

# **Women in Cybersecurity**

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## Motivation and introduction

Cybersecurity has a huge problem: Only a minority of the world's information security workforce are women. What is surprising because a significant number of women are willing to become politicians, craftsmen and even soldiers.

As a woman - talking to my female friends I figured, sciences has a bad image with women. While our grandmothers and mothers might not have had the chance to learn these professions, me and my friends are just not interested. Searching online, I found that the US has special programs to motivate women to work in the field of cybersecurity. However, I could not find a single program like that in Germany.

Two things are interesting in this context: First, the US as well as Germany are suffering of a lack of women in cybersecurity. Second, the US in contrast to Germany is taking action to tackle the problem. So, I asked myself why these countries deal with this problem in a different way? Actually it is a matter of national security. Without a workforce made up of men and women, cybersecurity companies will not build products that women – half of consumers – will buy and use. That means a cybersecurity risk. If the state wants everyone in the population to use a security solution or product, it is critical that the people designing those products are representative of that population. Only in this way they are able to integrate distinct needs and preferences.

In recent years attacks against information infrastructures have become ever more frequent and complex, while at the same time perpetrators have become more professional. Cyberattacks are launched both from within a country and abroad. Criminals, terrorists and spies use the cyberspace as a place for their activities and do not stop at state borders. IT systems are interconnected in global networks, incidents in other countries' information infrastructures may indirectly affect Germany or the US. Strengthening cybersecurity requires the enforcement of international rules of conduct, standards and norms. Thus, this field requires close cooperation between authorities worldwide.

During my research I have talked to different experts: industry representatives and experts in teaching cybersecurity, as well as women actually working in cybersecurity. I have asked several questions: what importance do women have in cybersecurity? Why there is a lack of women in cybersecurity? How women can get interested in this field and how female workers can get recruited in the field of IT security?

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## List of interview partners (in alphabetical order)

I would like to express my deep gratitude to each of these experts for their time and insights to support my research.

Baer, Merritt:

*Lead Cybersecurity Advisor*

Bate, Laura:

*Senior Program Associate, Cybersecurity Initiative*

Boni, William:

*Vice President Information Security at T-mobile USA*

Burkey, Joanna:

*CISO Siemens*

Carson, Cindy:

*Director Cyber Security Operations at T-mobile USA*

Clark, Lynne:

*Chief, National Information Assurance Education and Training Program*

*(NIETP) NSA/DHS National Centers of Academic Excellence in Cyber*

*Defense Program Office*

Cookson, Elizabeth:

*Digital Forensic Analyst at Kivu Consulting, Inc.*

Endicott-Popovsky, Barbara:

*Professor, Institute of Technology, University of Washington; Director, Master of Cybersecurity and Leadership, University of Washington*

Fenwick, Valerie:

*Director of Software Engineer*

Golbeck, Jennifer:

*Associate Professor, College of Information Studies; Affiliate Associate Professor, Computer Science, University of Maryland*

Jeffords, Susan:

*Vice Chancellor at University of Washington*

Jiggetts, Lisa:

*Founder & CEO Women's Society of Cyberjutsu*

Katz, Jonathan:

*Director, Maryland Cybersecurity Center*

Lymer, Will:

*Ambassador of Buzz at Loki Labs, a security services provider*

Ma, Shelley:

*Senior Analyst, Cyber Investigations at Kivu Consulting, Inc.*

McCarthy, Marci:

*CEO and President of T.E.N., an information security executive networking and relationship-marketing firm*

Morgan, Steve:

*Cybersecurity Ventures, a researcher and publisher covering the global cyber economy*

Niquette, Kim:

*CEO at Kivu Consulting, Inc.*

Pailen, Loyce:

*Director, Center for Security Studies, University of Maryland*

Plane, Jandelyn:

*Principal Lecturer-Computer Science, Director-MD Center for Women in Computing, University of Maryland*

Ponnambalam, Sem:

*President at XAHIVE Corporation, a cybersecurity company*

Sande, Corrinne:

*Director, Computer Sciences and Information Systems/CyberWatch,  
Whatcom Community College*

Santiago, Tamie:

*Professor Cybersecurity, University of Maryland, Graduate School*

Siraj, Ambareen:

