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REPRESENTATION, INCLUSIVITY, AND EQUALITY IN INFORMATION TECHNOLOGY

A study on the future of IT

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Also, a special thank you to the five women that agreed to be interviewed for this study as without you, this work would not have been possible. Your creative, honest, and expressive answers is the reason why I no longer feel alone as a woman in IT.

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Sammanfattning

IT har sedan länge varit en mansdominerad bransch med en evident underrepresentation av kvinnor. Historier sedan branschen skapades målar en bild av en ensidig bransch där kvinnors egna perspektiv och idéer oftast ignoreras och får en stämpel av att dessa perspektiv är oviktiga för IT och samhället.

Syftet med studien är att undersöka hur området nätverks- och systemadministration kan bli mer inkluderande för kvinnor. Detta utfördes genom fem semi-strukturerade intervjuer med kvinnor som jobbar (på ett sätt eller annat) som nätverks- och systemadministratörer. Studien i sig är kvalitativ och har kodats induktivt för att låta kvinnornas erfarenheter och tankar styra presentationen av data.

Resultaten av den här studien visar på att trots sin placering på jämställdhetsskalan så har Sverige fortfarande mycket kvar att göra inom IT-branschen för att den ska bli inkluderande för kvinnor. Rapporten presenterar även att det finns konsekvenser av underrepresentation på design av IT relaterade ting, system, och utrustning. Dessa resultat pekar också på att IT-branschen behöver bli mer inkluderande eftersom viktigt kompetens annars försvinner, men även att kvinnors inkluderande i IT kan ha en positiv påverkan på ekonomin. Ytterligare resultat visar även på att företag, enligt deltagarna i studien, måste bli bättre på rekrytering, representation, och att lyssna på kvinnors åsikter.

Abstract

IT has been a male-dominated area for a long time with a clear underrepresentation of women. Stories from when the field was created paint a picture of a very one-sided mentality type of field where women's own perspective and ideas are often ignored and that their perspectives carry no importance for IT and society.

The purpose of the thesis is therefore to study how the field of networking- and system administration can become more inclusive for women. This was done with five semi-structured interviews with women who (in one way or another) work as network- and system administrators. The study itself is qualitative and has been coded inductively to let the women's experiences and thoughts steer the presentation of data.

The results of the study shows that, despite its placement on the gender equality scale, Sweden still has a lot to accomplish within the IT-field in order for it to become inclusive for women. This report also shows that there are consequences of this underrepresentation on design of IT-related things, systems, and equipment. These results also show that the IT-field needs to become more inclusive because the field misses out on a lot of important competence, but also that women's inclusion in IT can have a positive influence on the economy as well. Further results show that companies, according to the participants of the study, must become better at recruiting, representation, and listening to women's opinions.

1. Introduction

As society is steadily evolving towards a highly digitalized future with advanced and useful technology, more and more people are needed to administer this technology. During its infancy, the gender distribution rate of women graduating with a degree in computer science peaked at 37% in the 1980s, but already as early as 1940, women were highly involved in the infancy stages of programming and computer science (Berkeley University, 2021). However, at the end of the 1990s the curve drastically changed as the number of female graduates in computer science dropped as low as 26.7% (Camp, 2001). In 2019, only 21% of computer science graduates in the United States were women (Berkeley University, 2021).

Despite this, interest in the IT-field is rapidly growing among young women according to a study conducted by Insight Intelligence, Microsoft, CGI, Bredband2, and the University of Linköping (2020) where 1000 Swedish women were interviewed. The study concludes that 40% of the interviewed women could consider a career in IT as of 2020 (but were not at the time involved in IT), which is an increase of 2% since 2016, where interest capped at 38%.

With the field of IT in constant evolution, the need for new specialists grows as well. According to the IT&Telekomföretagen (2020), projections suggest that around 70.000 new IT specialists are needed by the year 2024 in order to maintain the current infrastructure in Sweden. The lack of competent, educated employees in the IT sector could lead to a flaws in security, faulty or no maintenance, and underdevelopment of current and planned systems. And yet with the need for so many new administrators and IT specialists, only 29% of the current working-force in computer science in Sweden is comprised of women (IT&Telekomföretagen, 2020) though no specific numbers have been found to measure the current amount of women working in networking- and system administration.

While numerous studies in the area of gender equality in IT exist, they are generally conducted on a larger scale either globally or with its primary focus on the USA. Sweden, who places 5th on the Gender Equality Scale (World Economic Forum, 2021), is considered to be among the most gender-equal countries in the world while IT-related fields in Sweden continue to be largely male-dominated.

By gathering suggestions from women throughout a series of semi-structured interviews on how the IT sector could become more inclusive the hope is to compose a list of areas in which the IT-field can improve in order to promote an inclusive work-environment. The methodology will be conducted in a qualitative manner together with thematic coding and an inductive reasoning approach as to allow for the data to decide categorization rather than using pre-conceived notions. This will allow for more freely-given answers as well as a more unbiased view on the current circumstances.

The hypothesis is that finding answers on how to make IT more inclusive for women might be a step towards fulfilling the UN's sustainability goals (UN, n.d), while also giving the field a more inclusive pool of problem solvers, and make development of services more inclusive. Additionally, finding possible consequences of what could happen if women in IT are underrepresented might make an incentive for companies to hire more women, as well as actively participate in listening to suggestions from their employees. This is important from a design-choice aspect, gender equality, socioeconomic welfare, and the possibility for expansion of current and future infrastructure, to name a few.

Ultimately, the aim of the research is to gain insights on how to bridge the gap between men and women as well as bring more diversity and inclusiveness to IT. The hope is to gain a deeper understanding for the current working situation for women in IT and what areas need improvement from a gender-equality viewpoint.

2. Background

The need for networking- and system administrators is rapidly growing globally, with most of the necessary services and infrastructure (such as banking, trading, administration, etc) being completely or semi-digitized. As such, people are needed to administer these services effectively as many of them are crucial for society to function in the age of information technology. In order for there to be an inclusive infrastructure, these services need to be administered by both men and women and need to take into account different aspects and design choices (Marco & Tarantino, 2021).

In the field of medicine, for example, it is widely known fact that the symptoms of a heart attack are different depending upon a myriad of factors, wherein gender is one of them. While men tend to display their symptoms more outwardly and clear (tightness around the chest, pain in neck and jaw, profound sweating, etc), the symptoms shown by women are different (and considered subtler such as indigestion, dizziness, shortness of breath, to name a few) (Edmundowicz, 2020**).** In a 2019 study, Gao, Chen, Sun, & Deng, concluded that "*Although the incidence of CVD in women is usually lower than in men, women have a higher mortality and worse prognosis after acute cardiovascular events.*" and that the reason behind this was partially due to the disregard of gender while setting standard criteria for CVD. Because of this, women were far more likely to die during cardiovascular events than men.

This might be applicable to the field of computer science as similar points have been brought to light at the 2021 7th international workshop on sociotechnical Perspective in IS development (STPIS) where Marco & Tarantino (2021) wrote in their report about the importance of not only empowering women and girls, but also the importance "*...on the inclusion of women on the producer side, and that achieving such objective demands engagement and explicit actions from stakeholders at different levels, including the educational and the scientific levels."* (p. 258). Furthermore, Marco & Tarantino spoke about their approach in their discussion, having reached the conclusion that "*both technical and human factors are given equal weight in the design process, and the consequent implicitly inclusive nature*" (p. 265). Looking at these facts, it is clear that gender equality must be taken into account while making design choices as men and women are different and should be represented as such. The lack of inclusivity could lead to subpar IT infrastructure, working conditions, to name a few, which makes this study all the more important as a preventative measure. Similarly, Anita Borg once said "*Around the world, women are not full partners in driving the creation of new technology that will define their lives. This is not good for women and not good for the world….Women need to assume their rightful place at the table creating the technology of the future."* (anitab, n.d).

The prognosis from the study by IT&Telekomföretagen (2020) shows that a large number of administrators are necessary in order for Sweden's infrastructure to continue thriving and developing. In order to continue maintaining the IT-grid, thousands of new jobs need to be created. This makes gender equality a matter of socioeconomic welfare because in order to meet the rising demands, increase team performance, and increase profits, women need to be included as men can not fill all these jobs alone (Annabi & Lebovitz, 2018).

However, looking back at women throughout history, it is clear that IT, coding, and mathematics were considered to be fields well suited for women as "*Programming requires patience and the ability to handle detail. Women are 'naturals' at computer programming.*" (Little, 2021**)**. Despite the early rise for women, computer science eventually became an increasingly male-dominated field with fewer women applying for jobs and educational positions within the sector. Some of these

women throughout history have been instrumental for the development of IT and are today regarded as revolutionaries such as Ada Lovelace (who is considered to be the first computer programmer by many). Her translation of Luigi Meabrea's work on the Analytic Engine, and her own thoughts that she added in the form of notes, put Lovelace on the map. It is said that the translation "*...included the first published description of a stepwise sequence of operations for solving certain mathematical problems and Ada is often referred to as 'the first programmer'*." (Computerhistory, n.d).

Also among the revolutionary women in IT is Grace Murray Hopper, who served in the US Navy and is perhaps best known for her work in creating the first computer compiler (A-0), which is the first compiler that could handle English inputs as opposed to binary instructions. In addition, Hopper also created the programming language Flow-Matic. (Yale University, 2017)

During the 1940s, female programmers at ENIAC created the first programmable computer for the US military. Kay McNulty, Betty Jennings, Betty Snyder, Marlyn Meltzer, Fran Bilas, and Ruth Lichterman were taught "*how to manipulate its switches and cables, as programming languages did not yet exist*" (Little, B., 2021; Gürer, W, D., 1996). Despite their accomplishments, these women were neither given recognition nor acknowledgment for their achievements until the 1980s.

Additionally, the first Ph.D. in computer science was awarded to a woman named Sister Mary Kenneth Keller, who graduated with degrees in Mathematics and Science from DePaul University. A strong advocate for women in computer science, Keller founded the computer science department at Clarke College (University of Wisconsin-Madison, 2019).

