Horizon 2020 Program (2014-2020)

Cybersecurity, Trustworthy ICT Research & Innovation Actions
Security-by-design for end-to-end security
H2020-SU-ICT-03-2018

Cyber security cOmpeteNCe fOr Research anD InnovAtion [†]

Work Package 4: Policy and the European Dimension Deliverable D4.5: First report on Cybersecurity Workforce Diversity

Abstract: This document aims to introduce the objectives that CONCORDIA targets to address for increasing the women's inclusion in cybersecurity domain within Europe. It presents the process undergone for the identification a nd validation of objectives. The document also presents the design of different actions for supporting the women inclusion in cybersecurity, planned to be implemented during CONCORDIA's lifetime. The document is developed in the framework of CONCORDIA project, WP 4, Task 4.5.

Contractual date of delivery	*M24*
Actual date of delivery	*30.12.2020*
Deliverable dissemination level	*Public*
Editors	*Barbara Carminati - UI* *Elena Ferrari - UI*
Contributors	
Quality assurance	*Felicia Cutas (EIT-Digital)* *Tanja Pavleska (JSI)* *Thanh van Do (Telenor)*

[†]This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 830927.

The CONCORDIA Consortium

UniBW/CODE	University Bundeswehr Munich / Research Institute CODE (Coordinator)	Germany
FORTH	Foundation for Research and Technology - Hellas	Greece
UT	University of Twente	Netherlands
SnT	University of Luxembourg	Luxembourg
UL	University of Lorraine	France
UM	University of Maribor	Slovenia
UZH	University of Zurich	Switzerland
JACOBSUNI	Jacobs University Bremen	Germany
UI	University of Insubria	Italy
CUT	Cyprus University of Technology	Cyprus
UP	University of Patras	Greece
TUBS	Technical University of Braunschweig	Germany
~~TUDA~~	~~Technical University of Darmstadt~~	~~Germany~~
MU	Masaryk University	Czech Republic
BGU	Ben-Gurion University	Israel
OsloMET	Oslo Metropolitan University	Norway
Imperial	Imperial College London	UK
UMIL	University of Milan	Italy
BADW-LRZ	Leibniz Supercomputing Centre	Germany
EIT DIGITAL	EIT DIGITAL	Belgium
TELENOR ASA	Telenor ASA	Norway
AirbusCS-GE	Airbus Cybersecurity GmbH	Germany
SECUNET	secunet Security Networks AG	Germany
IFAG	Infineon Technologies AG	Germany
SIDN	Stichting Internet Domeinregistratie Nederland	Netherlands
SURFnet bv	SURFnet bv	Netherlands
CYBER-DETECT	Cyber-Detect	France
TID	Telefonica I+D SA	Spain
RUAG	RUAG AG (as replacement for RUAG Schweiz AG)	Switzerland
BITDEFENDER	Bitdefender SRL	Romania
ATOS	Atos Spain S.A.	Spain
SAG	Siemens AG	Germany
Flowmon	Flowmon Networks AS	Czech Republic
TÜV TRUST IT	TUV TRUST IT GmbH	Germany
TI	Telecom Italia SPA	Italy
Efacec	EFACEC Electric Mobility SA (as replacement for EFACEC Energia)	Portugal
ARTHUR'S LEGAL	Arthur's Legal B.V.	Netherlands
eesy-inno	eesy-innovation GmbH	Germany
DFN-CERT	DFN-CERT Services GmbH	Germany
CAIXABANK SA	CaixaBank SA	Spain
~~BMW Group~~	~~Bayerische Motoren Werke AG~~	~~Germany~~
GSDP	Ministry of Digital Policy, Telecommunications and Media	Greece
RISE	RISE Research Institutes of Sweden AB	Sweden
Ericsson	Ericsson AB	Sweden
SBA	SBA Research gemeinnutzige GmbH	Austria
IJS	Institut Jozef Stefan	Slovenia
UiO	University of Oslo	Norway
ULANC	University of Lancaster	UK

ISI	ATHINA-ISI	Greece
UNI PASSAU	University of Passau	Germany
RUB	Ruhr University Bochum	Germany
CRF	Centro Ricerche Fiat	Italy
ELTE	EOTVOS LORAND TUDOMANYEGYETEM	Hungary
Utimaco	Utimaco managment GmbH	Germany

