs are one of the critical phenomena that impede gender equality in various areas of educational and professional activity, and describes a state that confirms that the STEM has been perceived as a “male” field by society. Gill et al. (2008) state that some females who have skills in maths and science at schools are

considered exceptional by other women because these fields remain stereotypically masculine. This perception creates barriers for young girls and they start to believe that males are a better fit for the STEM studies.

Significant others such as parents, teachers, school atmosphere and peers play an essential part in the process of shaping the life and career-wise plans for school children. (Gabay-Egosi, Sheivit, and Yeish, 2015). The authors argue that these factors formulate certain gender expectations for girls and boys which are picked up by students as their own sentiments. The study also states that teachers treat female and male students differently and they can strongly affect students' choices: teachers underestimate girls' success in technical sciences, expecting them to have higher results in the humanities. McDaniel (2016) emphasized that the career expectations of youngsters can explain the presence of gender segregation during the choice of specialties at the university and later the profession as well.

Genrich, Toleman, and Roberts (2014) state that females at schools receive information about possible career options from different references, including family members, teachers, and counselors. To increase girls awareness and engage more females in the STEM it's critically important to deliver complete information about the existing opportunities of the field.

Powell, Dainty and Bagilhole (2012) explore the reasons behind adopting STEM as a specialty for female students in the UK. Their findings explain that the following factors affect women choices to study technology and engineering as a major in the universities:

1. Having a STEM background grants an opportunity to have an exciting career for them.
2. The problem-solving oriented nature of the STEM fields is appealing to females.
3. Pursuing a STEM degree is prestigious, even if the future profession is eluded from the initial choice.
4. The STEM-area is diversified; thus different career-wise opportunities exist for them.
5. The background in the Maths and science has heavily influenced their choice.
6. STEM-related jobs have relatively higher salaries compared to other positions.

7. The family members and their involvement in the field, close associates, and school teachers encouraged their decision.

Gill et al. (2008) confirmed that the engagement of the family members in the technology and engineering fields influences the study choices for females. Additionally, the support from teachers and skills in the Maths and sciences encourages women to continue education in STEM fields. Finally, some females students, pursuing their degrees in science and engineering, enjoy competing with their male peers in these male-dominated disciplines. (Gill et al, 2008).

Even though women studying the STEM disciplines know that gender cannot affect their career choices, Bucack and Kadirgan (2011) exposed that gender inclination still influence their decisions. Powell , Dainty, and Bagilhole (2012) explained this with the existence of plenitude challenges, encountered by female STEM students: competing in the environment which is mainly controlled by men and being a part of the community, which believes in the employment gender-balance but has career-wise gender standards at the same time, are among them.

The study by the U.S. Department of Education (2012) states that females hold the majority of health science and therapeutic degrees and jobs in the States but they are still under-represented in the STEM areas. Wang and Degol (2017) have identified the range of factors influencing this: seems that the cognitive capability and relative intensities, employment inclinations, lifestyle preferences, field-precise ability faiths, and gender-related stereotypes and choices significantly affect the gap between the women and men job decisions. In addition, the social and cultural perspectives play an important role here. The Women engagement in the STEM is influenced by distinctive factors formed by the culture females represent (Bamberger, 2014). The family background, religious values, community support, is the small list of these critical constituents.

One of the most crucial determinant of choosing a STEM career for women is compensation (Friedmann, 2018), as the ranked wages of the STEM jobs are comprehensively higher than the non-STEM salaries. This seems be the main trigger for females while choosing among future employment options. In the meantime, many women revealed distrust and solicitudes about specific features of the STEM area and the

way it affects their healthy life. This vagueness has become an ascertaining string and has not been interestingly confined to maturer professionals as it has been foreseen (Simon, 2006).

Based on Swanson and Woitke research (1997), the under-representation of women in the STEM jobs can be explained by the number of observed or existing limitations or challenges associated with the career in the STEM. These perceptions about the barriers affect female decisions negatively.

On the other hand, Betz (1994) argues that the female career choices in the STEM can be positively affected by introducing other women specialists, who pursue their jobs in the same field. Indeed, the study by Bush, Henle, Cohen, Jenkins, and Kossy (2002) revealed that some females have abandoned their intentions to enter the STEM because of the lack of women role models.

Additionally, the absence of career supervision and deficiency of the information explaining the academic requirements were relieved as one of the negative factors influencing the number of females in the STEM jobs (Kekelis et al. 2005). The Women may know that they can fit in science and engineering (Murphy and Whitelegg, 2006), nonetheless the lack of proper job-related guidelines makes this field stereotypically masculine for them (Farenga and Joyce, 1999).

David M Hua (2010) suggested that the following factors directly influence the female decisions to choose the STEM-related areas as their main field of professional activity:

1. The presence of the same gender specialists in the working environment, with whom they can share similar qualities and traits.
2. The possibility to receive counseling and mentoring assistance from experienced co-workers.
3. The perceptions about the STEM field and diversity of career opportunities.
4. The recommendations from family members and people employed in the same sectors.
5. The existence of organizational commitment in the companies operating in the STEM areas.

Even though the negative and positive factors influencing the female under-representation have been identified decades ago, this global problem has reached a number of countries. The studies below reflect several interesting findings justified on the regional basis.

Cultural multifariousness is a recognized phenomenon that impedes female career progress in South Korea. This inevitable inclinations against females and employment versus family concerns clearly represent patterns of the women deprivations in companies. This includes the shortage of female role models, access to resources, instructors, etc. (Cho 2018). Historically, Korean companies pose antagonistic environment for female workers who have been holding superior positions and it is one of the significant internal factors affecting number of women in STEM fields (Cho 2018). The above-mentioned explicitly-defined gender differences cast valuable personal characteristics, such as self-confidence, leadership abilities, authenticity, and productiveness, which contribute to the Korean women's professional advancement.

Moreover, Turkish females working in the STEM fields face gender segregation which strongly influences their employment statuses (Ecevit 2003). The number of women engaged in these sectors is surprisingly high in the country, however they are confronted with the difficulties in career-wise development. The females often question themselves about the reasons behind giving priority to them at workplaces as well as in regard to choosing STEM as the main field of future profession. Ecevit (2003) affirms that domain knowledge is the primary and genuine reason explaining the unusual representation of females in Turkish STEM jobs. At the same time, family backgrounds and the self-motivation for professional advancement play an essential role there.

On the contrary, the study by Aaltio and Huang (2007) implies that Chinese females, working in STEM, have a tremendous level of enthusiasm which is reflected on their career-based progress. The full realization of their capabilities, followed by the satisfaction received from the professional preferment explains this phenomenon. Meanwhile, successful career often interacts with females' personal lives (Aaltio and Huang, 2007). The so-called work-family conflict becomes the main hindrance for females - women give preference to their career and jobs to achieve success.

The findings about the Canadian women entrepreneurs also underline the existing barriers and beliefs about gender differences females have to face in their working environments (Ezzedeen, 2012). The deficit of the same gender role models and mentors, the lack of opportunities to receive guidance and assistance from other females, the business interactions with the masculine industries and sectors are among these obstacles. Apart from that, certain expectations and dogmas from the society, demanding females to focus their effort on family instead of career, brings into question their capacities and the ability to succeed. However, the main driving force for these women encouraging them to achieve progress in their domains is the interest and excitement towards their jobs (Ezzedeen, 2012).

Similarly, the study about Arabian women, working in the informational technology sector, reveals challenges and obstacles they confront and explains the factors behind women under-representation in the STEM employment areas (Marzouqi, 2011). The barriers from their family members, decreasing the confidence and enthusiasm in females, the cultural traits of considering STEM sector suitable only for males as well as the lack of understanding career opportunities, which exists in the industry strongly affect the number of the UAE women continuing career in science and engineering (Marzouqi, 2011).

Wijayawardena (2016) claims that women working in the technology companies of Sri Lanka tend to adopt the masculine characteristics to fit the male-dominated teams. The women have to demonstrate their domain-related and managerial skills in an attempt to earn recognition from the co-workers. Different strategies emerge for other females in the process of proving their worthiness, such as expressing the self-reliance and confidence or choosing a submissive position at work (Wijayawardena, 2016).
Likewise, the STEM labor market in Spain is still considered as a male-dominated and male-favorable industry for female employment seekers (González Ramos, Bosch and Martínez García, 2017). The gender-disbalance, particularly the amount of working times, has become the main impediment for women who want to continue their careers in science and technology. The constant pressure from the employers results in fewer work hours as well as decreased salaries. The principal reason behind the demand for reduced work-time is distinctive understandings of family life from females perspectives.

Additionally, the existence of overqualified women specialists, perceived as standard, implies that females have to prove their expertise conversely to male co-workers (González Ramos, Bosch and Martínez García, 2017). Last but not least, female STEM workers are less attractive for companies compared to their male competitors.

Although multiple studies have been conducted about the women under-representation in the STEM fields, revealing the reasons for low engagement of females at educational and career levels, the authors of this thesis considered the lack of research focused on the Estonian female STEM workers and centered the scope of the study, particularly on Estonia.

Methods and Data

Choosing the appropriate methodological approach is indispensable for analyzing the obtained data since it establishes and determines the direction of the study and contributes to the outlining of the research findings (Saunders et al., 2009). The qualitative and quantitative research paradigms can be applied to certain studies depending on their type and scope (Creswell, 1994). Both, these descriptive and inductive approaches have particular advantages and limitations (Atieno, 2009). Respectively, various factors are recognized and have influenced the researchers' decision of adopting the methodological strategy for data acquisition and analysis.

Kothari (2004) confirms that various methods and techniques can be applied to the research problem and choosing the specific approach indeed depends on the researchers, their perceptions and the way of thinking they surround the study. Apart from that, the qualitative or quantitative methods should be thoughtfully chosen based on the relevance of the actual problem. With the quantitative method, the theory appears prior to the observation, while the qualitative approach elevates the establishment of the assumptions based on the observation (Dunne, 2015).

Remenyi et al. (1998) state that the identification of the research topic (what?), the selection of the suitable research strategy (how?) and the recognition of the importance of the study (why?) are the three essential steps which should be taken by researchers to understand the aim behind the conducting studies.

The authors of this Master's thesis have selected the explorative methodology to understand the problem from the angle the participants of this study see and experience it.

Atieno (2009) states that qualitative research is focused initially on the process, the way respondents perceive, see and experience the surroundings. This descriptive approach explains the existing relationships and helps to understand the scope of the problem through in-depth interviews. The possibility of further elaborations from the participants' side allows the researchers to perceive the process in a holistic way. Bryman (2008)

considers the qualitative methodology to be "inductivist, constructionist, and interpretivist", however, states that the particular approach does not have to follow all above-mentioned recommendations at the same time.

The main contrast between the quantitative and qualitative approaches is that the latter tries to understand compound phenomena of the human mind through the sets of open questions. This inductive method does not believe that the singular reality exists. It observes different participants, their perceptions and individual experiences, and considers them unique (Atieno, 2009).

In accordance to above-stated, this Master's thesis aims to genuinely understand the perceived reasons behind the female under-representation in the Estonian STEM sector and reveal the suggestions which can become actionable solutions in increasing the number of women in the local science, engineering and technology jobs. Respectively, the qualitative method is the best fit for this thesis.

Additionally, different research methods have been considered as well, such as utilizing surveys for data gathering and case studies for obtaining the information, but authors eventually decided that the in-depth interviews and a well-outlined sample of participants could reveal individual and more reliable perceptions about the research problem. Thus the qualitative approach became the most suitable option for this thesis.

The researchers decided to conduct exploratory, face-to-face interviews with the sample group of 10 Estonian tech women working in Nordic and Baltic financial institutions in Tartu and Tallinn offices. The participants with different educational backgrounds and levels, age groups and family status were thoroughly chosen to collect unbiased data. All these females represented the Business Intelligence, Product Development and Software Engineering departments of the companies mentioned earlier.

Initially, the researchers presented the aim of the thesis and the resembling interview questions to 18 females employed by these financial institutions, ultimately 10 volunteers, with diverse qualifications, agreed to participate in the study to uncover the challenges and opportunities existing for women in the Estonian STEM market.

The participating companies are large-scale international financial institutions offering asset management, retail banking, and other services with the headquarters in Stockholm and London. Their offices in Tartu and Tallinn employ more than 2500 specialists in total and these offices are the main base for Business Intelligence, Product Development, and Software Engineering departments. The latter represents the majority of the technical workers of approximately 400. Another reason why the research focuses explicitly on Tartu and Tallinn offices is that the study investigates the perceptions of Estonian female tech workers.

It is worthwhile to mention that the women-to-men ratio in the STEM jobs is as low as 1:8, 1:7 and 1:5 in these institutions. The organizations will be referred to as Company 1 and Company 2 later.

The diverse backgrounds of participants and style of the interviews carried helped to obtain sufficient information concerning the research problem.

The explanatory interviews followed the semi-structured style so that firstly, the researchers could investigate certain topics and ask for further clarifications from the respondents if there was a need and secondly, the interviewers could maintain the set of questions as clear as possible, for avoiding any deviations from the scope agreed.

All ten one to one interviews were recorded in Company 1 and Company 2 offices using the audio recording software for follow-up transcriptions.

The set of interview questions allowed the interviewers to touch certain points and motives, which guided the discussion in the right way of meeting the aims and intentions of the thesis. The respondents' educational backgrounds, influences from close associates, challenges and opportunities existing at previous and current workplaces as well as suggestions for females entering the STEM field in Estonia and recommendations for promotional incentives were among the discussed topics.

The interview transcripts and the guide can be found in Appendix 3 and 4.

The identifiable names of the respondents and companies were removed so that the participants of the interviews remain anonymous.

The researchers and interviewees were granted access to the special meeting rooms equipped with audio-recording software. The generated audio files and transcripts are saved in secure cloud storage and will be deleted upon participants request.

The respondents had sufficient information about the thesis aims and the interview structure from the beginning of the meeting. The participant consent form (see Appendix 1), outlining the principal themes, has been delivered to interviewees before the audio discussions started to be recorded. It was accepted and signed by all respondents.

The findings accumulated from the 10 in-depth interviews are divided into several thematic groups. This structure allowed the authors to combine similar observations and perceptions into certain themes, identify the key influencing factors and accurately link them to the aims and objectives of the research. These themes are as follows: Educational Background, Close Associates as Influencers, Personal Traits, Career Experiences, Recommendations to Peers and Suggestions to increase the women engagement in the Estonian STEM.

Analysis and Results

Educational Background. The interviews revealed the importance and influence of the primary and secondary education on female's career decisions.