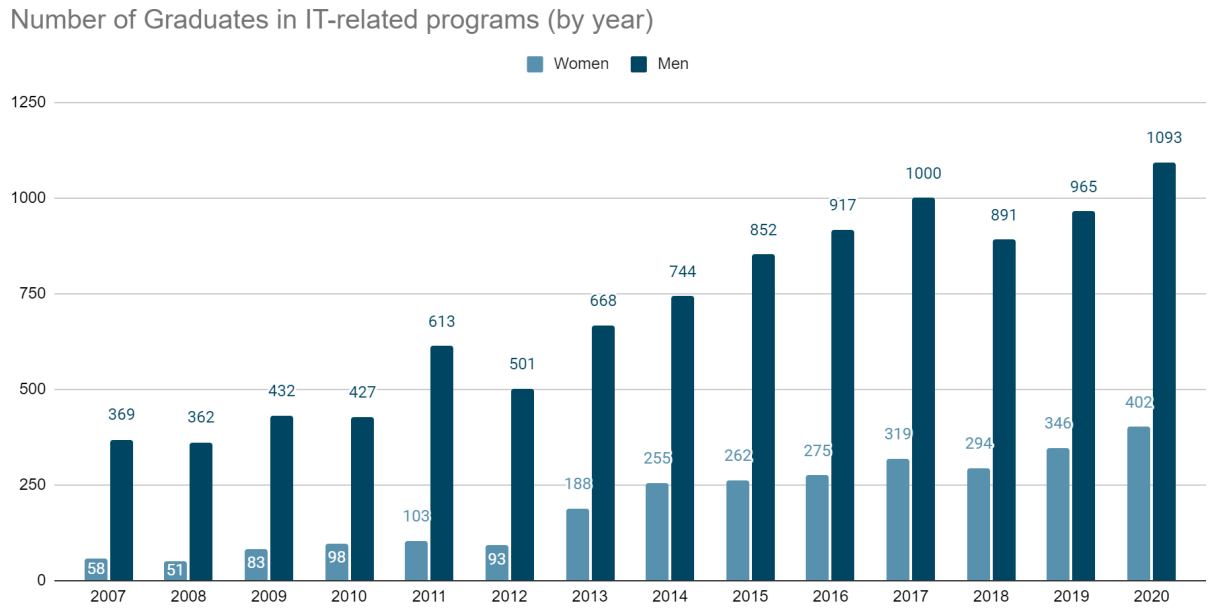
One of the most famous protocols on the internet, the Spanning Tree Protocol, was invented by a woman named Radia Perlman who is considered to be a revolutionary within the field of network bridging and routing and has been dubbed "the Mother of the Internet". Her invention, STP, allows for a loop-free bridged LAN and is widely used today. (Salim. N., 2010).

The history behind women in IT is important for this research because, in order to understand a problem that is current, one should look at the past in order to determine how the statistics have changed over the years. With a brief statistical analysis of past numbers, it is clear to see that women graduating with some sort of degree in the fields of IT in Sweden (See charts below) but that it is still only around 20% as opposed to men's 80%. While this could be explained as a lack of interest from women, among other reasons, this could be indicative of other underlying issues.

2.1 Women in IT in Sweden

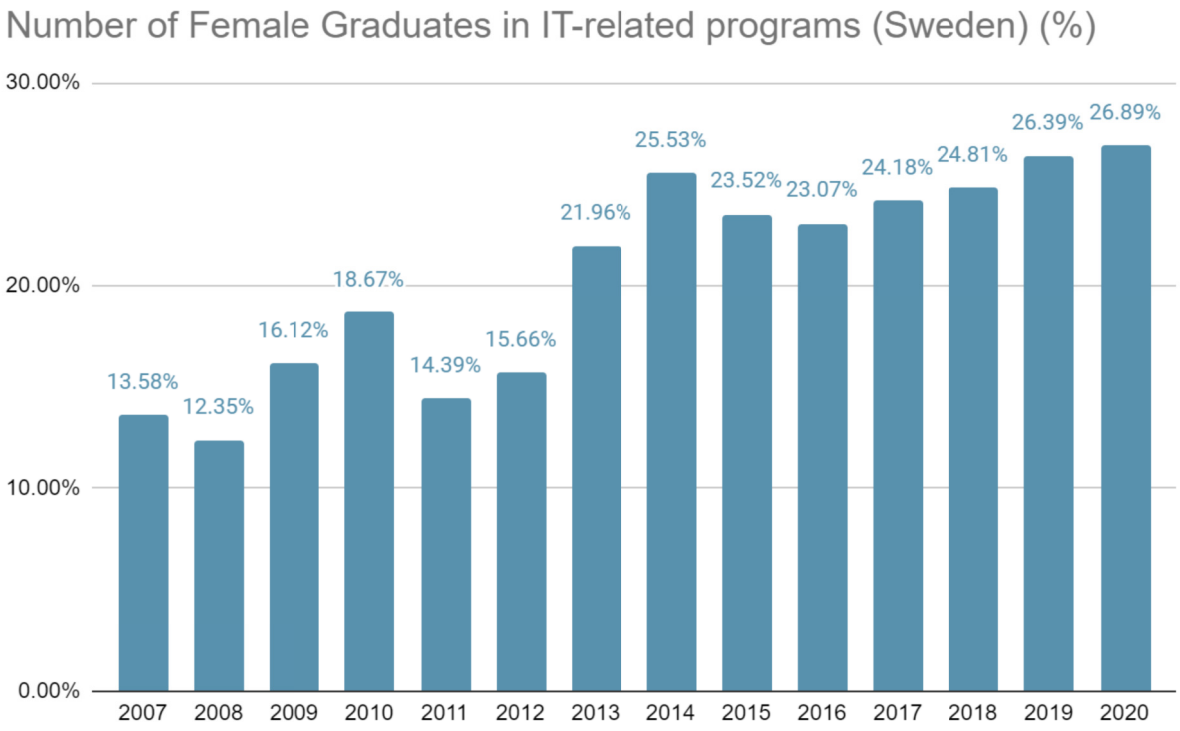
With an increasing global need for services, infrastructure, and hardware, human intervention in the form of administrators is necessary. As the purpose of this thesis is to examine specifically women in networking- and system administration in Sweden, it is interesting to see how many female graduates in IT there have been in Sweden during the 21st century. However, as the statistics for female networking- and system administrators are coupled together with the statistics of female graduates from all form of IT-related programs, no definitive facts have been found regarding the subject. From the statistics that have been found, however, it is possible to discern that the numbers of female graduates in IT as a whole has both grown and shrunk in the past circa fifteen years. Looking at statistics in more recent years (from 2007-2020) it is evident that the number of female graduates in computer science in Sweden has not reached over 30%.

Some of the statistics taken from SCB (Statistiska Central Byrån) might be applicable to the field of networking- and system administration though they represent the number of female graduates in IT as a whole as no specific statistics of networking- and system administration have been found.



(*SCB, 2022a*)

Looking at the statistics, it is evident that the number of female graduates in IT-related programmes in Sweden are steadily rising from the year 2007 and onward. Below is a chart representing the total number of female graduates in percentage by year.



(SCB, 2022a; SCB, 2022b)

3. Problem Definition

Currently, several government agencies around Sweden are working towards a more equal workplace between men and women (Försvarsmakten, n.d; jämnställdshetmyndigheten, 2021). While these agencies are working in order to achieve these goals, women are currently facing difficulties in male-dominated fields according to studies done by students at Swedish Universities (Lassu & Öhgren, 2016; Dau & Gustafsson, 2020).

Even in other work-areas, seen as typically male-dominated professions such as electrical engineering, truck drivers, etc. women declare that while they do feel happy at their workplace, they face different obstacles and challenges than their male colleagues (Lassu & Öhgren, 2016; Dau & Gustafsson, 2020). Many of the women interviewed state that they've been treated differently from their male colleagues in varying ways such as the way they are spoken to, how their ideas are viewed, and whether or not their boss' call upon them during meetings, to name a few.

It is the hope that this research will help contribute to the community of networking- and system administration and illustrate the current underlying issues in the IT-field as well as find a way to mitigate said issues. By interviewing women from several different companies, it is expected that a clear picture of the problem emerges and that conclusions can be drawn from these results regarding possible solutions.

3.1 Research Question and Aim

By careful examination of previous studies conducted in the area, it's evident that while there are clear issues, very few studies actually ask *how* these issues can be mitigated. Though it should be noted that some do exist and are valid in their own subsections of IT, the field of networking- and system administration has been left virtually without study. Also, the studies fail to take into account how women view what is missing that could make their workplace more inclusive for other women which would give employers a clearer picture of what to change. Subsequently, very few speak of possible consequences if women are underrepresented within IT. The most interesting questions that would need answering are:

RQ1: How can the field of networking and system administration be more inclusive for women?
RQ2: What consequences can underrepresentation of women in IT have?

The aim of the study is to gain perspective on how to make the IT field more inclusive for all genders and find out what consequences a lack of inclusiveness might have. In this context, inclusion is defined as the antonym of exclusion, i.e that the aim of the research is that no one should feel excluded (such as having previous or current experiences of being excluded in the workplace) because of their gender rather than aim for a 50 – 50 % balance between male and female employees. Feelings of exclusions are based upon the individuals perception and past, as well as current, experiences in the workplace regarding their gender and how they are perceived. Some examples of this is how a woman's ideas are seen during meetings, whether or not she feels less appreciated in the workplace by the boss', and what her thoughts are regarding the future of inclusion in networking- and system administration.

3.2 Limitations

This study is limited to gathering data only in Sweden and at five different companies from five different women in order to gather information on the current circumstances. The reason behind the limitations is to gather as much relevant data as possible in order to answer the research questions.

Ethnicity, race, age, and social status will not be taken into account. While this paves the way for a generalization (despite the fact that no two people are alike), it will allow companies in the future to see what they can change in order to garner a more diverse working crew and see the situation as a whole.

3.3 Related Research

In numerous studies conducted in the USA, it was found that women are a minority in IT and face biases. Cobb, Jonson (2018) concluded in her research "Plugging the skills gap: the vital role that women should play in cyber-security" that only 11% of the global cyber security force is comprised of women and that the reasons behind the lack of representation are not something that's known. While biases, unequal pay, and lack of interest and opportunity may be contributing factors, Yücel & Rızvanoğlu **(**2019) suggest in their research that lack of confidence might also account for the low numbers of women in IT. But the issues regarding lack of representation seem to stem from much earlier ages than that (Yücel & Rızvanoğlu., 2019). The lack of encouragement from parents, and traditional gender roles mean that fewer girls feel a sense of pride in being interested in IT or anything technological.