*Director, Cybersecurity Education, Research and Outreach Center, Assct.  
Professor, Tennessee Tech*

Wallace, Ian:

*Co-director of New America's Cybersecurity Initiative*

Weingarten, Elizabeth:

*Director of the Global Gender Parity initiative, New America*

Yamada, Melodye:

*Senior Security Consultant*

Zantua, Morgan:

*University of Washington APL, Center For Environmental & Information  
Systems*

## Basics

„Cybersecurity can be defined as all activities and measures intended to prevent and cover any threats regarding information systems connected to the cyberspace.“  
(Beissel 2016)

The field of IT security is as old as the cyberspace – and therefore quite as old as the first computer. However, cybersecurity did not become a global issue until the Internet became open to the public when the Internet transformed from a tool used by governments and academic institutions to an essential part of our society. Nowadays IT security is a field of growing importance due to the increasing reliance on computer systems and the growth of smart devices such as smartphones and televisions.

Cybersecurity is already questioning democratic rights. Every device connected to the Internet could possibly be threatened by an attack. The majority of citizens in the US and Germany are using the Internet continuously to shop, communicate globally and to benefit from the enormous knowledge available online. This trend goes hand in hand with the digitization and growing number of mobile devices. Individuals are enjoying constantly available shopping opportunities, communication possibilities from everywhere and an enormous knowledgebase. Cybersecurity concerns private and business people as well as governmental institutions (cf. Beissel 2016). The Internet provides freedom, opportunities and borderless communication. The flip side is that attacks are also borderless and can cause damage on a global scale.

While women were inventing programming in the 1940s, they only make up a small proportion of the cybersecurity workforce today (cf. Schafer & Thierry 2015). When looking at articles about Cybersecurity, the most common image to illustrate this topic is a young man in a black hoodie, sitting in front of a computer.

## Current situation

All of my interview partners agree on a lack of women in cybersecurity. Globally, women comprise only 11% of the information security workforce – a number that has remained steady since 2013 (cf. Reed et al.). „In North America, women comprise 14% of the cybersecurity workforce, the highest regional concentration in the world.“ (Reed et al.) Laura Bate, New America, explains: „Imagine the Venn diagram of women in computer science and then women in foreign and security policy. The segment of that is the number of women working in cybersecurity.“ Lisa Jiggetts, Founder of Women's Society of Cyberjutsu, makes clear that cybersecurity does not only have a problem with bringing women into this field, but also of women dropping out.

According to Reed et al., 51% of women surveyed indicated they have experienced various forms of discrimination. Jen Golbeck, University of Maryland, says that she has most of the time been the only woman in the classroom while working on her PhD thesis. „It can feel like a space where you are constantly fighting to be taken seriously.“ And Merritt Baer, a Lead Cybersecurity Advisor, points out that most women are struggling with doing a double shift, because they are working more hours on household and children than their male counterpart. „When a women leaves early to go get her child from daycare she is flaking. When a man does it, he is being a good guy.“

Furthermore the study found that women working in cybersecurity have higher levels of education than men, but fewer hold senior-level positions and earn less money (cf. Reed et al.). My interview partners pointed out that a lot of women have a greater impostor syndrome, where they question whether they are good enough. Women tend to think they need many degrees to get into the field or to proof the quality of their work. However, my interview partners agree that cybersecurity is a field where male and female employees get paid extremely well. Barbara Endicott-Popovsky, University of Washington, says that some of her students, regardless of gender, are earning \$150.000 to \$180.000 a year, only seven years after graduating with a master's degree.

Cybersecurity is a relatively new area. Its' market-growth potential is enormous. Ms. Endicott-Popovsky explains: „First when cybersecurity became a noticeable problem in the late 1990s, early 2000s, there were a lot of people that did not believe that cybersecurity was a field of itself. They thought it was simply a topic within computer science.“ The awareness among US-citizens only rises slowly. The hacking of the US presidential election in 2016 is one example that puts cybersecurity on the news. Susan Jeffords, University of Washington, says: „It becomes a problem that every company, every public entity has to find a way to fight these hacking attempts.“ Experts agree on the fact that the next war will take place in the virtual world.