Respondent 1, 25-year-old software engineer at Company 1, graduated from the school in Estonian countryside and continued the bachelor's studies focused on Cyber Security Engineering in Tallinn. Additionally, she starts the STEM-related Master's degree in the nearest future. This participant, when referring to the high school specialized courses, noted '*I was good at Maths at school, we had courses for students interested in advanced mathematics*.' Also, the exchange studies from the university became a significant factor affecting her future employability: '*I think, both of them [two exchange visits] were very important for me, and um, I'd say they played the huge role in my career.*'

Respondent 2, a 28-year-old Business Intelligence analyst at Company 1, graduated from the Tartu high school and pursued an undergraduate degree in Electrical and Computer Engineering in Bulgaria. Her further studies include the Master's degree from the Software Engineering program, another ongoing graduate course in E-governance and Technologies and the expected Ph.D in ICT. This participant retrieves '*I was pretty good at maths and physics during my high school studies. I participated in lots of competitions and have several rewards.*'

Respondent 3, a 23-year-old Software Engineer at Company 1, graduated from the Russian school program in Narva and took English-based Business Administration Bachelor's studies later. She gradually dropped out from the undergraduate course and pursued a bachelor's degree in IT. Currently, this respondent participates in the online Master's program specialized in data analysis. Discussing her secondary school experiences, she noted '*I never had any interest in mathematics or other natural science subjects during my school times.*'

Respondent 4, a 35-year-old head of the Product Development at Company 1, studied in Tallinn secondary school '*which was focused on Physics and Maths*' and obtained the degree in Law in Tartu. This participant did not engage herself in further graduate studies,

but noted that she '*took several prolonged courses in product and project management to comply with specific requirements my current job demands*.'

Respondent 5, a 24-year-old Software Engineer at Company 2, finished her school studies in Võru and was admitted to the Business Administration Bachelor's program in Tallinn, but she never graduated from it. However, the interviewee aims to pursue the degree: '*I'm definitely thinking about applying for it [undergraduate studies]...I'll take some online program ... distance learning'*. This participant also states that she did not have exceptional skills at Maths and Engineering during secondary school studies '*I was an ordinary student at school, nothing special*.'

Respondent 6, a 35-year-old Software engineer at Company 2, graduated from the gymnasium close to Rakvere and eventually obtained Bachelor's and Master's degrees in the field of Information Technology at Tallinn universities. Her primarily study choice was a program related to IT, but '*then I decided that IT is not my thing, because it was ... not practical at that time.*' The rejection from several other programs defined the respondent's study path. Referring to her school subjects, this participant states that basic courses in Programming and hardware use were '*useful and exciting at the same time.*' Similarly, the university lectures contributed to her future career: '*we [coursemates] studied lots of useful subjects ... I had so many things to learn and master*.'

Respondent 7, a 26-year-old Software engineer at Company 2, studied at the Tartu Gymnasium, applied for the Geography Bachelor's program but graduated from the Computer Science. This participant states that during school studies she '*had advanced courses in Maths and Physics*,' and the subjects offered at the university were related to the STEM as well: ' *I took some extra lectures from higher maths and advanced programming*.' Respondent 7 thinks that educational background is essential for the successful career '*they [courses] are the foundation for you and later ... you have to do deep learning...but without these introductory courses, it's a hassle in most of the cases.*' Respondent 8, a 37-year-old Software engineer at Company 2, graduated from the Tallinn gymnasium and started studying the bachelor's of NSIT in Tallinn as well. She doesn't have a degree from the university but took the STEM-related courses from the IT college. This respondent noted that school subjects involving '*computers with terminals*' positively influenced her career decision. The interviewee also commented on courses

taught at the university and the college: *'even though I didn't graduate from my Bachelor's, these courses helped me a lot in my career*.'

Respondent 9, a 28-year-old Software engineer at Company 1, studied at Tapa High School and during this secondary studies she '*had good results in Maths and Physics*.' This participant pursued a bachelor's degree in programming at the university in Tallinn. Similarly, Respondent 10, a 28-year-old Software engineer at Company 2, studied at Tartu Gymnasium and finished the Informatics undergraduate program in Tartu as well. During her school studies, this respondent expressed interest in the STEM courses, because as she informed: '*I always preferred to learn more mathematical subjects...I never liked reading or writing that much*.'

Close Associates as Influencers. The interviews identified the strong bond between the close associates and the way their perceptions, attitudes, and expressions affected the females' study and career choices.

Respondent 1 stated that the inspiration for her future studies became mother, who took IT-related courses and this participant helped her during the training process. '*The things I saw and learned really attracted me and I thought that I needed to grasp more, ... knowledge and practice*' added Respondent 1. The support and approval from the family affected her choice positively as well. On the contrary, the doubts expressed by male classmates and teachers disturbed her as they believed that '*it was pretty unlikely I [Respondent 1] would succeed in it.*'

Respondent 2 also declared that she decided to start STEM studies after receiving the convincing reference from the experienced friend: [he] '*recommended the university and the program...motivated me to apply*.' Another important factor for this participant was a family: '*without their trust in me it would be just impossible to achieve everything I'm today*.' Similarly to Respondent 1, this interviewee faces negative attitudes from school teachers '*they did not believe that the IT field was promising for girls.*'

Respondent 3, who didn't have a technical educational background and working experience, blindly applied to the IT position and with the help of the team leader and the mentor found the most suitable career opportunity: '*the inspiration and push for me was*

my brilliant TL who helped me to discover the hidden talent in myself.' The support and tolerance, expressed by the family members, also played a vital role for this participant.

Respondent 4, similarly to Respondent 3 didn't have the practical experience in STEM, and the motivator, to challenge herself and become the adequate fit for the superior position, became the employers and their perceptions about the importance of this participants contributions: [the employer] was '*the main thing encouraging me to specialize in the product development.*'

Respondent 5, coming with the social sciences background, also mentions the influence of the team member who introduced an innovative programming software to her: '*I liked it, and I felt it was not very difficult... downloaded it and started playing with it.*' Moreover, the assistance and guidance from the family member, who was highly qualified in this domain became the main driving force for her '*my brother was really helpful... I think he was my motivator, ... sometimes when I wanted to give up, like, he helped a lot with basics, understanding the tasks and put a lot of effort in me.*'

Respondent 6, unlikely to others, chose the STEM field because she '*didn't get in any other programs.*' The lack of information about the IT sector and opportunities offered by this field established STEM stereotypically masculine in her peers' perceptions: '*IT became quite popular but ... was not typical for girls.*' On the other hand, the respondent retrieved the sentiment connected to her studies and the support from the family: '*my parents bought the computer ... it was expensive... when I started my Bachelors, I hoped that I would know how to do basics with that machine...*' This emotion can be considered as a petite influencer for this participant.
Respondent 7, who was studying Geography as a major, received a reference from her sister to learn the programming language: ' *I liked it so much that I decided to continue my studies and career as well in IT*.' This participant's family approached her decision reasonably. Farther, the respondent added and interpreted: 'my parents have working experience in maths, maybe it explains things [their supportiveness] a little bit more.'

Respondent 8, like Respondent 6, mentions the gift, received from the family member and its significant value to her: ' *father bought the laptop, it ... played an important part in my decision later. I wanted to use it professionally and to make practical use of it.*' At

the same time, the early adoption of technology, assistance from school teachers and encouraging support from her father became the main factors forming the final choice.

Respondent 9 admits that parents, engaged in the maths and physics, helped her during the prioritization of the future career options: '*my parents influenced me a lot.*' Similarly to other interviewees, this participant also mentions the sentiment, the book, and the references from father, which inspired her: ' *he [the father] used to say that it [the book] was a future... At that moment I couldn't understand much, but I was kind of intrigued.*' While the family's reaction to her choice was supportive, friends and peers believed that jobs were defined by the gender: *'they didn't understand much, because back then programming was not a very feminine career.*'

Respondent 10 also mentions the influence of her peers: '*I was watching my classmates, who were using all these things [computers, internet, etc] and they so inspired me.*' The process of experiencing innovations also affected this participant: '*my friend, we did our first website... it was crazy. I felt I was a real programmer.*' Additionally, the positive attitudes from the close associates kept her moving forward: '*everyone was rooting me and telling ... you have chosen a profession of the future, that was giving me more motivation to study IT.*'

Personal Traits. The interviews identified how the personal characteristics affected the female's engagement in the STEM field.

Respondent 1 mentioned that she had skills, talents, and intelligence to achieve the superior position: '*I see myself as a Team Lead one day.*' At the same time, she rationally approached the personal goal and admitted: ' *I need to acquire knowledge in specific domains, to be … confident in things I'll be doing.*'

Respondent 2 experienced her skills almost in every field of STEM: '*during these times I tried everything that interested me, ... from practical physics to software engineering and now the process analysis.*' She acknowledged that disappointments made her stronger and the ability to enjoy doing exciting things kept her moving: '*I guess challenges and my interests brought me to the place where I stand today.*'

Respondent 3 claims that not having the relevant working experience didn't hinder her: ' *I was very persuasive and I got the job.*' The most important to this participant is personal satisfaction: '*what matters to me is that I'm happy with my choice.*' She has certain career goals as well: '*big data analysis, this is where I see myself in a couple of years.*'

Respondent 4 knows how the employer values her professional skills: '*my experience and ...expertise was needed much.*' At the same time, she's exacting to herself: '*I have to know everything.*' The challenges and obstacles become motivations for her:' ...*these little mistrusts helped me and umm, pushed to do more...*'

On the contrary, Respondent 5 expressed her fears and wrong perceptions: '*I didn't believe that I could do it, like, I could be as good as other guys [males] were.*' Noticeably, she perceives her achievements as luck as mentions the followings: '*I was an ordinary student at school, not special*' and '*surprisingly I got it [the job]*.'

Respondent 6, like Respondent 5 revealed her worries and doubts: '*I feel over-pressured, especially when I need to do multitasking.*' Later she explained the reasoning behind; the family responsibilities affect her career negatively: '*I lose my concentration and productivity*' and '*I'm not confident enough.*'

Respondent 7 regularly works on personal progress and doesn't believe that genuine constraints exist: '*I think it's me who sets some limits to myself and um, I'm always working on this.*' Besides, she follows her plans devotedly: '*I want to have a solid background and experience, and I think it will be the best investment for my future.*'

Respondent 8 noticed that observing the outcomes of her work keeps her achieving more. Similarly, Respondent 9, noted: '*I like the feeling when I find a solution for the hard or challenging task; this feeling means everything to me.*' At the same time, this participant like the Respondent 7, stated that she used to build artificial obstacles to herself: '*it was me, creating these barriers, I was not confident enough to speak myself.*' However, her current attitude is convincing: ' *I know what I want, and I usually don't fall under the influence of others.*'

Career Experiences. The interviews revealed the past and present career experiences, the positive and negative factors affecting women at workplaces and the existing opportunities and obstacles for the self and professional development.

Respondent 1, who has 5 years working experience in STEM, started her career as an Intern in Estonian start-up and soon moved to help desk technician position. She states that gender inequality and preference existed back then: '*women didn't have much chance to demonstrate their developing skills, like coding...they would give a superiority to the male newbies at IT positions...I never had a chance to be promoted*' The lack of female mentors at the workplace affected her aspirations negatively: '*we didn't have any female role model in the company who would inspire us…'* Her current employer is more loyal: '*nobody expects from you to move the mountains, and I can enjoy my work as much as I'd like to...*'. However, at the same time, she admits that gender disbalance is apparent.

Respondent 2, who has 9 years working experience in STEM, joined the Estonian sector as a research assistant and stated that the gender difference '*between male and female workers was huge and irritating...starting from the salaries to working hours.*' At the same time, she believes that this experience contributed to her personal and professional growth. Her current employer is more gender neutral, but she notices that '*most TLs are men in the company and it's a little bit problematic, maybe not problematic, but you know...*'. This participant also mentioned the common beliefs and their effect on women's career success: '*I think that the stereotypes about women negatively affect it and also increase the gap and.*'

Respondent 3, who has 3 years experience in STEM, hadn't faced any barriers or obstacles at her workplace: '*I've never experienced any inequality here. I can't cite gender discrimination or so.*' This participant admits that she had wrong beliefs about women in engineering: *'...when I joined the IT department and saw the female team lead I was so surprised... I never expected to meet a woman on such a superior position, especially leading men.*' At the same time, she mentions assistance and support for personal development, received from team members.

Respondent 4, who has 3 years experience in STEM, doesn't think that the current number of females, working at engineering and technology positions, has adverse effects: '*for my*

co-workers and me, it's not a concern...we do not face umm, implications because of the so-called 'gender disbalance.' At the same time, she observed that women don't usually apply for engineering and product development positions: '*we have lots of girls in operations, but engineering teams are mostly represented by males.*' This participant considers natural to doubt someone's ability to succeed in specific fields, herewith, she noted that had support from team members and employees which simplified her decision. In her closing notes, Respondent 4 admitted: '*it is a little tough to work in the male-dominated atmosphere.*'

Similarly, Respondent 5, who has 4 years working experience in STEM, started her career as a tester. She noted that males had much working experience compared to female co-workers and thus explained the gender pay gap. She also noticed that women didn't tend to achieve superior positions: ' *it's not because of their abilities or knowledge or so, it's just the comfort zone and lack of interest.*' This participant stated that the gender gap and career-related obstacles exist in most companies, but she didn't experience it personally:' *I think there won't be barriers hindering me, at least in [her current company]*.'

Respondent 6, who has 9 years working experience in STEM, noted that she never came across to gender disbalance at her workplace: '*I never felt that because I am a female, my male co-workers are underestimating me or my abilities.*' Furthermore, she noted that the IT sector doesn't experience gender inequality at all: '*there is no such a gender gap in IT field. Maybe it influences other sectors, but not us*.' At the same time, this participant mentioned the support and assistance received from co-workers:'*I have a good team who are always there for me*.'

Respondent 7, who has 3 years working experience in STEM, noted that her job requires much attention, analytical and critical thinking, but obstacles hindering her self or career development are not evident: '*I can't remember any specific moment or event which became a real barrier for me.*' Like Respondent 6, this participant never experienced the gender pay gap or disbalance at the workplace: '*I think super balanced and don't have such kind of negative influencing factors.*' She also noted that her company follows the Nordic footsteps and integrates thriving methods :' *that Estonia is close to Nordics, and we try to copy their well-established practices, including the annulment of the gender gap as well. We try to be equal in every way.*'

Respondent 8, who has 7 years working experience in STEM, joined the field as an application administrator. She noted about the first job: '*it was a valuable experience for me, like self-discovery and career wise as well. I established some contacts and learned a lot.*' Even though gender disbalance at her workplace exists, this participant doesn't perceive it as a problem:' *I never thought about it from this perspective, it never disturbed me, to be honest.*' She explained the reasoning behind her approach as well: ' *I don't think much about the gender of my co-workers, the best gets the place, that's how it works*.'