Yücel & Rızvanoğlu also state in their research: "*If a female knows about the existence of a negative stereotype regarding her competence with technology, she will experience more anxiety and lack of confidence because of treating it as an undeniable truth or because she will have to work harder to disprove the deficit that others believe in.*" (p. 354) meaning that society plays a bigger role in the underrepresentation than previously thought.

A Swedish study done at Örebro's University concluded that the lack of representation in the IT field could depend upon factors such as a sense of belonging, ability to be flexible with work-hours, and gender biases (Hamilton & Ringqvist, 2019). One study referenced in the paper suggests that some women feel unrepresented during meetings and that ideas initially brought forward by women are ignored until a man repeats it (Dice, 2018, referenced in Hamilton & Ringqvist, 2019). Additional factors such as appearance and the need to fill gender quotas could also contribute to a lack of confidence and be the reason why women choose to leave their workplace (Ashcraft et al., 2016; Dice, 2018, referenced in Hamilton & Ringqvist 2019).

A comprehensive study conducted by Bujdosó, Ghezzi, Hardman, Hillstone, Jaccheri, Kirchner & Pereira, (2016) estimate that the economic boon from hiring women could generate as much as 9 billion Euro annually in GDP (Gross domestic product) in the EU and gender equality would therefore be an issue of economic welfare. Bujdosó et al., (2016) also state that…"*We must strive to make the digital jobs and ICT-related research more attractive to women as a career path than it currently is."* (p.3) and suggest that work must begin at the student-level by encouraging faculty and department heads to nurture an interest for computer science in young women. The report aims to promote, recruit, and keep women engaged with additional suggestions for support measures.

3.4 Expected contributions and outcome

The expected contribution of this paper is a compiled list of ca. ten areas of improvements which recruiters and higher-ups can turn to while considering hiring women and use as a form of check-

list. The hope is that this list will be used as guidelines by recruiters and people in the process of hiring women for the sole purpose of being beneficial to both the employer and employee. The hope is also that this research gives women a chance to express themselves and their opinions in the form of anonymous interviews so that they may feel more comfortable in sharing their honest thoughts without fear of retribution.

The expected outcome of this paper is not only to give recruiters a list of improvements, but also a list of consequences of what could happen should women be completely excluded from the field of IT.

4. Methodology

The planned approach for conducting this study will be to conduct an interview study where the aim is to gather data on the current situation in Sweden, as well as examine what possible consequences exclusion can have for the IT-fields through the opinions of the interviewed subjects. The methodology chapter will contain the process of how this work is planned, the research method, a detailed plan on how to conduct the interview, an interview-guide, ethical considerations, as well as the method for data analysis.

The goal is to search for possible recurring themes within the answers given in the interview study. The compiled data will then be turned into a list of possible improvements in way of inclusivity. With both the recurring themes and the compiled list of suggested improvements, a list of possible consequences of exclusion will be presented, see figure 1 below.

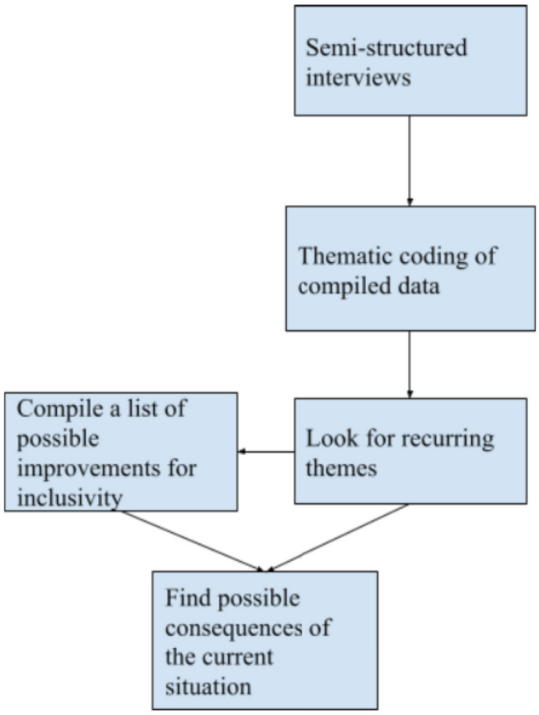


Figure 1 – Analysis Flow Chart (Author's own)

4.1 Research Method

As the research question is posed with a focus on gaining perspective on personal experiences and thoughts, a qualitative approach has been chosen with inductive reasoning to allow the subjects to answer in whatever way the question is interpreted. By structuring the research inductively, as opposed to deductively, the goal is to gain a deeper understanding of what is lacking in the workplace in way of inclusiveness for women and possible consequences to IT if women are excluded by leaving behind pre-conceived notions and biases and allowing the women to form their own opinions without fear of influence from an outside party. While this research could possibly reach the same results deductively, it would mean influencing answers and asking questions in a more yes or no oriented fashion in order to fit those answers into themes that have already been

constructed beforehand. The inductive approach fits this research well because it allows the women to speak about their own opinions and thoughts without needing to stay within pre-defined boundaries.

Furthermore, the hope is that the chosen approach will allow research subjects to speak freely about their opinions and experiences in such a way that the answers are as honest, open, and valid as possible without fear of retribution from an outside source. This will allow later for thematic coding of the compiled data, which is according to Braun & Clarke (2006) "*Thematic analysis is a method for identifying, analysing and reporting patterns (themes) within data*." (p.79). In addition, the validity of using thematic coding is described by Braun & Clarke as "*Through its theoretical freedom, thematic analysis provides a flexible and useful research tool, which can potentially provide a rich and detailed, yet complex, account of data.*" (p.78). As the data for this report is collected via qualitative means, quantitative measures can not be applied (such as quantifiable numbers, clear structures, etc). Therefore, any data collected from interviews will be compiled into "themes" (or categories).

4.2 Interviews

The planned approach for the interview portion of this study is to ask a series of six questions (See Appendix A) in a semi-structured way with each of the five individual women separately. The interviews will be conducted via any online platform (e.g Zoom or Microsoft Teams), which will be digitally recorded for later audio transcription and take on average 30 minutes to complete. In addition, notes are also taken to aid the process of thematic coding. During the interviews, the web camera is active so that the interviewer and the person being interviewed can see each other at all times. This creates a rapport and allows for the interviewer to determine the body-language of the participants and their subsequent reactions to certain questions (Bryman & Bell, 2013)

The interview questions are constructed in a way that allow for deep thinking and are designed to provoke an honest response from the participant. Several of the questions are left semi-ambiguous (i.e, design to help answer the research questions but open enough to leave room for interpretation by the participants) and asked in a manner which will allow for follow-up questions to be posed.

According to Wohlin et al., (2012) "*In a semi-structured interview, questions are planned, but they are not necessarily asked in the same order as they are listed*" (p. 62). By using semi-structured interviews, the respondents have the ability to both get concrete questions while also allowing for subjects to provide longer answers whenever they so desire. Also, semi-structured interviews allows for a more fluid interview process wherein the subject leads the discussion and the interviewer has the ability to ask more in-depth questions wherever these are necessary. By delving deeper into a given question, or picking up on something that the participants have brought up themselves, semi-structured interviews allows the interviewer the ability to gain more spontaneous information as it arises in conversation.

These interviews are done separately in order for the interviewed subjects not to be influenced by an external source. While it's arguable that group-interviews would allow for the subjects to build upon each others' answers, the purpose of this thesis is to study each women's individual thoughts and experiences. All of the women that have been chosen for the study are working in the field of networking- and system administration and have been taken from a list given by an unnamed source (in order to preserve integrity, confidentiality, and anonymity).

Prior to the interview, the participants have the right to request to be given access to any questions

that might be asked beforehand, the reason for which is to allow the participants to make an informed decision on whether or not to participate. In addition, a statement of intent for the study and information on processing of personal data is sent to the participants to showcase that their personal information can not lead back to them. All of the participants are therefore hence known as Subject 1-5 and any personal information shared during the interviews will be redacted.

The reason for doing semi-structured interviews, as opposed to surveys or questionnaires, is that these methods would not yield as many expressive answers, but rather simple yes or no replies to a given question. As many of the questions are meant to invoke deep thoughts, a semi-structured interview was chosen as the approach in order to allow each participant to talk as freely as they wanted without interruption.

Another factor is that interviews allow for more descriptive answers from a personal viewpoint of the participant and will give more unbiased sources for a thematic coding. By allowing the participants to expand upon the questions if necessary, more data can be saturated from each answer to allow for optimal data collection. "*Additionally, semi-structured interviews allow for improvisation and exploration of the studied objects*." (Wohlin et al., 2012, p. 63).

4.2.1 Interview Guide

The questions in the interview serve the purpose of: a) finding out what the current situation vis á vis gender inclusion in the Swedish IT workplaces, and: b) compiling information on changes to the current situation that the female participants would like to see in the future. The compiled themes of the current situation and identified threats against inclusivity compiled from the answers of the participants will be divulged as results under sub-chapter 6.1 Interviews, whereas suggested improvements during the interview phase will be presented under 6.2. Improvements. This will allow for a segregation between the present and the future as a way to present both the current situation and suggestions on how to improve these for the future.

4.3 Validity Threats

Validity threats are events that could steer, misinterpret, misrepresent, or call into question the validity of collected data and any such threats can be caused by bias, external, or internal sources (Kitchenham, 2004). These types of validity threats are represented by Wohlin et al., (2012) as:

1. **Conclusion validity**
   A type of threat that "affect the ability to draw the correct conclusion about relations between the treatment and the outcome of an experiment" (Wohlin et al., 2012). These types of threats will often render low statistical power, violated assumptions of statistical tests, and fishing and error rate. (Wohlin et al., 2012).
2. **Internal validity**
   Any threats to internal validity refers to a casual relationship between treatment and outcome and must not be influenced by factors that are outside the control of a researcher. These include single, multi, and social threats that can damage the outcome (Wohlin et al., 2012). A clearer example of a threat to internal validity could be misrepresentation of facts, which is covered in table 1 below.
3. **External validity**
   External validity refers to the ability to replicate the given outcome and conclusions to a different scenario and should therefore be able to be replicated and scrutinized. External validity threats hinder the ability to replicate these results in a generalized way and then

cause the conclusions to be singular and unsuited for generalization or replication (Wohlin et al., 2012).