The IT field is still dominated by stereotypes. Corrinne Sande, Whatcom Community College, says the image of working in a backroom on machines does not attract a lot of people. Ambareen Siraj, Tennessee Tech, therefore asks: „How can people prepare themselves for something, if they do not know what that is about?“ She informs that cybersecurity is not taught in the majority of schools or colleges in the US.

There are millions of cybersecurity job openings, especially in industry. Steve Morgan, Cybersecurity Ventures, points out that in 2017 there are 1 million cybersecurity job openings. By 2019 there will be more than 1.5 million job openings in this field. He further estimates that by 2021 cybercrime damages will cost the world \$6 trillion, double of the \$3 trillion incurred in 2015.

„There is a zero unemployment rate in cybersecurity,“ Cindy Carson, T-mobile USA, says. She breaks down the number of female workers in her department: „About a dozen women are working in my department at this point. That should be about 10% of our workforce.“ William Boni, T-mobile USA, reveals that there are just not enough educated, trained and experienced cybersecurity professionals to fill the vacancies - whether it is in the private sector, government or the military. Kim Niquette, Kivu Consulting, Inc., says: “The market for cyber employees is very tight so we will hire someone no matter where they live.“ Ms. Sande explains, the US-government is putting a lot of money into increasing the workforce. For example by providing scholarships.

The US government is making a huge effort to hire employees in cybersecurity. According to my interview partners, the US government has a more diverse workforce than most companies in the private sector. Lynne Clark, NSA, says: „NSA puts a high value on diversity, so we can reflect diversity of our population.“

If there is an attack we do not know what gender the hacker is. According to Joanna Burkey, Siemens, we know there is a large portion of very capable female black hat hackers out there. A black hat is a person who attempts to find computer security vulnerabilities and exploits them for personal financial gain or other malicious reasons unlike the white hats who are ethical computer hackers. Ms. Burkey states, we see very good hacking talent.

## Importance of a diverse workforce

All of my interview partners pointed out that it is not just about getting women into the field of cybersecurity. It is about creating a diverse workforce with people of different socioeconomic background, age, ethnicities and gender. Loyce Pailen, University of Maryland, points out that there has not much changed since the last decades: „I grew up in an area where I was usually often the only black female as well as at the IT meetings and the conferences I would go to. This was 20 to 30 years ago. When I go to these conferences today, it is not much different.“ Since cybersecurity is an extremely well paid field, Ms. Bate says that by cutting off any minority, you are denying significant economic opportunities to an underrepresented group. All of my interview partners agree that a diverse workforce would be more successful. Ms. Baer says: „Having brains in the room that think differently produce stronger results.“ Diverse perspectives can yield into larger and more competitive workforce, Ms. Plane is sure. Ms. Golbeck points out that men might just not be aware of some problems. „Women are targeted in particular ways. Like revenge porn or fake profiles for example. Women's icloud accounts are more often hacked than men's, because these hackers try to get compromising pictures of women.“

Women represent half the population and are needed to fill the number of job openings. Ms. Weingarten calls the fact that there are not enough women represented in cybersecurity a „major national security issue“. „We know that people respond to cybersecurity products very differently. If you do not have a group of people working on a particular product that is representative of the whole population, you are going to miss out on creating something people will use and understand,“ says Ms. Weingarten. The different perspective women might bring in can prevent attacks and save companies money. Tamie Santiago, University of Maryland, disagrees: „If Cybersecurity was an all-woman dominated field, I do not think we would be less secure. If it was an all-male dominated field, I do not think we would be less secure. I think both genders would provide expertise that would protect the nation. But together the forces are stronger.“

At the moment everybody other than white male will feel underrepresented working in cybersecurity. Most of my interview partners agree that cybersecurity is a hostile

environment. Ms. Baer for example says that women who are already in the field have worked themselves up and therefore are not necessarily warm to other women coming in. Jandelyn Plane, University of Maryland, says: „We do not have a critical mass. Women who are in the field always feel different. Once we have enough people from the other populations in the field that will naturally go away.“ She continues that labor laws in many cybersecurity companies do not match the need of women at the moment. This concerns for example maternity leave, which is usually only offered by big tech companies like Microsoft, Facebook or Google. Ms. Weingarten explains how companies can make good use of this: „The research shows that companies that offer paid childcare as well as paid leave and make it clear that they want their employees to take advantage of it, they see major increases in retention, productivity and loyalty.“