Respondent 9, who has 10 years working experience in STEM, described her first employer as '*very supportive.*' This participant stated that her male co-workers were deeply experienced and she was shy to ask for assistance from them: '*I thought that they would think I was not smart enough... I was not confident enough to speak myself.*' According to Respondent 9, her current company has high standards, and the hindering circumstances are not present:' *I can't say even one barrier or factor that influences me negatively.*' However, she paid attention to stereotypes, still existing at the workplace: '*when I have online meetings with my co-workers from different offices, they don't want to believe that I'm also a SE, like at a glance.*'

Respondent 10, who has 4.5 years working experience in STEM, described her first jobs as '*gender diverse*' and mentioned that one woman held superior IT-related position at the company: '*She was terrific, like a role model for all of us.*' She also added that it became useful experience for her future career steps: '*I was struggling with my social life and both, the studies and the work were a little bit messy for a while...*'. This participant stated IT-related jobs are the most appealing for her: ' *I have been thinking to change my profession a bit, but ... IT jobs are ones who are most exciting and um, interesting to me.*'

Before moving to the recommendations and suggestions given by respondents, we are summarizing main results (see Table 1).

Table 1. Keywords about main results from conducted interviews

Area of the study	**Keywords**
Educational background	STEM related Primary and Secondary Education, STEM Specialized Courses

Close Associates as Influencers	Family Members, Friends and Peers, Teachers, Co-Workers
Personal Traits	Goal Orientation, Persuasiveness, Knowledge, Fears and Doubts
Career Experiences	Gender Inequality, Gender Difference and Gender Beliefs, Gender Neutrality, Gender Pay Gap

Source: Authors

Recommendations to Peers. The participants offered advice, based on personal observations, to females entering the STEM studies and career fields.

Respondent 1 believes that self-confidence, self-reliability, and purposefulness are essential for women who are entering the male-dominated fields: '*the most important thing is to believe in yourself and set some goals and achieve them*' and '*any people won't accept you as a professional, but you can always prove that they were wrong...have faith in yourself.*'

Similarly, Respondent 2 states that the journey is individual, but having clear goals and trust in themselves leads females to the success: '*there is no ready recipe which guides you through this...the most important thing is to have an aim and to believe in yourself... then they [women]can do everything.*'

Following other's proposals, Respondent 3 also recommended that aspirations, having personal milestones, and readiness to challenges were crucial: ' *be more courageous...curious... confident and never believe in stereotypes, learn as much as it's possible and... don't be afraid of difficulties.*'

Respondent 4 suggested that women should follow three steps to success. According to this participant, self-confidence, domain knowledge, and enthusiasm could make females role models for others: '*they [women] should believe in themselves...it's about what you carry and how you use the knowledge…be interested in what you're doing.*'

Respondent 5 also believes women create obstacles and challenges by themselves '*...these barriers are in their [women] heads.*' She stated that with well-defined goals and faith everything is possible, even having a successful career in a stereotypically male field. At the same time, likewise, to Respondent 4 this participant indicated the importance of education and added that asking assistance from experienced peers should be natural: '*we should always be in search of something new ...never be afraid to ask for help.*'

Other participants declared the same: Respondent 6 thinks that STEM offers a myriad of opportunities and women should be open to new challenges, herewith, Respondent 7 added that these challenges form strong personalities: '*they [challenged] make you more mature...'*. Respondent 8 also agreed that the process of entering STEM is personal, followed by some unsuccessful attempts, but she recommends: ' *just don't be afraid that you'll fail, remember, it's normal, I do it every day, but I learn a lot from failures.*'

Similarly, Respondent 9 advised: ' *be curious, practice a lot and never give up*' and Respondent 10 added that negative references or stereotypes shouldn't affect females decisions, girls should be confident and aspire to personal career aims.

Suggestions to increase the women engagement in Estonian STEM. The respondents discussed the actionable areas and proposed the solutions which can influence the problem positively.

Respondent 1 talked about the influence of media on young girls decisions: '*the introduction of female influencers and successful women in tech can probe the situation from another perspective.*'

Respondent 2 also believes in the role of schools, educational institutions and social clubs. According to this participant, the problem is sensitive, and '*experienced specialists should carefully define the policies and incentives to reduce the gender gap locally in companies and globally in the country.*'

Respondent 3 mentioned the ongoing campaigns and events supporting women in STEM: '*national ICT is Everywhere campaign...Tech Sisters... Garage48... I think all of these will have a significant impact on the growth.*' She also added that hackathons, specially dedicated to girls, can promote science and technology among young peers. Besides,

Respondent 3 added: '*there are lots of successful Estonian women who will be more than happy to share their stories and encourage others.'*

Respondent 4 pointed out the importance of scholarship and other types of awards to attract more girls in STEM. Moreover, she believed that young women had the deficiency of adequate information about STEM opportunities. Thus this participant suggested: '*we need specialists who'll focus on first explaining to young girls what is STEM...what are future career options...motivating them to apply for it.*'

Respondent 5 also mentioned the role of government, dedicated programs, and assistance from domain experts of the field: ' *there should be people explaining things or helping students with choosing programs, ... it's so essential to understand what you [young girls] like and um, what you can do, also distinguish them as well*.'

Respondent 6 talked about the importance of career meeting, where companies and institutions operating in the STEM fields can present the opportunities and career chances existing in the sector: '*it should often be and more companies should engage in it.*' Moreover, she addressed the problem of small cities: '*every young girl has equal access to things and opportunities as well.*'

Respondent 7 pointed out how the job shadowing helps females who want to engage themselves in science and technology jobs: ' *lots of women see that there are other females employed by the company in STEM departments.*'

Respondent 8, like Respondent 5, mentioned the importance of social events promoting STEM disciplines among young women, while Respondent 9 stated that the research should be done about school students and investigate the obstacles and barriers they face or influences they have to enter the STEM studies and jobs later.

Respondent 10 mentioned the role models as well: 'having a woman as a president should be the coolest thing for Estonian females.' At the same time activities empowering girls, explaining the importance of STEM and motivating them to be part of it, are crucial according to this participant.

Table 2. Keywords about main results from conducted interviews

Area of the study	**Keywords**
Recommendations to Peers	Self-Confidence, Self-Reliability, Purposefulness, Knowledge
Suggestions by respondents	Promoting STEM through Media, Educational Institutions, Social Clubs and Events, Government Incentives and Companies

Source: Authors

Findings and Discussion

The researchers analyzed all interviews and sorted the findings into several themes. Respondents expressed their perceptions and experiences concerning the factors, which influence and hinder the Estonian females' engagement in the STEM sector. These attitudes, opinions, and thoughts were interconnected to the previously discussed literature. Although the findings were both, complementary and contradictory to the scientific literature presented in the Literature Review Chapter. The discussion of the findings relates the data discovered from the interviews to the theoretical part and to the aim and objectives of this Master's Thesis.

The first research objective was the identification of the possible causes affecting the female STEM-related educational and career choices.

Educational Background. Deliberately and cautiously chosen interview questions aided the researchers and respondents in the process of the discussion about the Educational Background. All the interviews had the same structure: the introductory part was followed by the opening inquiry to collect the information about participants' educational achievements. This query was '*Where did you study for school and university"*? Followed by the question about respondents' educational level and the major obtained: '*What are your degree and specialty*'?

The findings revealed that all the interviewees had different educational backgrounds: some of them were enrolled at the schools with a focus on technical subjects while others didn't put much effort in the science, maths and engineering courses during the primary and secondary education. Some women completed graduate studies and were aiming at Ph.D. while others had withdrawn applications from undergraduate programs. The diversity was evident in females' initial study choices as well; the sample consisted of participants, who followed either social sciences or information technology curriculums at the universities.

Several Respondents inferred that technical subjects taken at schools, colleges or universities became the foundation for their careers. While others, who did not have basic

domain knowledge, had either to apply to intensive short-period educational programs or academic studies later.

The researchers observed that women, who had received specialized education, further pursued the STEM studies and chose the career based on their skills in these subjects, at the same time, females, who did not practice in Maths, Science, and Technology at schools or universities, initially joined the social science programs and eventually withdrew applications.

Interestingly, Hyde, Fennema, Lamon (1990) concluded that the early adoption of skills in the technical subjects and the eagerness to participate in competitions was the primary determinant of their future career in STEM. Similarly, Gill et al. (2008) and A Powell, Dainty and Bagilhole (2012) stated that the skills in Maths and sciences encourage women to continue further education in STEM fields.

The group of the participants with non-technical educational background stated that the reason behind their original choice of profession was the lack of adequate information about the existing opportunities of STEM fields and the common perceptions that males excelled better at technical jobs. This is the reflection of the studies by Gill et al. (2008) and McDaniel (2016) confirming that teachers often underestimate females with unique skills in maths and science and gender segregation, typical for schools, influences young women's study and career choices.

Close Associates. The interviews reflected the roles and influences of close associates, including family members, peers, teachers and co-workers, on females study and career choices.

The initial question was '*When and why did you decide to specialize in science, mathematics, engineering, and technology?*', followed by the inquiry '*How did your family members, teachers, and friends react to your choice*,' but almost all the respondents listed the close associates and events related to them as factors determining their decisions after introducing the first question.

Several Respondents posited that the support from parents, the references from siblings and friends engaged in the STEM fields, assistance from colleagues and mentors at work motivated them to achieve their aspirations, while others talked about the negative attitudes from teachers, male classmates, and co-workers, who doubted their skills and talents.

Indeed, the study by Gabay-Egosi, Sheivit, and Yesh (2015) reasoned the impact of close acquaintances on student's study and career choices. The researchers outlined that teachers approach female and male students differently and their stereotypical perceptions can strongly and prejudicially affect students' choices.

Additionally, the findings by Powell, Dainty and Bagilhole (2012) and Bamberger (2014) revealed that the family members and their involvement in the STEM field, associates including friends and peers, as well as school teachers and colleagues often encourage females in the decision-making process. (Hassan and Marzouqi, 2013).

Personal Traits. The interviews also revealed that the individual characteristics and personal traits of females, participating in this research, had a significant influence on their perceptions and the way of overcoming distinct obstacles. Even though that majority of respondents indicated that the role of close associates was vital in the process of decision-making, the researchers found that qualities, such as ambitions, self-confidence, determination, and feeling, such as doubts, concerns and, suspicions, reflected in participants stories, influenced their paths.

Several respondents stated that the male-dominated workspaces became the motivation for them to prove their abilities and strengths. This can be related to Gill et al. (2008) findings declaring that females enjoy the competition with their male peers in the so-called masculine disciplines.

Participants also declared that personal characteristics such as self-confidence and purposefulness strongly affected their professional progress. In accordance with this notice, Cho (2018) and Aaltio and Huang (2007) explained how enthusiasm, interest, and self-reliance contributed to the success of Korean and Chinese females engaged in STEM jobs. Ecevit (2003) self-motivation in Turkish women.

Career Experiences. The researchers intended to collect information about the past and present work experiences, environment, attitudes from colleagues, personal and professional development possibilities from the Estonian women pursuing their careers in the STEM field for more than 3 years. The identified factors, which positively or negatively affected the females' employment, showed that the gender-disbalance is significantly reduced compared to previous years, at the same time the number of women tech workers is increased. The interesting findings were observed at the companies as well: females working in the Nordic company are less likely to feel the gender-gap compared to women employed by the Estonian company.

Respondents mentioned that the factors, positively influencing their profession, were the possibility of achieving higher positions and self-development, relatively high salary typical to STEM jobs, assistance and support received from the qualified colleagues and the cultural environments of the companies operating in the STEM field.

These findings reflect the conclusions by Powell, Dainty and Bagilhole (2012), who stated that the opportunity of having excising carrier, the diversity of the jobs and the high salaries, compared to other professions, were crucial determinants behind females choices. Similarly, (Kekelis et al. 2005) and (Murphy and Whitelegg 2006) found that the effect of the support and mentoring from colleagues.

Additionally, the researchers (Friedmann 2018) and David M Hua (2010) also pointed out the importance of the benefits received, heterogeneity of vocational opportunities and presence of organizational responsibility in the companies as positive influencers.

Several hindering factors were listed as well. The lack of female role models, gender preferences from the employers, family responsibilities and the masculinity of the STEM field were among them. Indeed, Betz (1994) and David M Hua (2010) affirmed the importance of the same gender specialist in the working environments and (Cho 2018) and (J L. Nixdorff and M K. Aryafar 2013) discussed this problem on examples of Korean and Canadian women. Furthermore, so-called work-family conflict and family obligations have been recognized as preventing factors by Wang and Degol (2017) and (Aaltio and Huang 2007).

Apart from that, the study by (Ana M. González Ramos, Núria Vergés Bosch and José Saturnino Martínez García 2017) affirmed participants notices about gender preferences. Findings stated that female STEM workers were less attractive for companies compared to their male competitors.

The second research objective was to identify the areas which can have a positive impact on Estonian females in STEM

Recommendations to Peers. All Respondents were asked to give suggestions, advice, and references to the young women joining STEM areas local. The question '*Do you have any recommendations to give to Estonian females entering the STEM sector?*' outlined several different approaches.

Majority of the participants listed the self-confidence and determination to achieve individual goals as the driving forces of the success. The researchers also observed that interviewees repeatedly noted that failures are natural and accompanying part of the personal progress and barriers only appear when females believe in their existence.

Having professional aspirations and milestones, possessing ability not to surrender and prove self-worthiness, being exciting and enthusiastic about the job and use every chance of self and personal development are the key recommendations from the participants to young females who are entering the STEM field, which is still male-dominated and considered as stereotypically masculine.

Suggestions to increase the women engagement in Estonian STEM. The respondents' also suggested the ways of political, educational, socio-cultural changes which would positively influence the females' engagement in Estonian STEM. Most of the participants emphasized the importance of pre-education, role-models and mentors, governmental and non-governmental programs and incentives.

The following suggestions were identified by the researchers:

1. The role of media, promoting female influencers and successful women in tech who share personal stories of success and therefore encourage others.
2. The engagement of qualified specialists in educational institutions to inform students about opportunities existing in the STEM fields and advice on study and career choices.
3. The introduction of national programs and incentives, such as scholarships and rewards for females engaged in science, technology, and engineering and optimization of the promotional events, including hackathons and social clubs, specially designed for women.
4. The commitment from companies operating in the STEM field, such as presenting themselves at career fairs and offering job shadowing for females to explain the opportunities available for women.

Respondents believe that these political, social and educational changes should have a positive effect on the young generation and increase their interest and engagement in the STEM disciplines and jobs later.

Conclusions

Understanding the reasons behind the female under-representation in Estonian STEM is vitally important to propose actionable recommendations and solutions which positively impacts the problem.

The objective of this work was to identify the reasons which influence the Estonian females decision to enter STEM studies and career.