4. **Construct validity**
   Threats to construct refers to the ability to connect the generalized results to the theory or hypothesis behind the research. Construction validity threats more often than not stem from a lack of clarity by the researcher during the research.

Possible validity threats to the planned research are related to the interview process. As such, several threats have been identified, described, and connected to a planned mitigation-tactic below as well as which stage of the research they might occur (see Table 1 below).

Stage	Identified threat	Description	Mitigation
Interview	Influencing answers	Accidentally influencing an answer given by a participant or steering a conversation to reach a pre-planned conclusion	Awareness and allowing participants to lead the conversation and answer accordingly.
Interview	Misrepresentation of answers	Accidentally misquoting, misrepresenting, or misinterpreting answers given by participants	Record audio for the interviews and transcribe into text format to ensure validity. Asking questions directly to the subject is also a way of mitigating the threat to validity.
Interview	Sample size	As there are only five participants in the interviews, the results are not representative of a larger sample.	Focus the research solely on the IT-field and in Sweden and narrow the scope down as much as possible without hindering data-collection.
Interview	Threats to confidentiality	A fear that a woman's answer, while looking at the all answers given, can be used to identify one or more of the participants.	Introduce a Subject X to ensure that no specific quote or data can be definitively connected to a woman while taking into account previous answers.

Table 1 – Threats to validity (Author's own)

4.4 Ethical Considerations

As a large portion of this work consists of interviews of personal subject matters, several ethical considerations need to be accounted for.

Sanjari, Bahramnezhad, Fomani, Shoghi, & Cheraghi, (2014) state that anonymity, confidentiality and informed consent are part of the cornerstone for ethical considerations in qualitative research. Therefore, any women participating in this study will be anonymous and will be given aliases to allow them courage to be more open and speak freely without fear of retribution from external sources. The confidentiality of the participants in the interview study will be protected and no personal information that would allow external sources to track these participants will be disclosed in this paper. In order to properly achieve this, while still sharing relevant information, a "6th participant" (dubbed "Subject X") has been added in order to present facts stated by a participant without being able to see which subject actually answered the question. Lastly, all information regarding data collection and how this data will be used will be shared with the participants of the interview study to ensure that the guidelines for informed consent are followed (Sanjari et al., 2014).

Any and all external information (such as articles referenced in this paper) will need proper citation as to not take the original author's words out of context and therefore threatening the validity of this research. As such, the sources used for this paper will be carefully considered to ensure authenticity as well as allow the original meaning and intent to not be misrepresented.

Furthermore, transparency and honesty will be closely observed before the interview process by giving the interviewees a thorough and proper explanation of the planned study, the importance of their participation, and how their confidentiality and anonymity will be protected.

4.5 Data Analysis

The data used for the research will be thematically coded using an inductive reasoning approach. This will be accomplished by conducting interviews from whence the collected data will be composed into several categories. Careful recording and transcription is important as to not threaten the validity of any of the collected data. This data will be analyzed by highlighting important and interesting facts that correspond to the hypothesis, setting an initial category, creating a theme, and summarizing the categories. In addition, a comprised list of possible consequences will be categorized and collected under areas of improvement later in this report.

In addition, under the results section of this report, the questions posed during the interview stage will be categorized into three themes: past, present, and future. The category "past" will contain the answers to any questions regarding past experiences in the field. The category "current" will focus on the current circumstances of the participants, e.g their current workplace. The "future" category will contain answers to any questions posed regarding their view on the future for women in IT. These themes will contain summarized answers given by the participants in this study.

5. Results

This chapter contains the results of the semi-structured interviews and is divided into three categories: past, present, and future. These results are presented without any analysis on the part of the researcher, but rather exists as a free-standing representation of the given answers during the interview process (See Appendix A - Questions).

5.1 Interviews

During the interview-process, several recurring themes have been identified and coded under chapter 6. Analysis. The more generalized view of the women, with regards to the questions themselves, are presented below.

5.1.1. Past

In regards to question 4, 2 out of 5 women report having at one point or another during their career felt excluded because of their gender while the remaining 3 mention that they have never felt excluded specifically because of their gender. Instead, the remaining 3 women report an overall satisfaction with their previous and current places of employments, but do not go into further details.

Subject 1 speaks primarily about her experiences at her first job where she felt her colleagues would treat her differently and even on occasion took her assignments from her; believing her incapable of completing her tasks, according to her, because of her gender. Subject 5, also recalls having similar experiences as Subject 1 and speaks about the time she was mistaken for a secretary during a test while she was, in fact, taking part in the examination.

While the remaining women do not report feelings of exclusion in regards to their gender, 2 out of the remaining 3 admit that they do not know if past exclusions have been because of gender or because of other factors.

5.1.2 Present

This sub-chapter represents the answers given to women in regards to questions 1 (including 1a and 1b) and question 3 in a summarized fashion.

When asked about whether or not the women felt like their workplace was inclusive for other women, 5 out of 5 answered yes. And when asked what it is about their workplace specifically that makes them feel included, the answered differed from “feeling like I’m one of the gang” (*Subjects 1 and 3*) as well as “feeling like everyone’s opinions matter” (*Subject 2*). The answers can be rated as over all positive and all but one of the women stated feeling very happy at their current workplace overall. Subject 4 specifically mentions the type of people she works with as being positive and energetic which have led to feelings of encouragement and motivation in her. Subject 5 states that her workplace is inclusive and says that she never would have been allowed an interview had it not been.

3 out of 5 women report that there’s no work being done at their workplaces (to the best of their knowledge) to include more women in IT, or make the women who already work in IT feel more

included. The remaining two are aware of work being done and answered yes, but state that they are not directly involved in the proceedings.

The 3 women who answered no when asked if work towards inclusiveness is something that they want to see also state that it's not something they feel is necessary at their place of employment and that it's not something they need to see be done. The two remaining women feel like it's something that they benefit from having though mention no specifics on how this work should look.

Several conflicting answers arose during question 3, pertaining to the respondents personal thoughts on whether or not they felt today's situation regarding women in IT felt inclusive. 4 out of 5 women answered no, but some also conveyed that they were not particularly aware of situations that were not their own and expressed doubt.

When asking Subject 1 if she could give any examples on what makes IT feel inclusive for her, she replied:

> *"*[...] *I feel like I'm being let in for who I am and not because of my gender."*
> *Subject 1*

While subject 3 replied no to the question on whether or not IT felt inclusive, she also replied with hope that the situation is heading in the right direction while Subject 5 cites previous experiences in the field and Subject 4 speaks about there being too much doubt regarding women's ability to perform their jobs.

5.1.3 Future

In regards to question 5, when many of the women were asked how they think the future for women in IT will look like in ten years, 3 out of 5 women expressed doubt that the current situation would change much while the other 2 remained hopeful that there would be a change for the better. Subject 3 specifically mentions that because she feels like the current situation with women in IT is inclusive, she wishes that her current circumstances do not change. Subject 3 also mentions that while she feels included, she does not necessarily believe the field to be completely inclusive to every woman, though she speculates that this might be because of personality rather than gender.

Subject 4 expresses a hope that women are more included in the future and suggest that continuous work towards breaking down traditional gender stereotypes might be the way to achieve the goal of equity for women in networking- and system administration.

Subject 5, while hopeful for a change, remains skeptical that it can be achieved within the short span of ten years, while Subject 2 feels that ten years is more than enough time to change the current situation and that it has to do with a mentality and society's view on women that is stopping that change from occurring.

6. Analysis

This chapter contains the thematically coded themes that have been identified during the interview-stage and presents both a personal and individual view as well as general views from all of the women. The most important excerpts from the interviews will be presented as quotes connected to each woman with the designation "Subject" with a signifying number attributed to their interview (I.e, 1-5). In order to ensure confidentiality, integrity, and anonymity, attributing a quote to a specific participant is less important than divulging any information that can be connected back to the woman in question. Therefore, a "Subject X" has been added in order to obscure any possible information that could be attributed to a single participant. While this could threaten the validity of the results (see 4.3 Validity Threats), the integrity of the participants must take precedence ethically.

6.1 Interviews

Five semi-structured interviews were conducted with women who are all working, in one form or another, in IT and all fall under the blanket-term of networking- and/or system administrators. The women from the interviews were asked six main questions (with possible follow-up questions where such were necessary) and depict the current working situation in Sweden's IT-departments as seen from their points of view. With the help of color-coding in the transcribed documents, recurring themes were identified, named, and coded for analysis. These themes are seen as possible threats to inclusivity in the Swedish network- and system administration community and serve as the basis for presenting suggestions for improvement. Some answers given during the interviews regarding any possible consequences if women are excluded from IT will be used at a later stage (see Consequences below).

While some of the language in the interviews was open-ended and ambiguous from many of the participants, it is the belief that the interpretations of such open-ended language (for example "them" is clarified) are correct as they fit with the context and the impression made upon the interviewer. These interpretations are only made while taking into account context of the question, or any possible follow-up questions, that have been posed. If a quote is divided into two parts (i.e interrupted by information not regarded as pertinent to the category or to answer the research questions) it will be divided with "[...]" to signal an interruption.

6.1.1 The male tone and language

All but one of the interviewed women speak about the male tone and language used by men as being one of the leading threats towards inclusivity. Subject 2 speaks about how men sub-consciously use language in a certain way towards women that can be construed as offensive and old-fashioned to such a degree that women might actually quit.

> *"*[...] *I might have this- well, I have this pre-conceived notion that many older gentlemen within IT have a certain way of speaking that they partially don't even think about- well, they might not think about it and it might just occur sub-consciously that you have a certain tone towards, predominantly young women within IT and that jargon can become wrong and very- not so "2022".* […] *If there are only men working at that specific place then that creates a certain tone, which is evident in previous studies as well, that there is a different atmosphere when there is just one specific gender at that workplace"*
> *Subject 2*

Subject 4 mentions that the language and tone used by her male colleagues sometimes differ from the tone they use with other male co-workers. An example for this, she says, is their need to explain certain work-related tasks in hyper-detail, as though she doesn't understand.