Document Revisions & Quality Assurance

Internal Reviewers

1. Tanja Pavleska (JSI) (review lead)
2. Thanh van Do (Telenor)
3. Felicia Cutas (EIT-Digital)

Revisions

Ver.	Date	By	Overview
0.1	*15/10/20*	*UI*	*Deliverable Structure*
0.2	*20/11/20*	*UI*	*First draft*
1.1	*28/11/20*	*UI*	*Final version for internal review ready*
1.2	*1/12/20*	*UI*	*First round of internal review*
1.3	*20/12/20*	*UI*	*Second round of internal review*
1.4	*28/12/20*	*UI*	*Final version*

Executive Summary

We have incontestable evidence that gender diversity brings benefits [1]. Men and women complement each other in their skills, attitude towards risk, and collaboration, bringing different perspectives to the workplace. The cybersecurity field, like others, can only take advances from a diverse and inclusive workspace. However, it demands a tailored gender-gap strategy. Indeed, compared to other STEM (Science, Technology, Engineering and Math) fields, we have to face the widespread perception of cybersecurity as a male-dominated and highly specialized IT field [2], which does not encourage women to join the field.

To cope with this challenge, CONCORDIA work plan includes a dedicated task - T4.5 - Women in Cybersecurity - whose object is to implement actions aiming at incentivizing women to join the field of cybersecurity. This task was originally planned to start at M20. However, we decided to take advantage of females' excellent presence in the CONCORDIA workforce (29% of CONCORDIA participants, with several leading positions, see Appendix A) to proactively work from the first year of the project.

In particular, during the first year, our efforts were invested into better understanding the gender situation in the field of cybersecurity and identifying the objectives that CONCORDIA should target to address women's inclusion in this area. During the second year, we have been designing a proper roadmap of actions to be implemented during CONCORDIA's lifetime. Moreover, we have already executed some of them.

This deliverable presents the progress of task T4.5 during the first two years of the project. The deliverable is organized as follows:

Chapter 1: This chapter provides an introduction to the situation of women inclusion in STEM in general, and in cybersecurity in particular. It presents the results of recent gender studies and provides pointers to relevant gender equality initiatives.

Chapter 2: This chapter provides details on building and validating the Women in Cyber – A Manifesto for Today, the document describing the CONCORDIA objective for women inclusion in cybersecurity area.[1]

Chapter 3: This chapter presents the process to determine the actions identified as needed to implement the Manifesto, describe the actions and the current status of implementation, priority based.

[1] https://www.concordia-h2020.eu/wp-content/uploads/2019/09/WomenInCyberMANIFESTO.pdf

Contents

1 Women in cyber in 2020

1.1 Women in STEM

The number of women in STEM fields has grown over the past years and keeps growing, but we are still far from reaching a gender balance. However, in the labour market they still remain underrepresented. There are many studies confirming this. For instance, according to a study by the National Girls Collaborative Project, there are only 28% of women in STEM fields as opposed to 72% of men.[2] Besides these figures, two further aspects reflecting lower women inclusion are the proportion of women in upper-level positions and gender gaps in salaries. For instance, according to a recent report from the EU Policy Department for Citizens' Rights and Constitutional Affairs Directorate-General for Internal Policies, only approx. 15% of grade A staff in STEM are women.[3] Additionally, women in the EU earn on average 16% less than men.[4]

On the other hand, the shortage of workers in the STEM sector is rapidly increasing all over the world. If we focus on the EU labour market, the European Commission estimated 900,000 additional employees needed in the IT sector by 2020, whereas for the entire STEM sector, seven million job openings are forecast by 2025 [3]. It is not possible to satisfy these market requests without filling the gender gap in STEM. Closing the gender gap in STEM would also be beneficial for EU GDP. According to an EIGE study, [5] it can increase the EU GDP per capita by 0.7-0.9 % in 2030, whereas by 2050, the increase is estimated between 2.2 % and 3.0 %. This will result in an increase of global GDP by EUR 610-820 billion in 2050.