The researchers found that primary and secondary education and early access to technology, support from family members and close associates, the personal traits including self-confidence and purposefulness, had a positive impact on females choice to enter the STEM field. On the contrary, the absence of the same gender influencers, male favoritism from employers, stereotypes and perceptions about the existing opportunities and the family responsibilities negatively affected their decisions. The researchers also identified that females working in the Nordic company less likely encountered gender disbalance because of the declared values and culture of the organization.

The researchers proposed the following changes to increase Estonian females engagement in STEM studies and profession:

1. promoting female influences and successful women in tech through media
2. engaging specialists at schools to inform students about the STEM opportunities and assist them in the decision-making process
3. launching the governmental programs supporting females in STEM and at the same time reaching more women through social clubs and events
4. and involving companies, which can host the open days to show females the current opportunities.

Although, the sample consisted only from Estonian females, the diversity of educational and career-wise backgrounds, individual beliefs and aspirations were salient. The repetitiveness and similarities in storylines were observed, but the respondents discussed and covered the addressed questions from different angles. Herewith, it must be realized

that the number of respondents, participating in this research, and their experiences, may not reflect the perceptions and suggestions of the larger sample of Estonian females engaged in STEM.

Thus, the first recommendation would be to increase the sample size along with the number of companies and engage male participants in the research. This allows investigating the problem from another perspective and identifying the additional root causes.

The second recommendation is to conduct the study on school and university students and uncover the factors affecting the choice of the STEM disciplines at primary and secondary educational levels. This enables the understanding of the type of changes needed for increasing the number of females interested in science, engineering, and technology.

Finally, the implementation of proposed actions, such as social events exposing the female role models and influencers or hackathons and job shadowing, and the observation of the short and long term consequences are recommended.

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Appendix

Appendix 1: Participant Informed Consent Form

Participant Informed Consent Form

WOMEN IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS: EVIDENCE FROM TWO ESTONIA BASED COMPANIES

The objective of this Master's Thesis is to analyze the backgrounds, experiences and existing gender disbalance of females, employed in the Business Intelligence, the Software Engineering and the Product Development departments of the two companies 1 in Estonia.
Each respondent is invited to participate in an interview, which takes around 1 hour. The interview itself will be digitally recorded and the data confidentiality will be maintained. Later, the audio files will be transcribed into the text files. The publication will not reveal the identificational information of the interviewees and the organizations they represent.

Please, ask existing questions before signing this consent form.

I, one of the respondents, herewith confirm the following:

1. My participation in the study is voluntary and I have a right to withdraw myself from the research at any point without facing any kind of penalties.

2. I understand that I can refuse to answer questions that seem discriminative, uncomfortable and apprehensive to me.

3. I accept the fact that the interview will be recorded, envisaging that my and my organization's confidentiality is being protected.

4. The representatives of my company will neither attend the interview nor obtain access to the recorded or transcripted files.

5. I've read and understood the explanatory information above.

6. The copy of the consent form was given to me beforehand.

_____ _____

Respondent signature date

For further information, please contact:

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Appendix 2: The interview questions

Introduction:

First of all, thank you for agreeing to participate in this research.

As you know, I'm the student of the University of Tartu, writing a Master's Thesis about the women in technology and I aim to investigate the reasons behind their under-representation in the STEM field. With this research, I intend to assess the difficulties females face in the ICT sector, reveal the possible gender gap which exists in their organizations and to explore the factors that triggered their choice of entering the STEM. The scope is particularly focused on Estonia, to be more specific, the research is held in two financial institutions and their Business Intelligence, Software Engineering and Product Development departments. 10 Estonian women, employed for more than 3 years in above-mentioned departments, will be interviewed in total.

The interview will be recorded, and the audio files will be transcripted into the text ones. Here, I'd like to mention that your and the companies' identity won't be revealed.

Before we start the actual recording, I want to remind you that you have a right to refuse participation in this research. Also, please, bear in mind, that during the interview, you can skip any question that is uncomfortable for you.

Additionally, this is the Participant Informed Consent Form which mainly contains the same information that I recently delivered to you.
Please, carefully read and sign it.

Basic information related questions:

1. Please tell a bit about yourself: what’s your nationality, how old are you, what is your family status, where did you grow up?
2. Where did you study for school and university? What is your degree and speciality?

3. When and why did you decide to specialize in science, mathematics, engineering and technology? Tell me more about the factors or events that inspired your decision.
4. How did your family, teachers and friends react to your choice? What kind of negative factors did you face while choosing to continue your career in the STEM field?
5. What's your current position and how long have you been working in this organization? How long have you been working in STEM in total?

The First and Current position related questions:

1. Let's talk about your first position in the STEM field in Estonia. What was your role and when did you start it?
2. How many women colleagues did you have in your organization in the STEM area? What differences did you feel compared to male co-workers?
3. What kind of barriers did you face in terms of self and career-wise development back then?
4. Now, let's discuss your current position. When did you start it? How many STEM positions did you have between your first and current positions? How many women colleagues do you have in your department? What kind of barriers do you face in terms of self and career-wise development in your current position?

General questions:

1. As you've mentioned earlier, you've been working in the technology field for X years. What are the factors that keep you moving in your career?
2. How the representation of women in the Estonian ICT sector has changed since you first entered this field? [explain representation as the increase/decrease in the number of women IT professionals, if necessary]
3. How the "Gender Disbalance" in STEM have influenced you at your workplace? What are the factors that negatively or positively affected it? What can be done to reduce this gap in Estonian organizations?

4. What recommendations do you give to Estonian females entering the STEM sector?
5. What local changes [political, educational, socio-cultural] can increase women engaged in technology?

Thank you again for participating in this. The transcript of the audio file will be forwarded to you so that you can confirm that all the information was precisely documented.
In case any corrections or revisions are needed, please, don't hesitate to contact me on the email(s) which is available on the consent form.

Appendix 3: Transcription key for the interviews:

I - Interviewer

R - Respondent

SE - Software Engineering

HR - Human Resources

ECE - Electrical and Computer Engineering

TL - Team Leader

BI - Business Intelligence

NGO - Non Governmental Organization

STEM - Science Technology Engineering and Maths

ICT - Information and Communications Technology

BA - Business Administration

CSA - Customer Support Associate

IT - Information Technology

BDA - Business Data Analytics

PO - Product Owner

PD - Product Development

BI - Business Intelligence

AML - Anti Money Laundering

BIT - Business Information Technology

NSIT - Network Systems and Intelligent Technology

Respondent, Interviewee and Participant refers to the same person

Appendix 4: Interview Transcripts

Interview 1

I - Hello, [name removed], thanks for accepting my offer. Let's start the interview. Please, tell a bit about yourself: what's your nationality, how old are you, what is your family status, where did you grow up?

R - Hi, thanks for having me. I'm a native Estonian; I was born in Assaku and spent my childhood there. Um, actually, it's more accurate to say that I spent more than half of my life in Assaku... I graduated from elementary school and then moved to Tallinn to my parents' house. After moving in here, I was spending much time in the countryside, still. Umm, I am 25 years old, and I'm engaged... Yeah, I recently got engaged. (smiles)

I - So you graduated from the Assaku high school, and what's about the university? What is your degree and speciality?

R - Yes, I entered the school in my countryside and, umm, then my parents decided that, like, for my future it was better to continue studies in Tallinn and yes, now I totally agree, that it was a right decision... About the university... I was enrolled at the Cyber Security Engineering bachelor's program at [the university name is removed], and during my studies, I did two exchanges in Brno Technical University and University of Antwerp, in Belgium. And um, I think, both of them were very important for me and um, I'd say they played the huge role in my career... And now I'm becoming the student again (smiles). I'm aiming at the Master's degree at [the university name is removed]. So, another round of my studies starts in September, I guess (smiles).

I - Oh, that's interesting... So you keep moving forward in your studies. Is the new Master's also in STEM? And why did you decide to start your studies in this field? Were there any factors or events that inspired your decision?

R - Yes, exactly, the new Master is in STEM, I hope I'll get it... I haven't received the final answer yet, like from the University (smiles)...

Um , about my choice...I think I was good at maths at school, we had special courses for students interested in advanced mathematics and played chess pretty okay... Yes, I'd say more than okay, and then my parents really encouraged me, like, supported, and the biggest inspiration was my mom... At this time she was taking advanced courses in

Informational technologies, and I was involved in her studies, I was kind of helping her, and I learned a lot as well. Umm, the things I saw and learned really attracted me and I thought that I needed to grasp more, like knowledge and practice... So I decided to specialize in this, and that's how I ended up at the University (smiles).

I - And how did your family and friends react to your choice? Did you face any negative factors when you were choosing the career in STEM?

R - Oh, no...From my family, I had huge support... My mom approved my choice immediately (smiles). But to be honest, I don't remember any assistance from my teachers or classmates, especially boys, they doubted this decision and umm, I can understand why not every 18 years old girl wants to become a programmer. One of my teachers said that this profession was too like troublesome or so for girls and it was pretty unlikely I would succeed in it. But we both see they were wrong. (smiles)

I- Oh, that's not very supportive… Let's talk about your current position, what is your job about, how long have you been working in this organization? And in STEM in total?

R - I'm currently working as a software engineer in the SE department of [the company name removed]. Um, I joined my team and the company over 1.5 years ago... Overall, in STEM I have 5 years experience.

I - It's very impressive! What's about your first STEM position in Estonia. What was your role and when did you start it?

R - I started my internship at one of the Estonian Start-Ups. Yes, it was an internship, surprisingly... Surprisingly because the company really needed fresh minds and they decided to onboard me as an intern and wanted to test me, like my possibilities in this field...

It took me more than 5 months to start working on the tasks independently, without like being controlled and my first job was a Help Desk technician. My team was mainly working on the technical issues within the company... I had direct communications with our employees and customers. And my role was to fix technical problems through remote access, to manage and monitor incidents. Also, I was working in the user management in Active Directory, Microsoft Exchange and Microsoft Lync. I started this job when I was 19 years old, and from this perspective, I think I was quite lucky.

I - Seems like your first job was a valuable experience for you. And how many women colleagues did you have in that company, in your department? Did you feel any differences compared to male co-workers?

R - Umm, my team was quite small... We were 7, and I was the only girl. At the end of the year, the number of women help-desk technicians increased to 4, while the overall number of the team members was around 15-16... I wouldn't say that I had an upsetting experience, but still, gender inequality existed and hindered me a bit... I can give you a small example... My male co-workers mainly worked in programming and as an IT support, while women didn't have much chance to demonstrate their developing skills, like coding. I remember that once the HR manager said that they would give a superiority to the male newbies at IT positions. At this time, a lot of experienced females could do the same job, I think it was a trust issue from our executives, they didn't believe in us... I don't know why though.

I - I see. And what kind of barriers did you face in terms of self and career-wise development back then?

R - Um... It was hard for me, and I think for other women as well to prove that we can do the same, we can be the same, that we are equal to men, I mean intellectually. Like, we didn't have any female role model in the company who would inspire us, and I felt like our voices were unheard in many cases. I worked there for 2.5 years, and even though I was quite good, I never had a chance to be promoted. I always saw myself in software developing and engineering, but I didn't have that opportunity there. I confirm that stereotypes play a huge role...Everyone believes that males should be developers, it's somewhat natural for them and if you are a woman...Especially, umm, a young woman in STEM they doubt in you so much that you start doubting yourself.

I - It should be very disturbing and encumbering...What's about your current position. Tell me more about it: when did you start it? How many STEM positions did you have between your first and current positions? How many women colleagues do you have in your department? And did you face any barriers terms of self and career-wise development in your current position?

R - Um, currently I think we are 8 women in SE department, and the number is growing... I think we're expecting two new joiners in upcoming months and yes, this is

huge(smiles)... What I really enjoy here is that I'm not afraid to admit that I don't know something and I need help or assistance...Nobody expects from you to move the mountains, and I can enjoy my work as much as I'd like to.... On the other hand, I see myself as a Team Lead one day, I believe I have skills and abilities to accomplish that, but I'm not sure how it works in [the company name is removed]. Still, the field is considered masculine, and you have to work hard to prove that you deserve the place. Um, I think this is one of the reasons why I decided to continue my studies. I need to acquire knowledge in specific domains, to be … confident in things I'll be doing...

I - I see, you feel you need more knowledge to succeed...As you've mentioned earlier, you've been working in the technology field for 5 years. What are the factors that keep you moving in your career?

R - Yes...It's been a long journey and also a challenging journey. But what kept me going is that enjoy being a software developer, I fancy what I do. (smiles) I think other motivators were my fiance and my mother, they greatly believed in me and encouraged in every hurdle I faced. Also, other women... It's surprisingly pleasant to see other females next to you, seems like we're inspiring each other and it helps a lot. At least in my case (smiles)

I - It should be a great motivator to see other females as well, I understand that… What do you think, how the representation of women in the Estonian ICT sector has changed since you first entered this field?

R - Oh. When I started working five years ago, it was only me, 19 years old girl in the male-dominated team... Umm, since then many things have changed...Or should have changed (smiles). Today the gender disbalance in my department is still apparent, males are ruling for sure (smiles). I don't think this is correct, but I don't blame the company itself. If women are not interested in IT jobs, what should the organizations do? Force them? It's very strange that in Estonia we need to motivate girls that much to enter STEM fields… Like with or without statistics or like official data, it's clear, not many women are interested in so-called masculine jobs.

I - What do you thing, does the "Gender Disbalance" in STEM have influenced you at your workplace? What can be done to reduce this gap in Estonian organizations?

R - Yes, the gap surely exists and it has much influence on women in STEM, um, I believe it does.

To be honest, I haven't thought about the factors which affect it either positively or negatively, maybe people and their perceptions? Yes, I'll stick with this opinion (smiles)....

I guess that it's us who decide that females can or can't do things and yeah, even though this is a cliche, somehow we believe in it and make stereotypes... Um, like I don't know what could be an ultimate solution to this problem...Definitely, we can't change others' mindsets... But companies can have certain goals: like increase the number of female tech employees, or do special training, team-building activities for them. That's all I can come up right now.

I - Do you have any recommendations to give to Estonian females entering the STEM sector?

R -Well, yes... I would say that the most important thing is to believe in yourself and set some goals and achieve them.

Sometimes it's easy, especially, when you have the support from family and friends, sometimes it becomes more difficult... You have to decide things alone. Many people won't accept you as a professional, but you can always prove that they were wrong. So, the best advice from me is to have faith in yourself.

I - Thanks and the last question, do you think that any local changes [political, educational, socio-cultural] can increase women engaged in technology?

R -Umm, well, I think everything starts with schools. It's like a foundation for our future-selves, you know... More access to science, technology, and engineering at the school level may increase female awareness...