> *"*[...] *Of course I know that a person can have one way of talking to, for example, me and another way with his male colleague that he's worked with for seven years. There's- the way he says "This Bind Daemon has stopped working" completely naturally between the two of them and then "you know this DNS-systems thing that exists in Linux, it's stopped working"* […] *It's that conclusion that "We must go into hyper-detail because she knows nothing", kind of."*
> *Subject 4*

Subject 4's statement highlights, what she refers to as issues of the male tone, language, and making distinct differences between male and female co-workers in regards to the lingual pattern and word-choices being used. When asked why she thinks the differences in language exist, Subject 4 answered:

> *"There's, well it could be because of an underlying ignorance and that it's something they have never had to care about before. Like, they have their jargon and we all probably know a paternal or maternal uncle, one of an older variant of gentleman, who can sometimes sit and talk about how "yeah, you know women are like this and that". We probably all know someone like that and that, sadly, still lives on in some people. It most likely comes from a harmless place, but it's not something that's particularly productive, to say the least.* […] *I don't believe that talk like that belongs in a work environment. It's the younger generations, they have this more equality-mindset."*
> *Subject 4*

The jargon used in the workplace by her older colleagues, Subject 4 says can be somewhat terse and old-fashioned and that while newer generations are more aware of their language towards women, some of the offensive language still exist sub-consciously in older generations.

Subject 3 mentions in some ways that being able to talk to her male co-workers can also be a challenge as men and women are different mentally and therefore have different ways of expressing themselves. This, according to her, can create friction and misunderstandings in the workplace.

Subject 1 speaks about the roughness at which a man speaks towards women and how she, as a woman, has had to adapt throughout the years.

> *"*[...] *I should add that I can have a rough jargon too, but I think it depends on how you are in your own personality, too. I've probably got a lot [of experience] with me since I've been working since I was, like, 16 years old and it's almost always been men that I've worked with. And then the question, of course, becomes "how much should I tolerate?". But I can be pretty rough as well. So I guess that might depend on how you are personality-wise, probably. How high the ceiling goes, so to speak, but if it should get too personal, I'd of course bite back."*
> *Subject 1*

6.1.2 The need to prove oneself capable and disbelief in female capabilities

One prominent recurring theme throughout the interview is the need to prove oneself and male colleagues' and boss' disbelief in the capabilities of their female colleagues. For some of the

participants, these feelings were only momentary at the beginning of their career, while some report that even after years at the same workplace, their superiors and co-workers still require the women to prove their capabilities.

One of the women, Subject X, even goes so far as to state that she is lucky to even be given the same information as her coworkers regarding work chores. Subject X also mentions the pressure that comes with being a woman in the workplace and still needing to prove herself capable of doing her job.

Subject X says that:

> *"For example, I've worked at the company for five years, but sometimes, I'm not given the same information as my colleague. Sometimes there's important information about a release, an installation, a change in a server and I'm not given that information. And I thought to myself "How am I supposed to know, how am I supposed to work if I'm not given the information I need". So I constantly have to keep reminding people that "By the way, I have the same title [as male colleague], I must have the same information as him!"*
> *Subject X*

Subject X cites that these issues stem from a need to constantly prove herself worthy of receiving information that will help her do her job properly. Subject X also states that she believes that her male colleagues have it easier because they are inherently trusted by the higher-ups at the company that she works at. She claims that while she's entirely capable of performing her job well, her boss still always prefers to go to her male colleague first when technical work needs to be done. She recites a story about being called into a meeting and needing to fight her superiors for a chance to prove herself capable of performing a task, to which her superiors initially agree. At the second meeting to discuss particulars of the task, however, Subject X states that the boss has suddenly changed his mind.

> *"He [male co-worker] needed to say "I think that "Subject X" can do it because she's done the same thing already in a test environment, so she knows how to."*
> *Subject X*

Subject 2 mentions this as being indicative of a larger problem surrounding the work-culture she calls the "little lady" culture wherein a male colleague or boss will go so far as to call her "little lady" or belittle her. When asked if she'd felt excluded because of it, Subject 2 says:

> *"Maybe not excluded, but possibly a little bit- that it becomes "Oh, you know that, little lady?". That type of phrase, maybe. I don't really know how to put it into words, but that you're not really- you're not given that trust, but that you rather have to constantly prove yourself capable. It doesn't come naturally. I want to say that if I'd been a man, I never would have been met with doubt, but rather they would have expected me to deliver, but that's not something you expect from women in the same way. And it's something I've felt, a little bit in the beginning of my career.* […] *Luckily, that disappeared pretty quickly, but it still occurred for a while. Which is a shame really."*
> *Subject 2*

While Subject 2 reports that this only occurred momentarily at the beginning of her career, she later goes on to state that it shouldn't have to occur at all and that her feelings regarding the subject are mixed (though she does not specify in which way).

Subject 4 mentions that the workplace culture is potentially a source behind why women feel the need to prove their worth at their place of employment. The general disbelief that women within the technical aspects of IT are capable of doing their jobs is often met with shock and surprise by male colleagues:

> *"*[...] *I have of course experienced some form of "Oh, you know IT? Oh, you can do that? That's not something I thought you could. That I didn't know. That I didn't believe.". Sadly, it occurs occasionally that there is a, what would you call it, work- underlying work-culture left. That sometimes it's unusual when there's a woman at the workplace with a deeper understanding within IT, of course"*
> *Subject 4*

According to Subject 4, she feels as though she is treated differently from the male colleagues and that the attitude with which she is approached could be because her male colleagues have worked together for years and have never had to adapt to having women in the workplace. This, according to Subject 4, creates mistrust in a woman's capabilities in the workplace, though she also mentions that this is most likely due to sub-conscious thoughts rather than conscious malicious intent. Subject 4 goes on to state that her older male co-workers often feel the need to tell her exactly how to execute specific commands in regards to the systems she administers, despite the fact that she already knows them.

> *"*[...] *And then there's the fact that "you don't have to tell me this; I already know this". And so, that attitude exists on one level. That they draw the conclusion that I am not capable or competent enough to do certain things. Such as managing Linux systems, for example."*
> *Subject 4*

In addition, Subject 4 also discusses the innate need for men to test women to see how capable they actually are.

> *"*[...] *Like, if you talk about Linux systems, then they* [men] *start to talk "Cause you know this variant, right? You know how many of these there are-" talk advanced stuff, like they're testing you, kind of. You know that if you wear an Iron Maiden t-shirt, someone has to walk up to you and ask: "What's the name of the band's drummer? When were they born? When did they make their first song?" Kind of. That part might not be as aggressive as I'm making it seem now, but there's still this underlying idea that you have to be tested with "how much does she actually know?". That, if you wear a band t-shirt then you have to be prepared to answer questions like "when was the band formed?". "Ah, nice t-shirt, did you know that the singer did this? Do you know when they released their first song?" And constantly things like that"*
> *Subject 4*

6.1.3 Past experiences

All but one of the women who were interviewed cite past experiences as a threat to inclusivity in the workplace and the reason why so many women are hesitant to both apply for jobs in IT, but also the reason why so many of them have quit in the past.

Subject 1 says that she experienced feelings of exclusion at her first workplace after graduating university, as well as having her capabilities questioned by her male colleagues. Subject 1 says:

> *"*[...] *I worked with guys only and then all of them- though it was probably mostly because I myself felt that "shit, these guys know so much!". But then there might have been some people there who felt like I didn't belong because… yeah, they judged you pretty quickly that "but what does she know, technology-wise?"*
> *Subject 1*

The pressure from her co-workers, who would often take over her work when she expressed a need for help, was one of the biggest reasons why she eventually did leave. Her past experiences include co-workers, but also a teacher who claimed that women did not belong in IT, which lead Subject 1 to instead develop a need to prove herself capable. Subject 1 choose instead to use it to disprove her teacher rather than letting the his words discourage her and today she reports feeling happy at her workplace and feeling like she's inherently a part of the group. Subject 1 also states that her current workplace leaves more room for uncertainty and says that she's never afraid to ask for help from her current colleagues if she needs it.

This, Subject 1 argues, could also be one of the reasons why women don't apply for IT-related work.

> *"*[...] *That you've since before worked in a place like that where there's not been any changes, so you carry that experience in your luggage. And that you think that "there's so much negativity surrounding it" and that you've gotten a bad start, I think that's pretty-pretty rough."*
> *Subject 1*

Subject 5 shares a story about a job application process which she says is one of those bad experiences:

> *"*[...] *One time, I applied for a role and there was a room and we were 11 candidates. So I went into a room where we were supposed to take the exam. So I arrived, and there were 10 small tables and you could sit anywhere. So okay, I saw some men that sat there and waited, and I think I had something- like a pen and paper, and up walks a man- another candidate comes up to me and says "Hi, I'm here to take the test" and I said "Yes, so am I". And then he says "You too?". He thought I must have been a receptionist or a secretary or something. I said "Yes, me too". And he replied "Oh? You too? Congratulations". He was so surprised, as though I was stupid and that I was lucky to even be there with him and all the others. And I didn't notice at first, but when I looked up, there were 10 men and 1 woman."*
> *Subject 5*

This, Subject 5 further states, is not an isolated incident, but rather just one of many. Subject 5 also recalls a story about her previous workplace experience where she was forced to take on responsibilities that fell outside of her scope and boundaries and that her boss tried to convince her to take on a sales job instead, asking:

> *"*[...] "*Could you consider to take on job as a sales person?" and I said "but I'm not a sales person. And I don't like that kind of job. And I have no experience as a sales person". And he replied "yes, but if I send you, you're going to meet all bosses- IT-bosses, and all IT-bosses are men and they're going to think that you can't do your job, so I recommend that you apply for a job as a sales person".*
> *Subject 5*

This, according to Subject 5, created numerous issues with the sales department as Subject 5 oftentimes had to take on additional sales responsibilities. Subject 5 recalls having a strained relationship with the sales department from that point onward because they felt as though she was encroaching on their territory, which in turn lead to a loss of revenue for the sales-team as commissions were not given to Subject 5 nor the rest of the sales-team.

6.1.4 Biases, pre-conceived notions, and gender stereotypes

Mentioned in one form or another by all of the participants are recurring themes of biases (self-imposed as well as societal), pre-conceived notions about the field and gender, as well as traditional gender stereotypes. Subjects 4, 5, 3, and 2 mention that gender traditional stereotypes and roles as seen by society, could be a threat to inclusivity in the workplace; citing that women would be forced into more traditional female-dominated workplaces such as kindergarten teachers, caretakers, nurses, etc.