People working in cybersecurity are digital translators. Shelley Ma says: „Our work is usually very technical and very jargon based so you need to have this ability to translate this into something that everybody can understand.“ Asking my interview partners if women bring special skills to the table, they gave me diverse answers. Ms. Burkey explains that certain people are better at putting themselves in other people's shoes. They tend to think like someone else and have an empathy and understanding of users as well as for hackers. „This is a quality men and women both can share,“ she says. „But studies have backed up the assumption that women tend to have stronger qualities in these areas than a lot of men.“ Will Lymer, Loki Labs, agrees: „I enjoy working with women because it creates a different environment.“ Ms. Niquette explains the most successful ransomware experts her company has are women. „When you are negotiating a ransom, the perpetrators are most likely male.“ Ms. Siraj thinks one reason cybersecurity needs more women is because women are better in conflict management. In cybersecurity there is always conflict between usability and security. Valerie Fenwick, a Software Engineer, on the other hand totally disagrees. She does not want women to be stereotyped and given the so called soft skill work. „If women are doing the soft skill work they are not going to be paid more and they probably will not stay because the work is not challenging for them.“

Since cybersecurity is a male dominated field at the moment, some women might feel intimidated by that. Ms. Niquette says: „Women attract women.“ She claims not having trouble finding any young female cybersecurity workers for her consulting business. Only at a senior level she is having a hard time recruiting for whatever reason. Ms. Fenwick claims that even the career options of school girls can be affected by women working in cybersecurity today: „When school girls see women working in Cybersecurity the more they see career options opening in front of them.“

## Cause of the problem

There is a number of reasons that may contribute to the lack of women in cybersecurity, including a lack of educational focus on and interest in science, technology, engineering, and math – fields which develop young women to be the experts necessary for a career in cybersecurity. There is a cultural piece to this as well as an educational. Marci McCarthy, T.E.N., thinks there is a stigma that girls do not do math, science or technology. „If you are a girl and you are good at math and science, if you are told it is not your thing, that has an impact,“ Ms. Golbeck says.

Since the first computer programmers were mostly women, Ms. Weingarten sees the reversal point in the 80's when the first personal computers were marketed to little boys. „Women just did not have the natural tendency to track into computer science like men did,“ Ms. Bate says. When computing became a major tool for management and strategic decisions, software activities were already socially constructed as masculine. „It is hard for women to break into the field, because of the large number of men,“ Ms. Yamda says. Women barely have any role models. Will Lymer points out that the few women in the field are not represented equally. „The trainings and conferences I go to it is mostly man. The very few women there are typically not profiled on panel discussions or presentations. They are just not presented at the same percentage as men.“

Mr. Wallace sees changes in the working environment as a reason why cybersecurity is dominated by men. He says manufacturing jobs, which have been outsourced or replaced by robots, were generally filled by males. Care giving jobs on the other hand still exist. And those jobs are traditionally female jobs. Mr. Wallace continues that from people coming out of the military a disproportionately large number of men naturally go into security jobs. The military however is looking for a more diverse workforce as well. These men have either been trained in IT security within the military or because of their education they can pick it up relatively easily. It can also be far easier for them to pass the security clearances. Most of my interview partners agree that cybersecurity can be a very hostile environment. Women can feel intimidated by the terms which have their origin in military, like cyberwar or warfare.

Ms. Jiggetts sees high standards as a reason why women often do not apply for a job. „Recruiters are putting out job descriptions like a Christmas wish list. And especially women tend to apply only if they match every single thing.“ Ms. Burkey says the imposture syndrome affects women more than it affects men. „This could be one of the reasons why women are less confident and less willing to push themselves out in particularly male dominated fields.“

The experts I have talked to made clear that a high percentage of people do not know what cybersecurity is. Especially women who do not seem to be naturally interested in computing, do not know that cybersecurity is actually a profession. Elizabeth Cookson, Kivu Consulting, Inc., says: “Even in my undergraduate career this was not presented to me as a career.“ Tamie Santiago, University of Maryland, says not everyone will feel comfortable or connected to IT as it stands today. „It is because the way it is advertised. You will see a skull and a man in a hoodie. Most women are not attracted to that. That is not something you would like to find yourself a part of.“

## Measures to attract women

Ian Wallace makes clear that there is no good research about the nature of the problem: „The issue overwhelms everything else including getting a more diverse workforce.“ Nevertheless the question has to be answered on two levels. One is what can be done for the current workforce and the other is regarding the workforce pipeline. In the following I list the solutions my interview partners have come up with.