But at the same time, I graduated almost 8 years ago, and I believe things

have changed, so it's difficult to judge from this point... Otherwise, I really like how the government approaches this problem, but um, maybe also TV and media can help here a little... Like the introduction of female influencers and successful women in tech can probe the situation from another perspective.

I - Thanks a lot for your answers, it was nice having you.

Interview 2

I - Hi, [the name is removed], thanks for accepting my offer. Let's start our interview. First, please, tell a bit about yourself: what's your nationality, how old are you, what is your family status, where did you grow up?

R - Hi, I'm Estonian...I grew up in Tartu and spent more than half of my life there... I'm 28 years old, not married and not in a relationship at this moment.

I - So, I assume you graduated from the school in Tartu. Was it a special school oriented on any STEM studies? What's about the university? What are your degree and specialty?

R - Well, yes... I graduated from high school in Tartu. And then joined [the university name is removed] in Bulgaria... For my undergraduate studies...And my specialty was electrical and computer engineering. Initially, I started the Informational Technology program and then switched to ECE profile... After graduating from [the university name is removed] I came back to Estonia and was enrolled in the [the university name is removed] graduate program of the Software Engineering... I have my master's degree from there...

Currently, I'm studying at the [the university name is removed], E-governance and Technologies. It's my second master's...After graduation, I plan to continue with Ph.D. in Information and Technology Communication.

I - This is very impressive! Can you talk about factors or events that inspired you to enter the STEM field?

R -Okay. I was pretty good at maths and physics during my high school studies. I participated in lots of competitions and have several rewards...But I couldn't decide what to choose for my future career... Like, I was between Business Administration and Information Technology... To be honest, I didn't know much about the last.

I'd say that my final decision was the part of the series of fortunate events (smiles).

My friend started his studies in [the university name is removed] in Bulgaria and recommended me the university and the program. Umm, I liked the curricula and decided to apply for the bachelors of IT.

It was a big challenge, but, but my family fully supported me. But after the first semester, I switched the profile to ECE and graduated from that program...I felt like it was more interesting for me.

Um, about the factors that influenced my choice...Umm, I think it was pretty auspicious that I had a reference... He who played huge role in the story and um, motivated me to apply. Secondly, also, undoubtedly important factor was my family and their support... I think without their trust in me it would be just impossible to achieve everything I'm today.

I - So you had a support from the family and friends. Where there any negative factors which you face while choosing the career in the STEM?

R - Well, I think the only, like, difficult part for my family was the fact that I was moving to another country and it which was not close to Estonia and also my age, I was pretty young back then (smiles).

I didn't face other negative responses from my family or friends, but I remember my teachers telling me that my choice was something like simply senseless, as they did not believe that the IT field was promising for girls... I had to answer questions like "what will you be doing for a living, updating operational systems for PCs?". And I have to admit that it was very annoying for me...

Then when I started working as an assistant-researcher in the physics lab, in Bulgaria, the first disenchantment I felt was that there were no other female co-workers... I found it quite difficult to approach male superiors with my questions or issues. And even like more than 10 years have passed since then, I do face the same problem during my studies and employment, the number of local tech women is so low.

I - I see. Tell me more about your current position. How long have you been working in this organization? And how long have you been working in STEM in total?

R - Umm, I joined the Business Intelligence department of [the company name is removed] 1 over a year ago, but have been working in the company for 2.5 years already... In total, I have about 9 years of experience in the STEM. Out of these, 3 years in Bulgaria as a physic lab assistant... 2 years in the international research programme, based in Estonia and my position was the data analyst... Then one year as a freelancer and another... And 1.5 years as a Software Engineer in this company... Yes (smiles). I've been moving a lot between different positions... I wanted to find the one which would perfectly suit me.

I - Both your studies and working experiences are very impressive. Now I want to ask about your first position in the Estonian STEM. What was your role and when did you start it?

R - Umm, when I came back from Bulgaria, in 2012. There was an international research programme about plasmonic nanostructures, and I joined the team as a data analyst... Basically, they needed someone who could understand physics, math and was able to code in specific programming languages and turned out I was the perfect match.

I - How many women colleagues did you have in the programme? Did you feel any differences compared to male co-workers?

R - Actually, I was the only female researcher in my team... I think there was another woman enrolled in the programme as well, but during 2 years of my employment, I never had a chance to meet her...

The difference between male and female workers was huge and irritating. Starting from the salaries to working hours, most of the time I had to arrange my working schedule with the calendar of the senior data analyst because he was working full time in another noble company and basically it meant evening shifts for me.

I - I see. DId you face barriers in terms of self and career-wise development back then?

R - Yes, certainly. I'd worked for that program for 2 years, and I knew that the chances for the career development were quite low, but at the same time I fully enjoyed my job, and I think that was the reason why I didn't drop out... Also, I have to admit that this position taught me a lot, like it played a huge role in my personal and professional growth, umm, because, umm, I used the skills and knowledge acquired there later, umm, during my freelance projects and in [the company name is removed] as well.

R - Than this explains a lot. Now, let's discuss your current position. When did you start it? How many STEM positions did you have between your first and current positions? How many women colleagues do you have in your department? What kind of barriers do you face in terms of self and career-wise development in your current position?

R - Well, umm, before I start talking about the current position, umm, I'd like to mention one more time that I joined [the company names is removed] almost 3 years ago as a Software Engineer and gradually moved to the BI department.
At this moment, we are three females versus 8 males in my team (smiles). My migration was not painful at all, I mean from my, as an employee's, perspective, umm, and the previous team lead was very supportive, and you know, he even encouraged me to apply for this position...
Like, I don't see any differences between the abilities of the female and male co-workers and also ... I believe ... um, there are not like huge differences in the compensations as well, at least as I know... But there is one thing, that most TLs are men in the company and it's a little bit problematic, maybe not problematic, but you know. Also, I think it's evident that we have fewer women specialists like overall in product and engineering departments. Like otherwise, I've not faced any hindering factors which would hold me back achieving my career-wise plans.

R - As you've mentioned earlier, you've been working in the technology field for 10 years. What are the factors that keep you moving in your career?
I - Yes... I've been studying STEM and working in this field since 2009, um, it's almost 10 years indeed, ... and during these times I tried everything that interested me, like from practical physics to software engineering and now the process analysis... I'm finishing my second masters, and I'm aiming at the Ph.D., and I think I keep moving because I like what I do and I want to challenge myself and face all the hurdles which appear on my way, you know... There were a bunch of disappointments and also periods of self-discoveries, but at the same time, my curiosity was so intense, that it kept me moving. Umm, I guess challenges and my interests brought me to the place where I stand today.

I - What do you think, how the representation of women in the Estonian ICT sector has changed since you first entered this field?
R - Umm, I won't be very dramatic, and hence I won't say that it's nearly the same, but from my perspective, the under-representation of females in Estonian STEM is a problem, and the recent statistics prove the same. Umm, I haven't observed the drastic growth of women tech workers in the field, but obviously there are more females in the product and process improvement teams, but still engineering, developing and science are not very popular among Estonian girls. If I compare my first and current jobs, the

ratio was 1:8 and now is 3:8, so based on this the increase is 200%, but we both know that this number doesn't reflect the reality.

I- Has the "Gender Disbalance "influenced you at your workplace?And what do you think, what can be done to reduce this gap in Estonian organizations?

R - Mmm, I think the gender gap exists in all Estonian companies, more or less. In my case, I think this gap motivated me... like to achieve more and to prove that I'm intellectually capable of the same things as males who work in tech. I think that the stereotypes about women negatively affect it and also increase the gap and ... one of the solutions I can suggest is representing the quotas. Some may argue about the negative sides of the quotas but... still, I think it's better than observing the crushing reality.

I - What recommendations can you give to Estonian females entering the STEM sector?

R - Well, the most important thing is to have an aim and to believe in yourself... I don't think that there are radical differences between new joiner females of STEM in Estonia and globally. I believe that ... there are more or less the same obstacles, umm, the same difficulties to overcome and... there is no ready recipe which guides you through this "male-dominated" field but still, if girls believe in themselves they can do everything (smiles). I hope this is not too pathetic (smiles).

I - Do you think that local changes [political, educational, socio-cultural] can increase women engaged in technology?

R - Umm, let me think about it... Umm, I'm actively following the updates from our governmental institutions and also from NGOs which try to increase the women awareness of the STEM, and their ... how do you call it? Incentives and programs seem pretty nice to me.

But if you've noticed, the problem starts with schools, girls don't know much about STEM, they don't believe that women can be successful programmers, engineers, mathematicians, scientists, and developers ... they don't see other women who could be their role models, who could motivate them or teach, or give some references... I believe that there should be more social clubs for females, interested in all fields of STEM, not only for new joiners but for oldies as well because it's extremely important to support each other... I can't comment much about the females who have families and work in tech

at the same time, as I don't have experienced it on my shoulders, but ... I assume this should be one of the biggest impediments for them.
Also, umm, we can't aggressively argue with people who believe in the ... popular stereotypes, such as the programming is for boys, but we can show and prove that girls can also do it (smiles). I think it's a susceptible case and experienced specialists should carefully define the policies and incentives to reduce the gender gap locally in companies and globally in the country.

I - Thanks a lot for your answers, it was nice having you.

Interview 3

I - Hello [the name is removed], thank you for participating in this. Let's start our interview, please tell a bit about yourself: what's your nationality, how old are you, what is your family status, where did you grow up?

R - Hello. I'm Russian-Estonian, I was born in St Petersburg and my family moved to Narva when I was 5 years old. Now I'm 23 and not married, but in a relationship.

I - So, it means you graduated from the school in Narva. What's about university? What is your degree and speciality?

R - Yes, exactly, I graduated from high school in Narva; my studies were in Russian. Then I moved to Tallinn and enrolled in the Business Administration program of [the university name is removed] and started working as a Customer Support in [the company name is removed]... After four months I moved to the IT department and dropped out of the BA bachelors. The next year I applied to the Business Information Technology program and graduated from it, so I'm the bachelor of Information Technology.
Currently, I'm doing my master's degree, specializing in big data and using the pros of distance learning (smiles).

I - Can you tell me more about when and why did you decide to specialize in this field? Where there any factors or events that inspired your decision?

R - Umm, I never had any interest in mathematics or other natural science subjects during my school times and I, to be honest, I randomly applied to the bachelors... Then, I started working at [the company name is removed] as a customer support associate, and after some time they announced the position of the intern in the IT department. When I read the description of duties and responsibilities decided to apply, I was like, why not? But I had zero experience in this field. I think I was very persuasive and I got the job (smiles). I had a fantastic mentor and team leader, and I learned a lot... After some time I decided that it was a better idea to abandon the program and take some IT-related courses, so I did. Back to your question, the inspiration and push for me was my brilliant TL who helped me to discover the hidden talent in myself (smiles).

I - What were your family members and friends reactions to your choice? Did you face any negativity from their side?

R - My family reacted, umm, how to say? tolerably fine to my initial choice (smiles). They knew that I was on my way of discovering the most suitable option, but... dropping out from the program and starting the new profile was a little bit unexpected even for them. I would blame it on non-awareness about the existing opportunities in the IT sector. In general, I didn't face much negative from my close ones… they were supportive... and what matters to me is that I'm happy with my choice and they are happy when they see my success.

I - I see, let's talk about your current position. What's is it, how long have you been working in this organization? How long have you been working in STEM in total?

R - I joined [the company name is removed] 4 years ago. Currently, I'm working as a Software Engineer, but I started my career as a CSA. In total, I'm in the IT field for almost three years, yes, in two months I'm celebrating my 3rd anniversary as a SE.

I - Okay, that's nice… It means that your current position is your first STEM related position… Do you want to add something more about it?

R - Yes, that's right... I've not changed the company or the team during these three years, and I guess the whole story behind me and SE is a little bit unusual. As I said previously, I didn't have many talents or even the eagerness to study any of the STEM disciplines, but accidentally ended up working in one of the most exciting spheres (smiles).

I - How many women colleagues do you have currently? What differences do you feel compared to male co-workers?

R - My department's approach is the smaller teams, the better the results (smiles). So, I'm the only female SE in my team; I believe there are around 10-12 women in SE department while the number of male co-workers is really high...the ratios can be as much as 70% men.

The gender disbalance or gap is not alerting at this point, but I'd like to see more females in my and other SE teams as well... The quotas became quite popular, but I against this approach, I think it's better to hire the best candidate for the position rather than fill the quota.

I - Do you face any kind of barriers in terms of self and career-wise development?

R - I don't feel like there are any barriers or I don't know, boundaries which restrict my career and self-development within my team. I've never experienced any inequality here... The different expertise levels of my co-workers can explain the contrast in salaries; I can't cite gender discrimination or so... I'm sure that if I express the interest in another field, such as product or process development, my team leader and my teammates will be more than happy to assist me and simplify the migration process... Yeah, it was the same from the very beginning.

I - As you've mentioned earlier, you've been working in the technology field for 3 years. What are the factors that keep you moving in your career?

R - Yes, but I'm holding the same position during these years... No, don't misunderstand me, it was, and it is my choice... These constant updates in the product and the process attract me and umm, I learn much every day. It's not a monotonous work, you see?; it's a lifetime experience for me. These people believed in my potential, and every day I try to prove that... they made the right choice. At the beginning of the interview, I mentioned that I'm pursuing the master's degree in the big data analysis, this is where I see myself in a couple of years... but it's a long and challenging path. I want to be ready... I mean I want to have enough experience and expertise when I finally move to BDA.

I - What do you think, how the representation of women in the Estonian ICT sector has changed since you first entered this field?

R - Umm,I don't have much information about it, but from my personal observations, definitely, it has increased. Like, I remember when I joined the IT department and saw the female team lead I was so surprised... I never expected to meet a woman on such a superior position, especially leading men. Since then, 10 of girls joined SE in [the company name is removed], but not all of them were native Estonians, and I have an impression that engineering and programming are not popular among Estonian females. It's quite surprising... especially considering the number of boys interested in the STEM field.

I - Is there a "Gender Disbalance" which influences you at your workplace? If yes, what can be done to reduce this gap in Estonian organizations?

R - Umm, I haven't faced a so-called gender gap... but I've heard several complaints from other Estonian females working in the STEM. Most of the time it's umm, the difference in salaries and like barriers in career development. But I think women themselves artificially create these things because they don't believe in themselves.

I - Do you have any recommendations these women or other Estonian females entering the STEM sector?

R - Well, yes, I'd suggest them to be more courageous...curious... confident and never believe in stereotypes, learn as much as it's possible and... don't be afraid of difficulties. I think that everyone should aspire to their goals and umm, being a woman should not be a reason incommoding you.

I - What local changes [political, educational, socio-cultural] can increase women engaged in technology?