Subject 4 states that if the stereotypes continue to persist that there will be a pre-conceived notion that women only want to work in female-dominated professions because women are supposed to be more caring and gentle in nature. Subject 4 further states that her own personal experiences in the field had a rather rough start as she was not informed by her guidance-counselor that IT was even an option when selecting a high-school:

> *"*[...] *But I was never given the information about a high school programme with a focus on IT. Language, Hotel & Restaurant, and then it was commerce and humanitarian programmes, that's what I was recommended by the guidance-counselor as "these are programmes you should apply for". And then I found out- through my own initiative that "I want to do something else". And then, at the high school I eventually ended up at, there was an IT programme, but that I hadn't even been made aware of its existence!"*
> *Subject 4*

Subject 2, however, states that in the opposite direction, her hesitancy to apply for jobs often stem from her own pre-conceived notions and biases regarding the field. Subject 2 mentions that she herself has biases regarding how men treat women in the professional workplace and that these stem from what she's heard from other women, as well as personal experiences.

Traditional roles in society, such as staying at home with the kids and keeping house, are also at the root of the problem as to why women have a harder time getting work in the IT-sector according to Subject 2. She states that:

> *"*[...] *You shouldn't, like, loose women to this traditional "old-school" role that we've had in the past. We shouldn't end up there again where it's we* [women] *who take care of the household and kids and the family, but rather that women should also be able to work and have a career then it's important that we get a chance to do so. And in order to get that chance to have a career like any other man out there, then we must first be let into the field and at workplaces."*
> *Subject 2*

In addition, the way society views what is traditionally male and female tasks and interests could, according to Subject 3, be one of the reasons why traditional roles and the view on IT persist.

"*Girls get to play with dolls and such often when they're little, so it is, in a way, the way it's always been, but that it might be important to go a different way.* […] *Getting more girls interested earlier, or showing that this [*IT*] is also a reasonable alternative also- also choosing, like, to become more technical and that.*"
Subject 3

Subject 3 further states that the key to breaking these stereotypes and gender roles assigned by society is to, despite society's expectations on gender, show young women that it is okay to like IT and that there exists an image of what men and women are supposed to like.

6.1.5 Gender Quotas

Several of the women mention not wanting to be part of a quota that the workplace needs to fill, but also mention some positive aspects about quotation and why such a thing could be necessary.

Subject 5 speaks about the need to give everyone a chance to apply for the job and that the recruitment process should encompass a fair view on the genders.

"If they start a process to recruit, then they could say "Ok, I want at least 50-50; 50 CV from men and 50 CV from women to start with". That doesn't mean that they're forced to take in half men and half women. […] *In order for a woman to get a job, she must show that she's good and even better than all the men that are applying. So that's why I'm thinking from the start, take the same number of men and women then you take a look at the competence."*
Subject 5

Similarly, Subject 4 points out that while gender quotas has its drawbacks, and there is a stigma around hiring after gender, she still believes that sometimes quotas are good:

"[...] *Of course there are negative aspects with it too, but there's a study that I heard about once on the radio that when male bosses are hiring, they prefer to hire other men that remind them of themselves."*
Subject 4

When it comes to this mentality, Subject 4 points out that most of the bosses within IT are men and further speaks about the dangers of underrepresentation:

"[...] *If we have, sadly, too many irresponsible bosses out there that, maybe shouldn't be handling the recruitment process at all, that never look at a woman favorably, then I think gender quotas can be very necessary."*
Subject 4

Subjects 1, 2, and 3 speak on the importance of personality, suitability, and competence in the hiring process. Subject 2 describes her workplace as inclusive for women, but that she wouldn't want to see gender quotas being used as a tool, but rather is of the belief that people should be hired because of their competence and skills rather than gender. However, Subject 2 also speaks about the importance of creating an inclusive environment and trying to actively recruiting women is important for the field of IT. Subject 1 shares a similar belief to Subject 2 that gender should not matter too much during the hiring process and that her workplace focuses on skills rather than gender as well. Though Subject 1 also quick to add that she has felt excluded because of her gender and that gender distribution in the workplace carries importance. Subject 3 believes that she was

hired at her workplace for her personality and skills rather than her gender, stating that she is the lone woman who works with the specific tasks she has.

6.1.6. Single-gender domination

All five of the women mention that a field dominated by a single gender gives off the wrong impression to applicants and therefore discourages the opposite gender from applying for a job at that workplace. Subject 3, specifically, notes that in order to get a good atmosphere and feelings of belonging, there need to exist a balance between the amount of men and women working at the workplace, and Subject 1 notes that she feels like those good vibes exist *because* her workplace is somewhat equal.

Subject 1 speaks about the good rapport she and her colleagues have and the each at which they converse with each other, as well as help each other out. This, Subject 1 attributes to the fairly equal distribution of men and women in her section and that she's rating the overall happiness at her work highly.

According to Subject 4, having just a single gender at the workplace would make for a fairly "tasteless stew" and would create a bland and boring work environment:

> *"I think that, on one plane that it can be so- it's such a good atmosphere when there's an equal mix at a workplace.* […] *Women and men are biologically different in many ways and so many times one might not be able to understand the other to a 100% and that's the way it is. And there might be a perfect- I don't know, a perfect software that's scripted by a woman that calculates exactly how your menstruation cycle will work. It might be difficult then if you're not as involved as a man.*[...] *I think that a more mixed compote makes for a better stew*."
> *Subject 4*

Subject 2 also briefly mentions the atmosphere in the workplace that a mixed workforce might create and that IT would be missing out on the understanding having mixed genders would create:

> *"If there's only guys working at a workplace then that creates a certain atmosphere, and that's something we've seen in previous studies also."*
> *Subject 2*

Subject 3 mentions that a single-gender field would pave way for generalization of genders and would reinforce certain "toxic" gender stereotypes and that by mixing, more knowledge and understanding can be incorporated into the work.

6.1.7 Salary

Two of the participants of the study concluded that salary and unequal wages might be a prominent threat to inclusivity. Subject X even goes to far as to state that she makes a substantial sum less than her male colleague with the same job-title. When asked about the salary at her current job and her dissatisfaction at the wage-gap between her and her current colleagues, Subject X admits that she is currently looking for a new job; citing that the lack of support from her boss and his unwillingness to give her a raise after years of work at the company are the leading causes. Though Subject X is dissatisfied with the current circumstances regarding salary, she holds no grudge against her male

colleagues that make more money than her. When asked about possible reasons behind the wage-gap, Subject X answers that she can only guess that it's:

> *"In the beginning, it's because I am new at work. I think it's normal for the company to try and save money. They don't want to pay as much as they pay right now, or they don't want to pay as much as they did to the person who had the position previously. They want to save money, and I understand. You start, and they say "Yeah- we don't pay that much, we have other benefits here though" and in the beginning you accept it "alright, ok". But the time passes and every year you have more experience, you understand more problems, you're capable of fixing- so it should go hand in hand; it should be better and better."*
> *Subject X*

Despite this, Subject X ultimately states during a later question that she can't see any feasible reason beyond the first initial months at the workplace and lack of experience to withhold a raise. She herself has fought numerous times for a wage equal that to her male co-workers with the same job-title. Furthermore, Subject X also states that her colleague has been at the company a few years longer than she has and that this, at least in her boss' eyes, is a reason for the wage-gap. Though Subject X is also quick to state that while her co-worker has been at the company longer, he previously held a different, lower-level position. As such, Subject X stated her dissatisfaction regarding her situation and that equal pay would have made her consider staying, although also states that the time for reparations has passed and that she will not be dissuaded from leaving once she finds work elsewhere. When asked if Subject X believes that this is because she works at a private corporation rather than for the government, she says that she has no experience working for the government and therefore can not answer the question with confidence. Despite that statement, Subject X still believes that it could be one of the reasons why she is not paid the same wage as her co-worker.

On the opposite side of the wage-spectrum, Subject 1 states that:

> *"*[...] *We have always been paid similarly, all of us. So at my current workplace, it's never been unfair in any way. So that's a relief! I thought there was going to be a big difference, actually."*
> *Subject 1*

Subject 1 attributes partial feeling of belonging at her workplace because of the equal wages and the reason behind the equal wages to working in the public sector. This, according to her, is important to her to feel like she can belong.

6.1.8 Lack of courage and encouragement

An underlying reason for the lack of inclusivity in IT could stem from the lack of encouragement and courage. From an early age, society's expectations on how men and women are supposed to behave, what hobbies they are supposed to have, and whether or not they are encouraged to pursue something that is considered outside the scope of traditional gender-roles, all play a part in whether or not women are included. The absence of encouragement leads to an absence of confidence which, according to Subject 5, is one of the leading reasons why women are excluded.

> *"*[...] *Because- it's because men have it easier to show that they are capable. They have, maybe, I don't know- they show more confidence and they say "Yes, of course I can do it.". And women are a little more cautious when they say that they can do something. They don't*

want to promise so much. And we don't want to promise so much, we want to be a little bit more realistic, maybe "well, I can try, but maybe it won't be so easy". And that's not wrong, we're just more cautious, we have a harder time saying "yes, I can do it!" while men can."
Subject 5

Subject 5 attributes this in a later statement to lack of courage and encouragement from other external sources and an innate inability to simply show a false front and project confidence. Women, according to Subject 5, have a harder time "selling themselves" as capable individuals and would rather incorporate blatant honesty when asked about their capabilities than lie.

Similarly, Subject 4 reports that she wishes that she had been encouraged from a young age to pursue IT and that the development in younger generations is going in a positive direction and that a lot of kids these days are encouraged (regardless of gender) to pursue their passions. Subject 4 also speaks about the need for women to show confidence:

"[...] *I wish we'd get in more of the "here we come, and we are capable, and we can do it, and look out here we come" mentality.* […] *In with- if you want to read an IT-curse or an IT related programme, do it! If you want to repair cars or something else, just do it. And that pre-conceived notions are left out of it. Some day, hopefully, they are gone. And that's good, I think!"*
Subject 4

Furthermore, Subject 3 speaks about the importance of encouraging young girls early in life in order to grab their attentions to show them the validity of choosing IT as a career.