On a broader perspective, the issue of increasing the women workforce in the STEM field pertains to the overarching issue of gender equality. Gender equality has been identified as one of the seventeen (17) Sustainable Development Goals (SDGs) included in the United Nations 2030 Agenda for Sustainable Development,[6] which was adopted by world leaders in 2015. Gender equality has been ranked as the 5th SDG and it is considered to be integral to the entire set of the identified SDGs. As far as Europe is concerned, it is worthwhile mentioning the EU Gender Equality Strategy 2020-2025 with its commitment to achieving a gender-equal Europe.[7]

[2] National Girls Collaborative Project. The State of Girls and Women in STEM, 2018. Available at: https://ngcproject.org/sites/default/files/ngcp_the_state_of_girls_and_women_in_stem_2018a.pdf

[3] EU Policy Department for Citizens' Rights and Constitutional Affairs Directorate-General for Internal Policies. Education and employment of women in science, technology and the digital economy, including AI and its influence on gender equality, 2020. Available at https://www.europarl.europa.eu/RegData/etudes/STUD/2020/651042/IPOL_STU(2020)651042_EN.pdf

[4] Gender Equality Strategy: Striving for a Union of equality. Available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_20_358

[5] https://eige.europa.eu/gender-mainstreaming/policy-areas/economic-and-financial-affairs/economic-benefits-gender-equality/economic-case

[6] https://sdgs.un.org/goals/goal5

[7] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0152

The gender gap issue that affects the STEM field is even worse if we focus only on the ICT sector, despite the fact that today ICT is higly pervasive in the job market, in that 90% of jobs require some basic competence in the ICT field.[8]

Despite these figures, only 17% of almost 8 million ICT specialists in Europe are women.[9] According to a 2018 report[10] from the EU only 17% of ICT students, 19% percent of ICT managers and 9% percent of ICT developers are women. A further study,[11] commissioned by the European Commission in 2018, shows how the percentage of Europeans with ICT-related education is decreasing despite the growing need of ICT skilled workers to cover the increasing job demand in the field. This is a common trend for both genders, but is much more exacerbated for women.

1.2 Women in cybersecurity

Today women represent only 24% of the workforce in the cybersecurity domain worldwide [4].

The figure increased over the years, but it is still far from reflecting a balanced representation of both genders. On the other hand, women in cybersecurity are better educated: 44% percent of men in cybersecurity have a postgraduate degree, compared to 52% percent of women [4].Therefore, the whole labour market can highly benefit from the recruitment of more highly-qualified women. It is estimated that there will be a shortage of nearly two million cyber positions by year 2022.[12] The COVID pandemic has further exacerbated the need for cybersecurity experts, with the massive using of smart working and remote services in general. These, in turn, are greatly exposed to cybersecurity risks [5].

A recent survey by the SANS Institute[13] collected feedback from 488 women with senior or leadership cybersecurity positions in their respective organizations. 35% of respondents said that their gender was the biggest challenge for career progress. 25% of the respondents said they have never been mentored, whereas only 7% had been mentored by another woman.

One of the main reasons for this gender gap is that cybersecurity is often perceived as a pure "man's world" and this perception is amplified by how cybersecurity is always approached in different media and communication channels (TV, cinema, social, press). Also, there is a need to change the perception that it is a

[8] European Commission, ICT for Work: Digital Skills in the Workplace, 2017

[9] https://eige.europa.eu/publications/work-life-balance/eu-policies-on-work-life-balance/women-in-ict

[10] More women in ICT: empowering women in the digital world. Available at https://www.europarl.europa.eu/news/en/headlines/society/20180301STO98927/more-women-in-ict-empowering-women-in-the-digital-world

[11] Increase in gender gap in the digital sector - Study on Women in the Digital Age. Available at https://ec.europa.eu/digital-single-market/en/news/increase-gender-gap-digital-sector-study-women-digital-age

[12] https://blog.isc2.org/isc2_blog/2017/02/cybersecurity-workforce-gap.html

[13] Women in Cybersecurity Survey, SANS Institute, 2020

purely computer science discipline, as well as increasing role models and mentorship efforts. In the following chapters, we will explain how task T4.5 addresses these issues.