R - Ooh, there are so many things happening right now in Estonia... I'm proud to be part of several events and training for girls who are interested in STEM. I want to see more females in technology and other fields of STEM as well, and I think that our primary focus should be schools because of more or less the primary education and early years cast you the person you are...

I know that we have national ICT is Everywhere campaign, there is some school(s) ? focused on girls who want to study programming and a lot of inspirational events from Tech Sisters, I think all of these will have a significant impact on the growth, but umm, yeah it takes time.

Also, I wish to see more girls at hackathons, several months ago Garage48 had an Empowering Women Hackathon in Ukraine, and I think we should keep this way and held events especially for girls... and show them that being women and being engaged in STEM is natural; there are lots of successful Estonian women who will be more than happy to share their stories and encourage others, I think.

I - Thanks a lot for your answers, it was nice having you.

Interview 4

I - Hello [the name is removed], thank you for participating in this. Let's start our interview. Please tell a bit about yourself: what's your nationality, how old are you, what is your family status, where did you grow up?

R - I'm Estonian... 35 years old… I was born and raised in Tallinn... I'm not married, and I have a kid.

I - Where did you study for school and university? What is your degree and speciality?

R - Um, it's a long story... I graduated from high school in Tallinn, which was focused on physics and maths and continued my bachelor's at [the university name is removed] in Tartu in the field of social sciences and humanities... Back then I was between choosing something technical and more or less innovative or something regular, and I ended up with the major in law. So, this means I had no interactions with technology or other STEM areas during my undergraduate studies. Then I moved to Belgium and was working in my domain for a couple of years... and during that times I'd not say that I had expressed much interest in technical fields... I've not continued my further degree studies, but I took several prolonged courses in product and project management to comply with specific requirements my current job demands.

I - Does it mean that you've changed your career path specifically because of this job? Alternatively, were there any factors or events that inspired your decision?

R - Yes, you got it right. My current employer and the position are the primary determinants which encouraged me to enter the technology field... Also, motivators behind my choice were the importance of this domain for the company... and my skills

from previous degree studies. I think we're back to the company again, which means that the main thing encouraging me to specialize in the product development is [the company name is removed]

I - I see. Did you face any negative factors when you decided to continue your career in this field?

R - Umm, not really, it was not a sudden or let's say instantaneous decision; I moved from one department to another where my experience and umm, expertise was needed much. I think that nobody from my co-workers or family reacted unreasonably to it (smiles).

I - What's your current position and how long have you been working in this organization?

R - I'm a senior team leader of the Product development department specializing in compliance... Umm, I've been working in [the company name is removed] since 2014... During the first two years, my position was the head of the compliance team, and in 2016 we understood that we needed the specially designed department focusing on the product itself, so I was promoted to the role which I currently have.

Umm, it was not easy journey, like changing your whole mindset, I mean adjusting it to the new environment, discovering or umm, uncovering specific abilities you have is not as straightforward as it may sound to someone. Also, umm, I put much effort into it, started additional courses and training and gradually involved myself in business processes, operations, and engineering. I have to know everything.

I - It should be really challenging. Let's talk about your workplace more, how many women colleagues do you have in your department?

R - Umm, I don't know the exact number, but in operations, I think the ratio is 1:1, but in business processes and umm, engineering the number is less, it can be as low as 15 or 20 %. Umm, for my co-workers and me, it's not a concern. Umm, don't misunderstand me; I wish to see more females in the STEM fields, but at this point, we do not face umm, implications because of the so-called 'gender dis-balance.' I personally attend all the new-joiner interviews, and for engineering and product owning positions, umm, we don't receive many applications from females. The reasons behind it should be disturbing I guess.

I - And what do you think, what are these reasons?

R - Umm, I think that women don't believe much in themselves and sometimes don't put enough effort into certain things. But, umm, I fully understand it... With family and other responsibilities, you know, it's not always easy to have umm, bright career… umm, sometimes you have to choose, and umm, the choice is the family in most cases.

As I said, we have lots of girls in operations, but engineering teams are mostly represented by males. Umm, I now realize that finding the reasons behind this is not simple. Maybe females still think that programming is the job for boys? and they have some stereotypes? At the same time, we had a girl who moved from operations to engineering, and it could be stimuli for other females to do so... Also, we rarely receive female applications for PO positions, and the competition is extremely high there, but I know 2 marvelous women, really... in [the company name is removed] who are the product owners of certain departments.

I - What kind of barriers do you face in terms of self and career-wise development in your current position?

R - Umm, there were no barriers from the company... or co-workers, but it took much time and effort to come to this place. Moving from the compliance to the product was one of the biggest challenges I've ever faced... Fortunately, I had support from others... but I think several people didn't believe it would work... I don't want to point fingers or prove something like they were wrong and I succeeded... but at that point, with all of the hustle it was not easy for me... Still... I think it's natural to distrust someone's abilities or even talents... And, em, I think these little mistrusts helped me and umm, pushed to do more. I think the results so far speak about what and how I've done (smiles).

I - So, do you think that these kept you moving in your career?

R - Absolutely, yes... I think it's my one of the best habits, you know, to have specific goals and achieve them... and if anyone or anything hampers me I don't give up (smiles). I do better, I do more... Also, what keeps me moving is that I like my job.. I believe that I'm doing something important... something great, you know... And this an impact on millions of our customers, umm, a positive impact. It is my motivation, and umm, I'm trying to motivate my team as well…

If you are not interested in what you're doing or if you don't understand the importance of your mission, you'll never reach the finish; you'll quit on the halfway.

I - That's very true. Let's talk about the representation of women in the Estonian ICT sector. Has it changed since you entered this field?

R - Um, I think it's better to talk about how the number of women working in technical departments of [the company name is removed] has changed since I joined them. Umm, I remember that back in 2014 we didn't have many female programmers... software developers or umm, product managers, and um, even right now I wouldn't say that their number is high, but um, still...there are umm, significant improvements.

In [the company name is removed] more women are taking operational tasks... while men are expressing their interests in developing and umm, business process management... It's not that we don't want more females in specific fields, but umm, when it comes to choosing the appropriate applicant, and the ratio of candidates are around 1:12, yeah, in most cases we end up with males.

I - Do you think there is a "Gender Disbalance" at your workplace and what positive and negative sides does it have? Also, what can be done to reduce this gap in your company and in other Estonian organizations?

R - Um, I think I've learned a lot from my male co-workers...and the influencing and umm, motivating factor for me was my position itself... I had a massive responsibility to the company and people...and I wanted to know every single detail and umm, aspect of my work; otherwise, I wouldn't succeed.

Um, and it's not about my success, it's about [the company name is removed]. Um, yeah, these were positive sides, but at the same time umm, it was, and it is a little tough to work in the male-dominated atmosphere. Umm, I believe that other Estonian companies face the same issues... Again, it's not that we have a lot of female candidates and we are rejecting them, no, the thing is that we don't… The problem starts from schools and universities... The primary education is essential, and it's really difficult to change your career at some point completely. So, let's start addressing this problem to educational institutions; they should prepare and umm, encourage girls to enter tech and STEM fields. I think this can abolish, umm so-called gender gap.

I - Do you have any recommendations to Estonian females entering the STEM sector?

R - Well, let me think about this…

First, they should believe in themselves... believe that they can achieve everything... and stereotypes exist to crash them.

Second, the most umm, critical part is to receive the education... it's not about degrees or the prestigious universities you graduate from... it's about what you carry and how you use the knowledge…

And, the last is to love and umm, to be interested in what you're doing…

If you have all of the three mentioned above on your to-do list, believe me, umm, you'll become a motivation for others.

I - What do you think, what local changes [political, educational, socio-cultural] can increase women engaged in technology?

R - Um, yes, all of three are very important... starting from political umm, perspective of possible changes to social-cultural... Yes, if our government is not interested in improvements and umm, doesn't have suggestions or solutions, you know... only the private sector can not do anything... they can not change the world... I mean everything is interconnected, the politics... and educational system,... social and cultural things... We need to define the problem and umm, unite around it... advise on possible ways of solving it...

Umm, I think, that the government has to focus on educational institutions... support girls who have skills in STEM fields, like give them scholarships... other types of rewards, and umm, at the same time, we need specialists who'll focus on umm, first explaining to young girls what is STEM... what are future career options... challenges, and motivating them to apply for it. And, umm, there should be much more social events, like specially addressed to women... it's important for us to see that we are not alone, that umm, other females are doing remarkable things as well. It motivates us, you know…

I - Thanks a lot for your answers, it was nice having you.

Interview 5

I - Hello [the name is removed], thanks for participating in this. Let's start our interview. Please tell a bit about yourself: what's your nationality, how old are you, what is your family status, where did you grow up?

R - I'm Estonian, 24 years old, um, I'm not married. I was born in Võru and um, lived there until I started my Bachelor's studies.

I - So it means you graduated from Voru school, what's about university? What is your degree and speciality?

R - Huh, yeah, I graduated from the high school in Voru and umm, then moved to Tallinn for my Bachelor's studies. I, I was enrolled at the [the university name is removed] Business Administration program, but um, I never finished it (smiles).

So, I'm not holding any degree at this moment, but umm, I'm definitely thinking about applying for it, maybe umm, I'll take some online program, I mean, umm, distance learning.

I - Oh, that's very nice. Let's talk about the factors or events which inspired you to start your career in the STEM

R - Umm, It's not a typical story, like when someone discovers that a child has talent in maths or science, no, on the contrary, umm, I was an ordinary student at school, not special (smiles).

My oldest brother is a software engineer; umm, the difference in the age is 10 years; so his job never interested me when I was younger... I didn't know much about what I wanted to become, like, which career to choose, so I umm, blindly applied to the BA program and like, after some time I started participating in hackathons, and it kind of interested me. Umm, during these hackathons, most demands were for developers...programmers... or engineers and I was not any of them... But still, I was joining teams and using my business vision, or so (smiles). Then during one hackathon, umm, my team member, an engineer, started using Tableau Software for some analytics and I liked it, and I felt it was not very difficult, umm at least from the glance. When I came home, I downloaded it and started playing with it, umm, asking questions to my brother, and that was how it started... Then I gradually moved to R Software and Python, and I'm still working with these two programs...

I - How did your family and friends react to your choice? Did you face any negativity from them?

R - Reaction to what? Like, dropping out from the university? or choosing programming over the studies? (smiles). Well, yeah, I won't say the first one pleased them, but um, more or less my family knew the field, because of my brother and umm, I didn't face any negativity from them. Also, my brother was really helpful; Umm, I think the was my motivator, like, sometimes when I wanted to give up, like, he helped a lot with basics, understanding the tasks and put a lot of effort in me (smiles). At some point, I didn't believe that I could do it, like, I could be as good as other guys were, but somehow I kept going and moving and ended up here.

I - What's your current position and how long have you been working in this organization? How long have you been working in STEM in total?

R - I joined [the company name is removed] when I was 20 years old, in 2015 as an intern and now I'm a software developer at AML department. So it's been 4 long years, in [the company name is removed] and the STEM as well (smiles). My whole programming experience is connected to [the company name is removed] (smiles).

I - So, you started your STEM career with [the company name is removed]. What was your position back then?

R - Umm, [the company name is removed] announced the internship, and umm, I applied for it. By that time I was learning programming, using some online sources, but umm, I didn't have any working experience, and umm, I wasn't sure if I would get the chance. Umm, surprisingly I got it. Umm, my internship lasted around 6 months, and then I continued as a tester. I remember, I couldn't believe it when they offered me moving to another team… back then it was my most significant achievement and at the same time it motivated me to do more… and to accomplish more.

I - How many women colleagues did you have and what differences did you feel compared to male co-workers?

R - I think we were around 3 testers in my team out of ten. The other teams had a different ratio slightly, maybe 4:9, 2:5 something like this. Boys were more experienced when I joined the team, and I always wondered why didn't they move somewhere, I mean different department or senior positions... I don't think we had a gender pay gap, at least

in my team, but most of the time boys were working extra hours when there was something crucial or so, and it affected their compensation of course.

I - What kind of barriers did you face in terms of self and career-wise development back then?

R - Um, everything went smoothly, it took me 6 months to move from internship to the software tester position and then 1.5 years to the software engineer... I was quite fast, but umm, some women work as testers for years, umm, it's not because of their abilities or knowledge or so, it's just the comfort zone and lack of interest. But I had my own goals, and they boosted the speed, I guess... Also, I was, and I am grateful to my team leads that they believed in me and gave a chance development.

I - That's really motivating. Now, let's discuss your current position. How many women colleagues do you have in your department? What kind of barriers do you face in terms of self and career-wise development in your current position?

R - Well, we are less than in the testers' team; currently, only 2 girls are working as SEs in my unit, and umm, the ratio is 2:9, so umm, it's 2 times less than previously. I joined SEs less than 2 years ago, and umm, I'm still learning and exploring things... the product is evolving so fast, and I need to keep up the pace... At this moment, I feel that I still need more time to learn... grow and show my progress and um, I'm not thinking about moving up, I mean other position or department before I master things here... And, also I'm thinking about taking some extra learning courses, like to have a degree in this field... And, um otherwise, I think there won't be barriers hindering me, at least in [the company name is removed] (smiles).

I - How the "Gender Disbalance" has influenced you at your workplace? Are there any factors that negatively or positively affected it? What can be done to reduce this gap in Estonian organizations?

R - Umm, I want to see more females in SE... not only at my workplace but in general. Um, I think the gender gap exists in every organization, but it's very subjective, I mean debating about the number of women at certain jobs is not always umm, reasonable... Um, I mean it's women who choose to enter a specific field, and we argue why they are misrepresented and how can we increase their number in companies... Is not it better to investigate the route-cause problems rather than umm, demanding things or bonding

obligations from companies? Um, I think sometimes this gaps becomes a stimulus for us, women to change... learn more and show others and we are equal, we can do the same things… um at least it was, and it is in my case. Umm, it's tough to talk about companies and organizations and share their perspectives about reducing the gap; I'm not sure I have ideas or suggestions at this point.

I - No worries, it's totally fine. Do you have recommendations you can give to Estonian females entering the STEM sector?

R - Um, I think the most important thing is to have an aspiration to something and umm, carry through it... It doesn't matter how much time it takes, the result is relevant. I know that some girls still have stereotypes about programming and code writing, but these barriers are in their heads, and they should challenge themselves and never be afraid to ask for help (smiles). Um. and also, we should always be in search of something new, all spheres of STEM are rapidly changing and um, it's crucial to keep the path. And, I forgot about the knowledge, education and the desire to learn more things are helpful, it's what keeps you moving

I - The last question, what local changes [political, educational, socio-cultural] can increase women engaged in technology?