"Like, it's about getting more girls interested at a younger age, maybe, or show them that this is also an option. This alternative- this is something you can choose and become more technically inclined. That way, we can get more women interested in the IT-fields."
Subject 3

6.2 Improvements

After conducting interviews with the five women, several possible suggestions for improvement were discussed and have been extracted from the participants' answers. These vary from being recurring to being the thoughts of a single woman but all have the collective view of inclusion in common.

The list of suggestions for improvement has been compiled to aid those in the process of hiring women for jobs in the networking- and system administration sector as a way of gaining a deeper understanding of what women need in order to feel validated and included at the workplace. This would, hopefully, aid recruitment of women into the field, as well as provide some additional information on how to make the workplace more inclusive for women.

6.2.1 Equal wages

The need for equal wages for equal work is not isolated to the IT-field alone, but also occurs in conversations in every field in the professional world. Though inexperience might play a part in the inequality, it is also evident that gender plays a large role. By listening to the experiences of Subject X and Subject 1, it is evident on both ends of the spectrum that the need for a fair wage is important regarding a woman's positive feelings of the workplace. As reported by Subject X, because her wage differs so much from that of her male co-worker with the same job title, Subject X is looking for a new place of employment. The lack of interest from her employer to pay a fair wage is only one of the reasons why Subject X feels as though she wishes to leave, but that it is perhaps the most prominent reason.

While Subject X expresses deep dissatisfaction, Subject 1 reports feeling both shocked and elated that the wages at her workplace are so equal and that it's one of the reasons why she feels included. Subject 1 also further states that this could be because of her work in the public sector while Subject X works in the private sector.

It is of interest to note that only two out of the five subjects specifically mentioned their wages (both as positive and negative aspects in their line of work) when taking into consideration the well-known facts that women generally make less money than men. Although this is a well-known factor to women's feelings of exclusion in the workplace (not just in IT-related areas), its impact on networking- and system administration has previously been left unstudied and therefore warrants a mention. It is also important to mention that whether this is because of gender, education, or some other factors is currently unknown and should be further researched in the future.

6.2.2 Representation and female role models

Having more representation and a female presence during recruitment, during career days, and at seminars Subject 3 argues is important as women tend to look up to other women and that having a man in the same position is not the same.

> *"I think we need more female role-models in the IT-field. So you have someone to look up to- you feel like you can relate more than if you look up to a man, it might not be so- yeah, you can't relate to a man in the same way."*
> *Subject 3*

Subject 3 believes that the way to accomplish this is to reach out to young women earlier and showing that careers in IT are not just for men, but that a woman's presence during such events is preferable.

Furthermore, Subject 2 and 5 share these views and speak about how career-days, seminars at school, and similar events could be the key to get more women to feel included in the workplace. Subject 4 mentions that getting women to feel more included is also about removing the stigma around what is "male" and what is "female" and that she wishes for more women to be the face outward.

> *"*[...] *I'd like to see the CEO of Samsung, or the CEO of something talk to a female developer, for example"*
> *Subject 4*

By positively utilizing the women in the workforce, companies would encourage more women to apply.

6.2.3 Equal chances for men and women

According to several of the women, what they would like to see most during the recruitment process is an equal starting-point for men and women and that the chances given are the same for both genders. Subject 5 feels like we should give men and women an equal chance by taking the same amount of resumes from both genders and then making an informed decision would raise the chances for inclusion for women in IT. By being given an initial chance by the company, women would have a better chance of positively presenting her abilities as a worker and that would therefore lead to a more equal division of genders at the company. Though, Subject 5 also speaks about how the lack of these given chances would lead to an unequal gender-distribution.

> "[…] *How is she supposed to get a chance to learn and develop with all the other men that she's competing against for the position? So it's always the fact that- that it doesn't matter. She has a diploma, but she wasn't given that alter- that chance to start working so it's always going to be more and more. But if you look at her male classmates, they are rising and rising. They got other alternatives for work, they got other chances"*
> *Subject 5*

Subject 2 mentions that giving chances to workers ultimately falls within the scope of responsibilities for the higher-ups and that they need to be imbued with a certain mindset while hiring in order for men and women to be given equal chances to a position.

> *"It's very important that the bosses- or the people who are in charge, that they have this in their mindset that you always account for both men and women and try to keep it as equal as possible."*
> *Subject 2*

The importance of different personalities in the workplace, Subject 3 argues, is important for the overall atmosphere and will benefit the company positively if women are given the same chance as men.

Therefore, changing the way the recruitment process works, and ensuring that male and female resumes are initially viewed the same, this would possibly ensure that women are further included in the IT-field and therefore feel more overall satisfaction with her workplace.

6.2.4 Promote a better understanding of the opposite gender

The process for understanding how men and women are different, and how they relate to one another, is important for both genders to feel comfortable working together at all. Subject 1, 2, 3, and 4 speak about the difference in how men speak to their female coworkers as opposed to their male ones and that the tone and the jargon can get rough and unrefined; ultimately not suited for the workplace.

While the way men relate and speak to women might be indicative of a larger societal issue, it is still important to take women who report such events seriously while simultaneously making it clear to the workers what is and what is not appropriate talk for the workplace.

Subject 2 specifically mentions that the way men treat women might be a contributing factor as to why so many women leave and that bosses need to be aware that a dialogue is needed for the future:

> *"*[...] *And IT needs to see a positive development where a confrontation needs to happen, or a dialogue needs to occur where you really get to the bottom of- really deal with this so that that atmosphere or that jargon can not occur in the workplace at all. Because if had been between two men, then that way of speaking would not have been as degrading as it is around women, because it's exactly that type of language that occurs- or can occur that I have noticed."*
> Subject 2

6.2.5 Encouragement

One recurring theme that has been present during all the interview has been, in some form or another, related to a lack of encouragement. Subject 4 speaks about the lack of encouragement from student counselor and teachers alike and mentions that she would have liked to be given more options regarding her own education and more information regarding her available choices. All of the subjects mention a "can-do" attitude that is sorely lacking in women and speculate that this can be because of a lack of encouragement from an early age.

While this can not be influenced by a recruiter, it is important to actively encourage women through campaigns and projects before these women choose their careers for the future. Therefore, as mentioned above in sub-chapter 6.2.2, career-days, promotion, and representation is also important for encouraging women to choose IT as their field of work.

6.2.6 Include women in decisions regarding women

Anita Borg once said: "*Around the world, women are not full partners in driving the creation of new technology that will define their lives. This is not good for women and not good for the world….Women need to assume their rightful place at the table creating the technology of the future."* (anitab, n.d).

Similarly, as brought up earlier in this paper, Marco & Tarantino (2021) talk about the importance on including women in the design-choices made in IT as these decisions directly impact women. As mentioned in the results-section of this paper, none of the women who have been interviewed are currently involved in work regarding inclusion of women at their workplace, and several mention not having heard of such work being conducted at their workplace at all. While some of the participants do not believe that work of that nature is necessary at their place of employment, they do speak about the importance of including women in choices that directly impact women. Specifically, Subject 4 mentions the importance of being involved as a woman because of what women can do for society, specifically in the terms of entrepreneurship and developing new IT-related services.

6.2.7 Ask opinions and listen

Subject 2 mentions feeling as though her opinions are well regarded and listened to by both her colleagues and her boss' and that this is important for her over-all feelings of belonging at the workplace. Because of this, Subject 2 states that she does not feel excluded at the workplace and that her boss' make a conscious effort to listen to her opinions.

On the opposite side of the spectrum, Subject X mentions feeling as though she constantly needs to repeat herself in regards to her own capabilities as her boss still does not listen to her. In that sense, Subject X mentions the need for women to be heard, and subsequently for people to listen, in regards to what women need in the workplace rather than just brushing such opinions aside.

6.3 Consequences

When asked what consequences exclusion has for women in the IT-field (as well as the consequences this might pose to women in society), many answers regarding design, competence, lack of interest and courage, and stigmas surrounding the IT-field emerged.

Subject X reports that design matters because of her work that she conducts with the police and that the bulletproof vests that they use at work are not adapted to the female bodies and proportions. A bulletproof vest, by definition, protects the wearer against ballistic projectiles and should these be ill-fitting, this could have catastrophic consequences in case of a shooting. This therefore poses a risk to a woman's safety, and though Subject X has raised these concerns with her superiors, the official answer is that bulletproof vests made for women and female proportions are simply not being manufactured.

The consequences underrepresentation could have for the women in society presents itself in the form of user-experience and design choices. Subject 4 speaks about a theoretical application regarding a woman's menstruation cycle, though doubts that if women are not involved in the process of designing and developing this app that it won't appeal to other women as men don't have the same experiences in the area. This could mean that if there are no female programmers that applications, systems, programs, etc. that are made for women would not be made or be made without taking into account the opinions and expertise of women.

Furthermore, 5 out of the 5 women interviewed all agree that should women be excluded from IT then the field itself would loose valuable competence that is necessary in order for Sweden to continue administrating its infrastructure, as well as expand in the future. As the demand for administrators grow, the supply would diminish and would eventually lead to a lack of operational expertise.

More so, an almost unanimous answer is that no more women would apply for jobs in IT, citing that those women would probably feel discouraged and ill at ease knowing that they would be alone. This, in turn, would mean that the field of IT would continue to be male-dominated and could even cause issues for Sweden as well. Not only could this lead to sub-par infrastructure, reaching goal five of UN's goals of sustainability might no longer be an option.

7. Conclusions

This chapter is a presentations of the conclusions drawn from both the analysis and the results presented in previous chapters. These conclusions are drawn from the semi-structured interviews and the answers given by the five women who have recounted their own personal opinions and shared their stories.

By looking at the results and analysis of this report, it is clear to see that women in IT have very mixed experiences where some recount feeling lucky for ending up at “good” workplaces, though sometimes cite bad past experiences. It is evident by viewing the answers given that no two women are the same and that no experiences mirror the others’, though recurring themes of feeling excluded occur. Even for a country as gender equal as Sweden, there is still a long way to go before Sweden is truly gender equal and that the future of IT is still unclear.

Threats to design, inclusion, equality, and the work environment are just some of the possible consequences that have been identified and that IT is not done developing in regards to inclusivity. Missing out of valuable competence, a more inclusive workplace, and more inclusive solutions are just some of the issues IT might be faced with should the current circumstances not be changed.