### *Education*

All of my interview partners agree on the fact that there has to be more education about computing in schools. „All areas of the pipeline need to be addressed, we cannot say that one is more important than the others. We all need to do parts to increase the diversity and education about cybersecurity from elementary all the way up to teachers and people who are in the field,“ Ms. Plane says. Melodye Yamada, Senior Security Consultant, says cybersecurity should be taught as something fun for children at the age of six. She also points out the importance to talk about the ethical aspects of hacking to older children. „The draw back for teaching cybersecurity in the schools at the moment is that teachers do not know,“ Ms. Pailen says. Ms Zantua points out that teachers in the US usually never have worked in industry. Since cybersecurity is high in demand most experts go into the private sector. Microsoft for example is lending some of their workers to classrooms for a certain amount of time.

My interview partners, whether male or female, made clear to me that it is important to introduce children early to computing. They have all had computers at an early age and could grow a naturally interest, like the example of Ms. Golbeck shows. „I got my first computer when I was six. I remember my dad bring it home and I wrote that infinite loop program in basic which I thought was the coolest thing.“

Ms. Pailen came up with the idea to start a nationwide socialized campaign to get children understand cybersecurity. Ms. Sande explains how GenCyber, a summer camp for school girls funded by the NSA, can help educate children: „The idea is if we introduce them to the field early they can play out that is what they are going to do.“

Ms. Jeffords thinks the way mathematics is taught should be changed and connected to real life issues that people can understand why it is valuable. „Children cannot see the connection between their math expertise and other things they care about.“ Jonathan Katz, University of Maryland, agrees to expose students to computer science in high school. Female students are often the ones who do not have any background in computer science when they come into university or college. They then see others who have taught themselves. Ms. Golbeck thinks computational thinking could help all children. „It is useful for everything like diagnosing what is wrong with your car or your washing machine up to more complicated tasks.“ She says that children could learn this mindset best by knowing the basics in programming.

Solving a pipeline problem like this might take a decade to see a big change. Sem Ponnambalam, Xahive, says it goes back to the influencers like parents as well. „You need to have support from your home and similar you need to have support in the school system itself.“ She also makes clear to have these conversations with young boys as well. „They are going to be our future co-workers or future partners in different businesses.“

Future generations need to understand what cybersecurity is. Even though most people do not decide to work in this field, the technology of their smart devices affect their lives. Even at the beginning of first grade, children could playfully get in touch with cybersecurity. Boys and girls will learn that it is something they are equally good at. At a high school level students should be introduced to coding. By then they know what a career in this field looks like and whether they like it.

### ***Role models***

„Role models are very important. You need to see yourself in that field. If you do not see anybody that looks like you then you are starting to think I do not belong here,“ Ms. Sande says. Ms. Zantua thinks it is even a matter of role models in the classroom. Most of my interview partners agree on the fact that it would attract more women into cybersecurity if there were more women holding leadership positions.

„When I founded the national women in cybersecurity conference four years back, I wanted to show them a community of support and bring role models to the mass who have been very successful in their career,“ says Ms. Siraj. She wanted to give an example of women working in the field, whom others can ask for support. „Some women might get tired of being the only woman in the room.“ Ms. Bate adds the image of women working in this field should also be presented in the media more often.

Role models can show junior employees what they can achieve. Female role models can help other women not to feel like they are the only one in the room and can attract women to start this career.

### **Mentoring**

„Mentoring makes you feel you have a space and your issues are valid,“ says Ms. Golbeck. My interview partners agree on the fact that mentoring can help women to feel taken seriously. Even though some people I have talked to feel like there is too much focus on women in the field of cybersecurity at the moment. „I am always double checking on myself that I am not thinking too much about women and ignoring the men. I feel like right now we are still in a place where we need the focus on women because the numbers are still such a small percentage,“ says Ms. Burkey. „A criticism that I would get sometimes is why do you need to do a women only conference. It is not a women only conference, rather a community of women and also men who are advocates for diversity that meets once a year,“ says Ms. Siraj, Founder of the National Women in Cybersecurity Conference.