R - As far as I know, there are some governmental incentives, like promoting STEM for girls... I don't have information about the recent statistics and if the number is that alarming, but...I think the government role is essential here... and they should have definite plans, or programs, and like projects which are focused on this problem... Also, education, yeah, I think that is the main problem... the lack of accurate information... like when I was applying for the Bachelor's I didn't know much about the BA… it was a blind choice, um, there should be people explaining things or helping students with choosing programs, because um, it's so essential to understand what you like and um, what you can do, also distinguish them as well. So um, yes, both of them need to be carefully addressed, I guess. About the social and cultural changes, nothing comes up to my mind at this moment.

I - Thanks a lot for your answers, it was nice having you.

Interview 6

I - Hello [the name is removed], thanks for participation. Let's start our interview. Here is the first question: what's your nationality, where did you grow up and how old are you?

R - I am Estonian, I am 35 years old and I grew up next to a small town Rakvere, in the northern part of Estonia.

I - Did you go to school in that town?

R - Yes, but um, my school was 8 km away and every day I had to take the bus… It was really tiring

I - What's about university? What was your degree and the speciality?

R - After I graduated from the gymnasium, I started my studies at [the university name is removed]… Um, I specialized in informatics, then I decided that IT is not my thing, because it was like really... umm, not practical at that time. We were 5-6 girls in groups, and others were guys, and all together we decided that it would not fit us... Then I did my maths exam again, I mean I re-took it and got better results.

At that time, logistics was very popular, different types of logistics... So I decided to apply for it, but I got rejected and my second option was the BIT at [the university name is removed]. I enrolled in the program and did 3 years of Bachelor's studies and then 2 years of Master's, both in informatics, both in Tallinn.

I - Do you think that subjects you took during your studies were useful for your career?

R - Umm, partially yes. We studied lots of useful subjects, but at the same time when I started working, I had so many things to learn and master, like from the very beginning that I think maybe other lectures could be useful as well.

I - Okay, can you talk about the events or factors that inspired you to continue your studies and career in STEM?

R - Umm, I remember that when I was at school, once a week I used to go to IT training and also we had computers there, so it was really useful and exciting at the same time... We did some programming in Pascal, mostly basics, and it was really impressive for me back then.. To be honest, I was not interested in IT at that time. Why did I chose this field? Well, I didn't get in any other programs... I really wanted to study Maths and Statistics at [the university name is removed], but my math score was not high enough. Also, Economics needed really impressive exam results or paying the tuition fee, and umm, the last option was not suitable to me... Meanwhile, IT became quite popular but um, was not typical for girls. The next year I applied for it and started my studies in Tallinn. I remember we were 35 on the course, only 7 of them were girls.

I - Oh , the number is quite low...At that time, how did your family and friends reacted to your decision?

R - Um, they supported me a lot. Even my father said it was fine that I didn't get in the university with the first try. Also, when I was in the 12th grade, my parents bought the computer for me, I remember it was expensive, and I didn't know how to use it... Umm, when I started my Bachelors, I hoped that I would know how to do basics with that machine at least and well, I umm, learned much more (smiles).

I - So, did you face a negative factors while choosing to continue your career in ICT field?

R - Umm negative factors… I am thinking… There was one, but I think it was my fault, you know, I was not good enough with time management and priorities... I started working as soon as I moved to Tallinn, my working hours were not flexible, and I had to miss lots of lectures. And, yeah, my grades went down, and I think I lost a lot of things, from the knowledge perspective, you know? Right now I really regret it.

I - Let's talk about your career. What's your current position and how long have you been working in this organization? How long have you been working in STEM in total?

R - I'm working as a SE and I joined [the company name is removed] in 2004. But I had a maternity leave for 6.5, so my overall time in STEM is around 9 years I guess.

I - Oh, this is very impressive. What's about your first position in Estonian STEM? What was your role and when did you start it?

R - Umm, I started working as a tester in [the company name is removed] when I was doing my Bachelors. I remember there were several positions available and I applied for 4 of them and started working as a system and application tester. I had an experience in this, and I think it played the considerable role in the selection process.

I - **How many women colleagues did you have in your organization in the STEM area? What differences did you feel compared to male co-workers?**

R - Umm, back then we were around 40 people and women were half of them. My first TL was a female as well. I never felt that there was any difference between male and female employees.

I - Okay, but did you face any barriers in terms of self and career-wise development back then?

R - Not really, everything was smooth for me. We were using different applications during the working process, and I also learned the databases because I wanted to improve my knowledge in that domain. My TL was very supportive, and I didn't face any obstacles, I guess. . . Even the schedule was flexible, I could go to University when I had my classes, there was no pressure from superiors or co-workers.

I - **Were you paid less compared to male co-workers?**

R - Well, yes! But um, there was a reason behind it. The day I started my job at [the company name is removed] there was another male newbie. We had a small talk after the interview, and he said that his salary would be 13 K Kroons, while mine was 11 K. Seemed that he asked for that amount, because he had working experience in another Estonian IT company. But still, I also had a good background with systems and applications and the news was a little bit de-motivational for me.

I - Yes, this is very unfair… What's about your current position? You're working as SE, but when did you start it?

R - Umm, I joined this team in August, 2017, so it will be 2 years soon.

I - And how many women colleagues do you have now?

R - We have a big department but um in my team, we are 6 out of 16 people. So males are dominating again (smiles)

I - Do you face any barriers in terms of self and career-wise development in your current position?

Well, yeah, I would say yes. Because the specialty is really complicated and I remember that when I joined [the company name is removed], I had so much information to digest that I was afraid I couldn't do my job correctly.

Even today, sometimes I feel over-pressured, especially when I need to do multitasking. And, um I was at home for 6.5 years, and lots of things have changed and I forgot much things. This time put me backward I guess. And still, I'm not confident enough.

I - Did you feel at some point that other co-workers were judging you because of low level of domain knowledge when you came back from maternity leave?

R - No, never! They are very supportive. The guy who brought me here, in this team, he had 6 years experience, and um, was helping me a lot. Another was very supportive as well. Even they had much experience, I never felt that because I am a female, my male co-workers are underestimating me or my abilities.

I - Are you paid less compared to male co-workers?

R - Umm, No, I don't think so. I don't know the salaries of my co-workers, but still I think we're paid equally.

I - Do you think that this approach, when everyone is treated equally, is common in Estonia or is it just in specific companies?

R - Umm, I don't have much information about other companies and about the global situation, but um, from my perspective, there is no such a gender gap in IT field. Maybe it influences other sectors, but not us, as far as I know.

I - As you've mentioned earlier, you've been working in the technology field for 9 years. What are the factors that keep you moving in your career?

R - Umm, I wanted to be challenged and to have an exciting job. Umm, I think the primary motivation is that I have interesting work to do and um, I have a good team who are always there for me. My previous team members were mostly Russians, and I couldn't

understand a word when they were discussing job-related issues or updates. So, yeah, it was challenging, but now everything is different. Um, the salary as well. It's another critical factor for me to continue my career here.

I - Based on your observations, do you think that the women representation in Estonian ICT sector has changed since you first enter this field?

R - Yes! Increased definitely. There are lots of IT-related jobs, they're basically everywhere... Every area already needs competitive IT specialists. And, um, I think this national trend influenced the number of women, but um, still it's not as high as it should be.

I - Fine, maybe you have some recommendations for Estonian females entering the ICT sector?

R - More knowledge you have, more confident you are. Meaning that you need to learn a lot and there are lots of things, and you don't need to be afraid to enter the STEM. My husband thinks that if you don't know Java you are not an IT specialist, but you can do many things in this sector. You need to be open minded, and there are lots of opportunities. Sometimes men think that women are not capable of specific things, but that's not true.

I - What local changes [political, educational, socio-cultural] can increase the women engagement in technology?

R - Umm, let me think about it. Um, we have these career days, and lots of STEM-related companies usually search and find applicants from there, and it's not like you don't have access to this information. But, well, it should be often and more companies should engage in it. There are also a series of events from Tech Sisters... my sisters have been there, and they gave me a good reference about it. I think we should integrate this approach in every city and town, so every young girl has equal access to things and opportunities as well.

I - The last question from my side, how hard is it to have family and how it affects your career?

R - I remember that before kids I had a lot of lieu hours. We were 40 developers and only 2 testers so, yeah, I was doing much extra work back then, sometimes I was going home

after 8 pm. But now I have family and yeah when I am working on something, I am trying to be focused, and suddenly I remember my kids and planned activities with them, so I lose my concentration and productivity. Well, it affects me a lot. But from the other side, nobody from my supervisors complains about it, they understand that it's natural and family, especially kids, need time and attention.

I - Thanks a lot for your answers, it was nice having you.

Interview 7

I - Hello [the name is removed], thanks for participating in this. Let's start our interview. Please, tell me more about yourself, what's your Nationality, where did you grow up and how old are you?

R - Hello, I am Estonian, 26 years old and I grew up in Tartu.

I - Seems that you graduated from the school in Tartu, what's about the university?

R - Yes, exactly, I studied at the gymnasium in Tartu and then continued my Bachelor at [the university name is removed] in Tartu as well.

I - Was you school or university program specialized in science, mathematics, engineering and technology?

R - Well, during my school studies, I had advanced courses in maths and physics because my gymnasium was oriented on these. And then when I moved to undergraduate education, I also took some extra lectures from higher maths and advanced programming. Well, my specialty is CS, so I had lots of STEM courses apart from them as well.

I - Do you think that these subjects were useful for your career?

R - Yes, definitely, both from school and from the university. In general, they are the foundation for you and later when you choose the specific field for a career you have to do deep learning. But without these introductory courses, it's a hassle in most of the cases.

I - When and why did you become interested in STEM?

R - Well, I was always better in math rather than in languages or history. But initially, I applied for the Geography undergraduate program and later migrated to CS. I took a Python as a course when I was studying Geography, um, because my sister suggested so and I liked it so much that I decided to continue my studies and career as well in IT.

I - How did your family and friends react to your choice?

R - Um, I think they were happy with my initial decision, but when I moved to CS they didn't express any kind of negativity towards it, um, supported me a lot. Also, my parents have working experience in maths, maybe it explains things a little bit more (smiles).

I - Let's talk about your your current position, what role do you have and long have you been working in this company?

R - Um, I joined [the company name is removed] 3 years ago and currently I'm working as a SE in KYC team.

I - How many women colleagues did you have in your department?

R - my department is quite big, but in my team we're around 16 people, I think it's kinda half-half, maybe actually now we, females, are more.

I - Did you face any kind of barriers in terms of self and career-wise development?

R - Well, my profession is quite demanding, I need to be always focused on things, use my analytical, programming, math skills, and it's not always easy to stay in shape. I mean, I can't remember any specific moment or event which became a real barrier for me. But still, there are little obstacles, which have to be overcome, to achieve something planned, something required... and well, it's not that these barriers are artificially created by the company or someone else, I think it's me who sets some limits to myself and um, I'm always working on this.

I - Are you paid less in comparison with male co-workers?

R - To be honest, I don't know, but it shouldn't be that way. Because we have the same responsibilities and spend precisely the same amount of time at work, so, most probably no, um as far as I know.

I - As you've mentioned earlier, you've been working in the technology field for 3 years. What are the factors that keep you moving in your career?

R - SE is very challenging, and you can improve yourself and become a better specialist here. I am gaining knowledge and studying something, um, awesome basically every day. At this moment I'm not concentrated in higher compensation and salary, I want to have a solid background and experience, and I think it will be the best investment for my future. Yes, I really like what I'm doing as a SE and I think this also motivates me a lot.

I - Do you think, based on your observations, that the women representation in the Estonian ICT sector has changed since you first entered this field?

R - I think that the gap is getting small... At University, of course, males were more, but it was not that huge, what I have heard from other countries... The ratio was around 3/2, and I think it's not that bad. So I guess, the number of females in the STEM is increasing gradually.

I - Have you experienced the influence of the "Gender Gap" at your workplace?

R - No, not really! I can't remember anything like that, I think we're super balanced and don't have such kind of negative influencing factors.

I - Do you have recommendations for Estonian females entering the STEM sector?

R - Um, well (smiles). I think that girls shouldn't listen to people, who define what they can or can not do. We are everywhere, there is no such thing which can be only masculine or feminine... we create some stereotypes and are bound to them... Don't be afraid of challenges, they make you more mature and use each and every opportunity you have.

I - What local changes [political, educational, socio-cultural] can increase the women engagement in technology?

R - Mm, I don't have the answer to this question, I haven't thought about the political or socio-cultural factors. But what comes to my mind is [the company name is removed] approach, we usually do job shadowings, and lots of women see that there are other females employed by the company in STEM departments. This should be motivational for them.

I - And the last question, what's your general understanding of gender balance, does it occur in particular companies or in Estonia, globally?

R - Well, I personally have never faced the gender disbalance, and I think the reason behind it is that Estonia is close to Nordics and we try to copy their well-established practices, including the annulment of the gender gap as well. We try to be equal in every way.

I - Thanks a lot for your answers, it was nice having you.

Interview 8

I - Hello [the name is removed], thanks for participating in this. Let's start our interview. Please, tell me more about yourself: what's your Nationality, where did you grow up and how old are you?

R - Hi, I am Estonian... I grew up in Tallinn and I am 37 years old.

I - So, did you graduate from the school in Tallinn? What's about the university?

R - Yes, I went to the gymnasium in Tallinn, it was the pre-school for [the university name is removed]. Then I applied for the Network Systems and Intelligent Technology at [the university name is removed], started my studies, but never graduated from there... Um, later I entered the IT college and um, it was my umm, most significant experience from the educational perspective in STEM.

I - Was you school or university program specialized in science, mathematics, engineering and technology?

R - Well, yes, that pre-school was a preparatory institute for the university, and the subjects were mainly focused on maths and technology... programming I mean. Also, because of my specialty, I had lots of lectures which required an understanding of technical domains, and even though I didn't graduate from my bachelor's, these courses helped me a lot in my career.

I - When and why did you become interested in STEM?

R - I think it started in high school. I remember we had computers with terminals and from the10th grade, we were participating in those classes, teachers explained things well... It was really exciting, I was so interested in it. And, um, before that my father bought the laptop, um, back then having computers or laptops at home was not as common as today, and it also played an important part in my decision later. I wanted to use it professionally and to make practical use of it.

I - What was your family's/friends' attitudes towards it? Did you face any negativity back then?

R - Um, all of them were supportive, especially my father. He has a so-called technical mindset, and I think he understood what I wanted to become and why I chose IT for my future career. Um, I can't remember any negative remark towards my decision from my close ones.

I - Okay, nice, let's talk about your current position. What's your role and how long have you been working in this company?

R - I joined [the company name is removed] 7 - 7.5 years ago, and I've been working and a Software Engineer since then. My focus is on infrastructure engineering, to be more specific.

I - What's about your first STEM-related position in Estonia. Please, tell me more about it.