While conducting the interviews, several answers point towards the fact that a lack of knowledge and experience in the area has previously led to male colleagues regarding them differently and rather than offer help, would then shun the women. In some capacity, all of the women spoke about experiences in the field with both a favorable, and unfavorable, view. It is evident by the collected data that the common factor in these experiences have been men and their treatment of women. Because of these factors, it is important to recruit women into IT, but also teach men in the workplace how to regard women.

It is clear that many of the women had a lot of suggestions on what can be improved, though that a few of them felt that when trying to express these ideas to high-ups they were shut down or ignored. Presenting these in an anonymous medium has yielded many usable results for the future and should therefore be regarded by future employers in the IT sector as useful for the recruitment process.

Similarly, women’s exclusion from the workplace can have consequences according to the five women interviewed in this report. How bad these consequences would effect the field of IT (and society) vary, though it is evident that they could span from catastrophic to mild. Most of all, IT is needed in society and competent people are needed to develop and administer this infrastructure.

Lastly, in order for the field of networking- and system administration to be more inclusive for women companies should be offering equal wages, promoting a better understanding of the opposite gender, providing equal opportunities and chances, as well as encouraging women to apply could allow for this.

8. Discussion

While the process of this report was not flawless, the results presented and the conclusions drawn are still important for the field of IT and presents a picture of how the current situation regarding inclusion looks. As there always is with interview-studies, there is risk of contamination from the interviewers side as some of the questions posed can be construed as leading. It is however the belief that while some answers might be seen as “leading”, the ultimate goal was not to taint the validity of any answers with biases but rather to build upon answers from previous interviews as a way of finding recurring themes. These questions were also asked as a way of clarifying whether or not the answers had been correctly interpreted by the interviewer.

Though this study would have benefited greatly from also adding additional sources from a literature review, the lack of one does not threaten the validity of the results of this report as the answers given are a matter of opinion rather than a definitive statement of facts. Regardless, the literature review could have helped also determine how the current situation in Sweden differs from that of the rest of the world.

As this is a qualitative study conducted with the help of semi-structured interviews, no definitive, quantifiable conclusions can be drawn from the collected data, but rather can be seen as a generalized view taken from the personal experiences of the participants. It is still the belief that these views represent, at the very least, a fraction of the struggles women currently face in the field of networking- and system administration in a country as high on the gender equality scale as Sweden. The conclusions and results in this report, while not representative of the population of Sweden as a whole, is largely the same as other research conducted in IT-related fields. The results, therefore, were not of a surprising nature.

On the topic of the future of IT, the women were asked how they thought the situation regarding inclusivity might look in ten years, some exhibited skepticism that any major changes would occur, though they still expressed hope that IT would only continue to become more inclusive. This is partially important for the specific reason that not everyone working as a networking- and/or system administrator is educated, but rather depend on their own knowledge, expertise, and experience in the area. Thus the question becomes if gender truly is the contributing factor to why so few women choose to become networking- and system administrators or if a lack of education in the area (possibly brought on by a lack of encouragement, knowledge, and misinformation of the field) is what is causing women to not apply for jobs in networking- and/or system administration.

8.1 Contribution

This research is important because few studies exists about networking- and system administration that also study gender equity and it is therefore interesting to study. Furthermore, it would pave the way for more researchers to build upon this work and continue to fight for a more gender equal field.

As not all IT is the same as the other and IT is a very broad term used as a common denominator to describe work in computer technological areas, not all problems regarding gender equity have to exist for all areas of IT (or all countries). There is an argument to be made that IT is a well-respected field for women in many other countries, this study specifically aimed to study Sweden, which is ranked as number five on the gender equality scale.

Some of the examples in the text (such as the need for equal wages) are not unique to networking- and system administration, but as the area is relatively unstudied, it becomes important to bring such issues to light. Many people know that women want equal pay, but as of 2022 the gender-pay-gap still exists in Sweden, meaning that while this statement keeps repeating in almost all areas of work, it still has not disappeared. Therefore, it is the hope that this paper contributes knowledge, the personal opinions of women working in networking- and system administration, and a concrete list for recruiters on what needs to be offered to women in order to get them interested in the field.

8.2 Societal aspects

As concluded in this report, there are consequences of women's lack of representation in IT. The impact this has on society can be wide-spread. These include scenarios where future planned (and un-planned) expansions of systems, services, etc. will not be possible because of a lack of workers to administer these changes. With an estimated 70.000 new planned IT position in Sweden (IT&Telekomföretagen 2020), there are not enough men to fill these positions when looking at the current number of recent graduates in IT-related programmes in Sweden. However, if women are not included in IT, these positions might not be filled, and might therefore leave Sweden's infrastructure without enough competent administrators to administer it. It is possible that this report might benefit society as a way of pointing out what needs to change, and what consequences the lack of a change might have.

8.3 Ethical aspects

While conducting this research, several ethical aspects had to be considered, such as the participants' need for anonymity, the sample-size, and ensuring that the validity of the research is not compromised. As the participants' in this study were all anonymous, this research can not be repeated with the same group of women in order to yield similar results. The need for anonymity is common in qualitative research and must be intact in order to not breach any ethical boundaries.

With a sample-size of only five women, this research is not representative of the opinions of every women working in networking- and system administration in Sweden. However, it is important to note that without discussing the answers with each other beforehand, the majority of the women reach similar conclusions and tell similar stories about being a woman in IT. Therefore, it is the belief that the opinions spoken about in this paper by these women (while not representative of every woman in Sweden) still holds some validity to the conducted research.

Another ethical consequence of the overall size of the female work-force in IT makes it easier to determine the identity of the five women who participated in this study. The mitigation to this has been to introduce Subject X as a way to prevent identification.

As with any interview-study, ensuring the comfort and integrity of the participant is crucial as to not step over any ethical boundaries. Therefore, questions were posed ambiguously to allow the participant to choose how they wanted to answer. No questions that were of a too sensitive nature were posed as special permission would have need to have been applied for in order to publish this study.

8.4 Scientific aspects

Scientifically, the hope is that this paper serves as a basis for future research in the area and that it gives the research community a foundation upon which to build. While this thesis is a good place to start further research, it is by no means complete and the area of networking- and system administration would benefit greatly from further studies regarding IT and gender. Furthermore, the information presented in this paper (while not always unique to the field of networking- and system administration) could be applicable in other areas of IT as well and therefore could be useful for the rest of the IT research community.

8.5 Interview process

This research was conducted thematically with an inductive reasoning approach and done with the help of semi-structured interviews. The reason for using inductive rather than deductive reasoning has to do with the nature of inductive reasoning itself (i.e the lack of pre-configured themes to which the subjects need to adhere) and therefore allowed the women to create their own opinions and thoughts rather than let themselves be steered in a certain direction, which is one of the threats brought up in the sub-chapter validity threats.

The interviews were conducted via an online platform (Zoom) and took anywhere between 20 to 50 minutes to conduct. While the interviews could have been longer and conducted in person, as a face-to-face meeting could have yielded a closer relationship between the interviewer and participant, it was decided beforehand that the interviews would take place online because of Covid-19. In lieu of an in-person meeting, a web camera was used in order for the interviewer to determine if a question made the participant uncomfortable, apprehensive, etc. Additionally, in order to not allow the women to influence each others' answers, all the interviews were conducted separately. While a group-interview could have allowed the women to take inspiration from each other and build upon answers, the separate interviews allows for the researcher to see recurring themes as an individual response rather than the view of a group. The threat to internal validity can be greater in group-interviews as there is more than one person to influence an answer and therefore a subject could fall victim to peer pressure.

The answers (which becomes the results of this paper) were transcribed (as to allow the researcher to return to the answers at a later date without loosing context, sight, or facts) and compiled into three categories: past, present, and future. These themes occurred naturally during the process and encompass what has possibly been wrong in the past, such as bad experiences, what might currently be good or bad in the workplace, and what the participants' views on the future for women in IT are.

Looking at the answers given by the five women, several themes could be created for the thematic coding and further analysis from which a list of improvements and consequences could be drawn. The hope is that these are used as guidelines for recruiters and/or those in the process of hiring women.

The major difficulty that arose during this process was the interpretation of the data and how to present it in such a way that it clearly represented the subject's opinion; all without giving away any information that could lead to her identification. Minor difficulties include finding the proper translation, as the interviews were conducted in Swedish, as well as finding proper names for the thematic codes that accurately described the content.

8.6 Future Work

Because IT is constantly evolving, the areas of research within computer science continues to broaden with time. For future research, a larger study into the inclusive culture in and around Europe could become relevant in addition to studying the work-culture at different companies. A large-scale survey would also help gather opinions from a bigger selection of women and thus encompass a more generalized, broader view.

Also, because of the nature of the study and the ever-changing nature of the IT-field as a whole, a study depicting the current situation would be relevant again in the future to see how the situation has actually changed. While no definitive answers can be drawn from this study (other than presenting opinions of the participants), finding other such studies from other countries and conducting a literature review on the differences between Sweden and the rest of the world could be beneficial.

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Appendix A - Questions

1. Tycker du att din arbetsplats är inklusiv för kvinnor? **Om ja:** Vad är det mest positiva på din arbetsplats som gör att du känner dig inkluderad? **Om nej:** Vad tycker du kan förbättras?
    a) Utförs det arbete på din arbetsplats gällande just inklusivitet för kvinnor inom IT? **Om nej:** Är det något du skulle vilja se?
    b) Har du några övriga förbättringsförslag och synpunkter på din arbetsplats gällande inklusivitet?
2. Vad tror du samhällskonsekvenserna blir av att kvinnor är underrepresenterade inom IT?
    a) Vad tror du konsekvenserna av underrepresentation för kvinnor blir för IT branschen i sig?
3. Känner du att situationen idag med kvinnor inom IT är inklusivt? **Om nej:** vad skulle du vilja se ändras eller förbättras? **Om ja:** Har du några exempel på det som gör att IT känns inklusivt?
4. Känner du eller har du någonsin känt dig exkluderad inom IT-branschen på grund av ditt kön? **Om ja:** På vilket sätt?
5. Hur tror du att inklusivitet på arbetsplatser inom IT kommer att se ut om 10 år? Ser du någon större förändring från dagens situation? Tror du att det är bra eller dåligt?
6. Har du några avslutande tankar som du vill ta upp angående ämnet?