Across the US there are a lot of conferences women in tech can go to and can get support. „The contacts you are making at a conference are people that will actually think of you for work or will actually refer you to people. Things like that where younger women are joining groups of women who have been in an established career is beneficial,“ says Ms. Cookson. Ms. Zantua is sure, that women in important places will give back. „It is not only the mentoring, it is also coaching. Sometimes women might feel uncomfortable with networking. Mentoring takes organisation and sometimes funding.“

Ms. Burkey, working for the German based company Siemens, says „promotion within European companies is based on relationship“. On the other hand she says that US based companies are not as open to the quality of women as their German counterpart. „I feel that there is more of a mindset in the United States that men should be the executives and men should be the ones running everything. I feel like that exists more in the US than it does in Germany.“

Since the impostor syndrome affects women more than it does affect men, mentoring can help women to grow and get the support they might need. Mentoring can also make women feel like their problems are valid and others appreciate their work.

### ***Information***

My interview partners agree that most people do not know enough about cybersecurity. Even though the US government is spending a lot of money and the topic is moving towards the front row, „the average citizen does not understand what cybersecurity means,“ Mr. Lymer says. „You have to talk to people about the real impact of technology on their personal lives,“ says Ms. Santiago. „Everyone likes money but if you do not understand what is happening with bitcoins for instance, you have a problem when digital currency takes over your physically currency.“

Ms. Weingarten explains that women tend to be more attracted to careers that emphasize a human-centered nature. Ms. Jeffords says in medicine for example women dominate in medical schools, whereas there are fewer women in surgical training. „I think once those aspects about medical interactions with patient care were really highlighted and it was not just about biology and organic chemistry, a lot of women were attracted to that.“ My interview partners explained that cybersecurity is not always all about the technical aspects, even though those are important to understand the technology in the first place. „There are so many different ways to go into cybersecurity. Cybersecurity does not mean you have to become a computer scientist to become a cybersecurity professional. It involves technology, it involves policy, it involves law,“ says Ms. Siraj. My interview partners agree that to succeed in cybersecurity you need to have the ability to communicate and the ability to work with other people. Cybersecurity is already impacting different areas. Ms. Santiago says

cybersecurity should be interlocked into other career fields. Ms. Sande suggests: „You have to be interested in solving puzzles. People who like figuring things out and solving problems are perfect for this field. The whole thing is just a giant puzzle.“

Most people do not know what cybersecurity is and they think it is something that does not affect them. As said in this paragraph, cybersecurity has to become a burning issue. It has to be on people's mind which leads to the image of cybersecurity.

### ***Image***

As I have said before, cybersecurity is suffering from a poor image that is dominated by the geeky man who is working on his own in his basement on computers. My interview partners would like to change this image, because it does not sound appealing to a lot of women. „When you are a woman and read a story about a cybersecurity issue and all of the people cited in that story as experts are men and it is written by a man, it is hard to see yourself in that industry. The more other women can read stories about women in the industry, the more that introduces the concept and might open up their eyes to that,“ Ms. Weingarten says.

She also sees the need to change the language used in cybersecurity to attract more women. „It is this combination between the tech industry and the national security industry which both have been historically male dominated and focused on technical jargon but also kind of war-like jargon. So talking about attacks and talking about our enemies can feel off-putting for some women.“ Ms. Jeffords would like to highlight that „cybersecurity is one of the aspects of computer science that is not just about coding and gaming but you are actually working on relation problems or on human behavior problems. I think it would be far more appealing to a lot of women.“

People might wonder what cybersecurity is about. They never naturally got in touch with it and think it is something young men work on in their basement. Journalists, recruiters and politicians need to think about the image they spread. A job in cybersecurity has to become something that will attract people.