R - Oh, it was more than 10 years ago. There was an Estonian IT company, and they had a major database crash. My friend referred me... suggested my candidature, they contacted me, and I fixed the data. This is how I got my first job, I stayed there for 2.5

years, worked as an application administrator and um, it was a valuable experience for me, like self-discovery and career wise as well. I established some contacts and learned a lot.

I - How many women colleagues did you have in your department?

R - I don't remember exactly, but it was a small company, a maximum of 40 people in total and um, quite gender-balanced. Most managers and TLs were women, and it was unusual at that time.

I - What kind of barriers did you face in terms of self and career-wise development?

R - The thing is that the company was not growing much, but it was a perfect place to begin a career, supportive team and lots of work to do. The experience and mastering things come after practice, and I much needed it.

I - Were you paid less in comparison with male co-workers?

R - I have no idea, maybe. I never asked though But well, I should have done (smiles).

I - Now, let's discuss your current position, as you said you started it 7.5 years ago. How many women colleagues do you have in your department?

R - At the moment, we are a minority (smiles). Apart from the manager, I am the only woman. We are 12 in total, so the ratio is 1:5. I never thought about it from this perspective, it never disturbed me, to be honest. The most important thing is to get things done, I don't think much about the gender of my co-workers, the best gets the place, that's how it works.

I - As you've mentioned earlier, you've been working in the technology field for 10 years. What are the factors that keep you moving in your career?

R - I have been a tech-savvy since I remember myself. I literally grew up with computers, enjoyed investigating things and... solving problems, playing with data. I also like helping people and see the results of my hard work. Yes, probably thinking about severe queries and maintaining the product, the ability to help others are these, um moving factors for me.

I - **Do you think, based on your observations, that the women representation in the Estonian ICT sector has changed since you first entered this field?**

R - Well, I'm not sure. I see some new faces joining our teams, but I don't have much information about other companies. It's very hard to measure the progress from my point of view. I wish it has increased, but still, I don't have any updated data about it. So I don't want to assume things blindly.

I - What recommendations will you give to Estonian females entering the ICT sector?

R - Just try it out, you can change things at any time. When I started my studies, I promptly picked the right subjects for me, the ones I was passionate and interested in, but it took me 3 more years to go to the IT college. But it will be different for you, it's very personal, just don't be afraid that you'll fail, remember, it's normal, I do it every day, but I learn a lot from failures. So, yeah, go for it.

I - And the last question, what local changes [political, educational, socio-cultural] can increase the women engagement in technology?

R - Actually, there is a huge salary gap in the IT field. I think women are afraid to say that they need more compensation for their work, they are worried about losing jobs or being unheard. Um, the new generation of women are more confident to ask about it, and it’s right, that's how the things should be. And, um, the social events are also helping a lot. I have not been there, but I know that there are lots of people at those events.

I - Thanks a lot for your answers, it was nice having you.

Interview 9

I - Hello [the name is removed], thank you for participating in this. Let's start our interview. Please, tell me more about yourself: what's your nationality, how old are you, what is your family status, where did you grow up?

R - Hello, I'm Estonian, 28 years old. I grew up in Tapa and I'm not married.

I - Where did you study for school and university? What is your degree and speciality?

R - I went to the gymnasium in Tapa... And during school studies, um, I had good results in maths and physics, because um, my parents are teachers and they had kind of individual lessons with me, I think, almost every day. And, um, then for the University I moved to Tallinn, I graduated from [the university name is removed], um, I have a degree in programming.

I - And, when and why did you decide to specialize in STEM? Tell me more about the factors or events that inspired your decision.

R - Well, to be honest, it was not my independent decision, my parents influenced me a lot... but not in a bad sense. They were training me really hard, both of them are teachers, their specialties are math and physics, and since very early childhood I was practicing a lot, preparing for different competitions... um, and my father had a book, and Pascal was well explained there, and he used to say that it was a future... At that moment I couldn't understand much, but I was kind of intrigued, you know? But the thing was that we didn't own a computer and I was writing some codes on the paper (smiles). Well, it's funny now, but this is how I mastered the thing.

I - So, I guess family's reaction was positive towards your decision. What's about friends? Did you face any negativity from them?

R - Um, yes, about the family it's absolutely correct. My father was so proud of me, well, he still is (smiles). But friends... I think they didn't understand much, because back then programming was not a very feminine career, I hardly knew any female in that field, and yes, their reactions were not positive, but ...it never affected my choice or my aspirations.

I - Let's talk about your previous position. How long have you been working in this organization? How long have you been working in STEM in total?

R - Um, I started my IT career when I was 19. So, it's almost 10 years. It was a long journey for me and um, today I'm at the place I belong to. I joined [the company name is removed] 2 years ago, and I'm working as a software engineer here. And, I have a feeling that I found my comfort zone and I don't want to leave it (smiles).

I - Okay, that's amazing, not everybody finds that. What's about your first position in Estonian STEM. What was your role and when did you start it?

R - Um, it was an internship, from the university. I had astounding grades (smiles), and my program manager recommended my candidature to his friend... At first, I didn't want to start the job, because I thought it would affect my studies and my educational plans would crash... but my father suggested that I should've tried it... My position was a junior programmer, well the position was an internship, yeah, the role was a junior programmer, and my supervisor was very supportive... He used to take into account my schedule and praised me every time I had some improvement. I worked hard as well, and it was noticeable for everyone... And, some months later, they offered me a part-time job, and I agreed.

I - How many women colleagues did you have in your organization in the STEM area? What differences did you feel compared to male co-workers?

R - It was a small company, um, 15 people maximum and there was another woman doing Java. So, yeah, not many females (smiles). About the male co-workers, they were very experienced, and at some point, I was afraid to ask questions, I thought that they would think I was not smart enough. Well, yes, it took me some time to get adjusted to things and the environment.

I - What kind of barriers did you face in terms of self and career-wise development back then?

R - I think it was me, creating these barriers, I was not confident enough to speak myself. I remember, once we were discussing the problem and I found the mathematical solution to it within minutes and coding it was not hard as well, but I never said a word, because I was afraid my finding was not correct. Then, another co-worker said exactly the same and I was like damn, why didn't I raise my hand? (smiles). Otherwise, negative factors from the company? I can't state any.

I - Now, let's discuss your current position in depth. So you started it 2 years ago? How many STEM related positions did you have before it? How many women colleagues do you have in your department? What kind of barriers do you face in terms of self and career-wise development in your current position?

R - Yes, I started working here 2 years ago, and I regret that I didn't apply earlier (smiles)... I stayed in the first job for 3.5 years and then I was doing some IT freelance projects because I moved to Denmark with my boyfriend and well, at that point, it was the most suitable option for me. I came back to Estonia, around 3 years ago and um, joined one Start-Up... I spent around a year there as a software developer, but the job was not what I wanted. So, then I sent my application to [the company name is removed], and that's how I ended up in here. About the women colleagues, they are not many, I'm the only one in my team, but my department has around 10-11 female programmers, but we never face any complications because of that. The most important is that I enjoy being part of this awesome company. I can't say even one barrier or factor that influences me negatively…

I - As you've mentioned earlier, you've been working in the technology field for almost 10 years. What are the factors that keep you moving in your career?

R - Um, it never gets boring... There are so many things I can do, and every time something new is released I keep learning, reading and coding. Sometimes, I even do the math and physic problems, not to forget them. Isn't it crazy? (smiles). Well, this is what I enjoy the most, so why not? I like the feeling when I find a solution for the hard or challenging task, this feeling means everything to me, and I think this keeps me moving forward.

I - How the representation of women in the Estonian ICT sector has changed since you first entered this field?

R - Um, I'd say that still, IT or STEM in general, is not popular among Estonian females. Well, the numbers should have been increased, but it's not that high as we would like to see.

I - Has the "Gender Gap" in STEM influenced you at your workplace? What can be done to reduce this gap in Estonian organizations?

R - Um, it's not that the gap is visible, at least in my current company, but still, it exists. To be more specific, it's kind of stereotype... female and programmer? People hardly suppose it. Sometimes, when I have online meetings with my co-workers from different offices, they don't want to believe that I'm also a SE, like at a glance... Well, it never affected my decision or career-wise aims, neither positively, nor negatively, because I know what I want and I usually don't fall under the influence of others. But, well, it can be more sensitive for some women.

I - What recommendations do you give to Estonian females entering the STEM sector?

R - My three tips for girls entering the STEM would be: be curious, practice a lot and never give up. If they decide to continue their studies or career in science and technology, it obviously means that they have brilliant minds, so use them accurately. The best thing you can do for yourself is to find the place where you feel confident and comfortable. Never forget this.

I - Maybe you have some ideas, what local changes [political, educational, socio-cultural] can increase women engaged in technology?

R - All of these factors are very important, the correct use of them can have an impressive effect, and this effect will be expressed in um, astonishing numbers. At this moment I can't come up to innovative ideas, but yeah, the problem is present, and professionals should work on it very accurately. We need a lot of data, starting from schools, what are the triggers for young girls to enter STEM, what are barriers, the same from universities... I hope I answered the question more or less…

I - Yes, sure. Thanks a lot for your answers, it was nice having you.

Interview 10

I - Hello [the name is removed], thanks for participating in this. Let's start our interview. Please, tell me more about yourself: what's your Nationality, where did you grow up and how old are you?

R - Hi, I am Estonian... I grew up in Tartu and I am 25 years old.

I - So, did you graduate from the school in Tartu? What's about the university?

R - Yes, I went to the gymnasium in Tartu, it's one of the best schools in Estonia (smiles). And for the university, I went to the university name is removed], umm, my major was informatics, also the best one in Estonia [laughs].

I - Was you school or university program specialized in science, mathematics, engineering and technology?

R - Well, in my case yes. Generally, you have to choose one of the fields you want to study stronger and um, harder, and I decided to go with math... I never liked reading or writing that much, um, I always preferred to learn more mathematical subjects, you know?

I - When and why did you become interested in STEM?

R - Umm, it's a hard question... because in my generation computers, internet and other technological innovations were, um, introduced at the same time, so basically if you were a curious kid, you would dig into computers...and we all did, I was watching my classmates, who were using all these things and they so inspired me... I remember with my friend, we did our first website... it was crazy. I felt I was a real programmer or something… [laughs]

I - What was your family's/friends' attitudes towards it? Did you face any negativity back then?

R - Well, I am very grateful to my parents because they have never ever told me what to do, yes, they could give me suggestions and tips, like what was better, but never forced anything. I remember, at that time everyone was rooting me and telling me, oh you have chosen a profession of the future, that was giving me more motivation to study IT.

I - Okay, nice, let's talk about your current position. What's your role and how long have you been working in this company?

R - It's a funny story. Actually, I was applying for an internship in the IT department of one company. I was on the final stage, and they rejected me, and it was painful (smiles). After a while, I got a call, and HR specialist offered me a real job [laughs]... instead of

an internship, I got a real job. I didn't work there a lot, like, only a few months, I was a tester, and then I got a job offer from my current company, and I moved here.

I - What's about your first STEM-related position in Estonia. Please, tell me more about it.

R - Um, as I said I was a tester at one Estonian company. It was exciting and very interesting because I had just started my career and it meant a lot to me... Hum, I wanted to learn everything, and I was asking for lots of irritating questions. Well, I guess it was a good strategy (smiles). That job helped me a lot, I'm really grateful that I had that opportunity.

I - How many women colleagues did you have in your department?

R - It will be hard to count (smiles), I don't remember the exact number, but were quite diverse, gender-wise and one of the senior managers in the team was a woman. She was terrific, like a role model for all of us. I even wanted to be like her when I graduate.

I - What kind of barriers did you face in terms of self and career-wise development?

R - Um, I had a crazy schedule, I was working so hard... because during the day time I was in the office and then, in the evenings, I was studying for my university. So basically, I was struggling with my social life and both, the studies and the work were a little bit messy for a while... Then I lifted myself, and things got better.

I - Were you paid less in comparison with male co-workers?

R - I have been working so short time of period that I can't say a thing about it. But, um, maybe yes, but I'm not sure though. I didn't ask much salary, I just wanted to have a job, and initially, the compensation didn't mean a thing for me and also I had some leaves for the university, so, it affected my salary, I guess.

I - Now, let's discuss your current position, as you said you started it 3.5 years ago. How many women colleagues do you have in your department?

R - Currently, I can say that women man ration is 55% to 45% because one of my colleagues is on maternity leave, so it caused a slight disbalance. But generally, I can say that my team is more-less gender-balanced... There was a time when we [women] were majority [laughs]

I - As you've mentioned earlier, you've been working in the technology field for 4.5 years. What are the factors that keep you moving in your career?

R - Umm, I have been thinking to change my profession a bit, but as long as I look at the job market, IT jobs are ones who are most exciting and um, interesting to me. Most of IT products are solving some kind of problems, and this is really great, that you can help people and change the world from the keyboard. Also, l will be honest, compared to other jobs in IT you can get higher salaries, that's also very important.

I - **Do you think, based on your observations, that the women representation in the Estonian ICT sector has changed since you first entered this field?**

R - As long as, I don't have experience of decades, I can say that yes, it's definitely changing, I mean, it's increasing. Also, from my friends, I have heard that at university the number of girls who want to study IT is increasing, but um, still I think it's not as many as the number of boys. I think we have to do some inspiring things to push women in tech.

I - What could be these things? Maybe some political, social or educational factors?

R - Well, I think we're doing them currently. First of all, I would say that having a woman as a president should be the coolest thing for Estonian females. That's a huge motivation, at least for me so I would say that political-wise we are quite good. But other things… umm… I think that social events are having a good impact on people, in general, so events which empower women should be frequent and with a bigger notable scope. And I would add one more [laughs], some cool educational activities for youngsters will be useful as well, youth generation will understand more how the modern world moves around the STEM and what vital importance it has.

I - And the last question, what recommendations will you give to Estonian females entering the ICT sector?

R - If you have any kind of lousy reference about women and IT, about barriers, issues… just forget them. It's only in your mind, no one is going to laugh at you because you are female. So I would grant all the new generation girls to be relaxed and just do whatever you want.

I - Thanks a lot for your answers, it was nice having you.

Table 3 Participant Information

Participant #	Company	Department	Age	Technical Education	Family Status	The number of years in STEM
1	1	SE	25	Yes	Engaged	5
2	1	BI	28	Yes	Single	9
3	1	SE	23	Yes	Not married	3
4	1	PD	35	No	Has a kid	3
5	2	SE	24	No	Not married	4
6	2	SE	35	Yes	Married	9
7	2	SE	26	Yes	Married	3
8	2	SE	37	No	Married	7
9	1	SE	28	Yes	Not married	10
10	2	SE	28	Yes	Not married	4.5

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