## **Job hunting**

„There is a lot that can be said of how they do that recruiting like how they actually write their job postings and the language they use. Being conscious that looking for cyberwarriors and cyberninjas is probably not the right approach in some cases,“ says Ms. Bate. Companies need to think about what their recruitment material looks like. How many photos of women are shown on the website for example?

„I think particularly middle managers have a very big role to play here. Managers in the middle level of the company are the ones' that identify a coming talent. These are the people that are really the biggest voices to who gets attention and promotion within a company. I believe once middle managers understand to value the role of women in technology and security then you can have a mindset change within the organisation,“ says Ms. Burkey.

When it comes to applications, Ms. Jiggetts demands blind auditions. „Take the names off the resume and let the resume and the person speak for itself.“ She also suggests for every man having a woman interviewed. However there are so many unfilled positions in cybersecurity, many interview partner talked about how hard it is for women to enter the field. „Companies need to be more encouraged in hiring people based on their potential not their experience. You need to put in a little effort and train the people,“ says Ms. Cookson.

Recruiters should think about how they attract people. A neutral language and the image of women can help to attract females. Companies also need to take some risk, hire people based on their potential and consider blind auditions.

## **Work environment**

Asking if the opportunity to work from home could attract women, I have been given various answers. While Mr. Boni says: „If you work from home three days a week then you are happy and the company is happy because they do not have to rent another building.“ Ms. Sande argues: „Working from home can isolate you.“ Working hours in this field can vary. Some cybersecurity professionals need to be at call 24/7 while others have working hours during the daytime. „We should not have to decide

whether or not we can have a family and work in this field. I think being able to have a family and to have respectful working hours is a part of the attraction. That needs to be improved,” says Ms. Santiago. Another point that could attract women is maternity leave. My interview partners explained that in general only big tech companies offer maternity leave in the US. Small companies cannot afford to miss an employee. „If we have an employee making \$180.000 and we get them four month off and we have to pay someone else \$180.000 to cover for them we just economically cannot do that as a small company,” says Ms. Niquette.

For most companies it might seem impossible to improve their working hours or to offer maternity leave. Nevertheless the working conditions in some cybersecurity jobs could draw away women. This problem can only be solved on a higher level.

## **Summary and Outlook**

Cybersecurity is a fast-growing market which is expected to grow rapidly within the next decades. The importance of cybersecurity will rise within the next years. As cybersecurity is impacting the industries around it, it is becoming a part of these industries. Already there are millions of cybersecurity job openings. It is booming because there are not enough people who can secure the networks. The small representation of women in cyber is a big opportunity for them to enter this field. Cybersecurity offers job security and excellent salary opportunities. Depending on the company, the job could also offer flexibility.

Nevertheless those arguments do not count if someone is not interested in working in the IT field. To arouse the interest of young women which are not naturally drawn to computers, computing and even the basics of coding need to be taught in schools. It is important to encourage girls into the sector at a young age. It should be a matter of national security to introduce people to cybersecurity. Everything in society is now connected: our economy and our defense are based on being able to communicate across the Internet and across different networks and they are vulnerable to attacks. It can be dangerous to think about how to design and how to educate only for half the population. In the end the human being is the weakest link. The biggest challenge in cybersecurity is to change the behavior of people.

Media needs to think about the image of cybersecurity they spread, recruiters need to reflect their job applications and recruiting material they give out. Politicians need to bring cybersecurity professionals into schools to teach children. People working in the private sector could help bridge the time until the education of teachers has caught up. Companies need to provide a welcoming environment for diverse careers and help their people grow. Women in the field need to become prominent speakers in discussion panels and presentations about technical subjects. The issue of some women could be confidence. Supervisors need to help to grow those and offer mentoring. Being mentored can help to consider mentoring another employee if needed. It does not have to be a woman, just someone who wants to encourage others.

The importance is to rise diversity in cybersecurity and to make sure that all points of view are represented in a conversation. The industry needs a more diverse group of people to look up to. Different experiences can make the group see different things. It can also help to reduce discrimination within a company.

It will take time to increase the number of women in cybersecurity. In my research I have focused on the situation in the US but the situation in Germany is not much different. In fact, the situation in Europe is even worse. Women comprise only 7% of the cybersecurity workforce compared to 14% in North America (cf. Reed et al.). We do not only have a skills gap, we have a serious gender gap.

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