1.3 Gender equality initiatives

Several initiatives have been undertaken by different institutions to close the gender gap in the field of STEM, ICT and Cybesrsecurity. Table 1 reports for each of them, their main domain of interest, the location where they operate, as well as a link to their web page, whereas Table 2 provides, for each of them, a brief description of their goal.

As can be seen from these two tables, there are up to now many initiatives undergoing, but still, there is the need for more of them to invert the trend that we have so far described. Some of the initiatives vertically address gender issues by targeting one aspect only (e.g., role modelling, education, industry). Rather, the goal of CONCORDIA task on Women in Cyber is to exploit the unique CONCORDIA ecosystem made of different stakeholders (universities, research centers, industries, SMEs, etc.) to develop a set of actions not targeting a specific sector only (e.g., education, entrepreneurship) but instead considering the issue of diversity with a holistic approach. Moreover, we would like to overcome the today-widespread model according to which the initiatives for promoting women in cyber are mainly organized "by women and for women." The ambition of CONCORDIA, by relying on a big and diversified consortium, is to address gender issues in the field of cybersecurity with the deep involvement of both genders.

Gender issues are also a crosscutting priority in the entire H2020 Work Programme. Moreover, there is also a dedicated H2020 funding scheme, 'Science with and for Society', which funds specific initiatives supporting the gender equality strategy, addressing complementary issues wrt to those targeted by the CONCORDIA project. GENERA[14] (Gender Equality Network in the European Research Area), and GEECO (Gender Equality in Engineering through Communication and Commitment)[15] home) had the goal to set up gender equality plans for universities and funding organizations in the STEM area. In contrast, the goal of the EFFORTI (Evaluation Framework for Promoting Gender Equality in R&I) project[16] is to analyze the influence of measures to promote gender equality on R&I outputs.

1.4 Impacts of COVID-19 on Women

The spread of the COVID-19 pandemic has undeniable impacts on each country's social, political, and economic systems. The pandemic is intensifying pre-existing inequalities, with the vulnerable paying the higher prices. Among them, women

[14] genera-project.com
[15] geecco-project.eu
[16] www.efforti.eu

Initiative	Domain	Location	URL
ACM-Women	ICT	Global	women.acm.org
Australian Women in Security Network (ASWN)	Cybersec	Australia	www.awsn.org.au
Code Like A Girl	ICT	Global	www.codelikeagirl.com
Codess	ICT	Global	www.codess.net
CybHer	Cybersec	USA	www.cybher.org
ECSO Women4Cyber	Cybersec	Europe	women4cyber.eu
European Association for Women in STEM	STEM	Europe	www.witeceu.com/
Executive Women's Forum (EWF)	Cybersec	USA	www.ewf-usa.com
IEEE Women in Engineering (WIE)	ICT	Global	wie.ieee.org
Inspiring Fifty	ICT	Global	inspiringfifty.org
Int. Consortium Of Minority Cybersecurity Professionals (ICMCP)	Cybersec	USA	www.icmcp.org
LATAM Women in Cybersecurity (WomCy)	CyberSec	Latin America	www.womcy.org
OWASP Women in AppSec	Cybersec	Global	telaviv.appsecglobal.org/program/women-in-appsec
She Secures	CyberSec	Africa	shesecures.org
TechWomen	ICT	US	www.techwomen.org
WiCyS (Women in CyberSecurity)	Cybersec	Global	www.wicys.org
WoSec (Women of Cybersecurity)	Cybersec	Global	wearetechwomen.com/wosec-women-of-security
Women in Informatics Research and Education (WIRE)	ICT	Europe	informatics-europe.org
Women in Science	STEM	Global	www.awis.org
Women in Security and Privacy (WISP)	Cybersec	Global	www.wisporg.com
Women in Tech Network	ICT	Global	www.womentech.net
Womenâ€™s Society of Cyberjutsu (WSC)	Cybersec	USA	womenscyberjutsu.org
IAPPâ€™s Women Leading Privacy	Cybersec	Global	iapp.org
Women in Technology (WIT)	ICT	USA	www.womenintechnology.org

Figure 1: List of initiatives promoting gender equality in STEM, ICT and Cybersecurity (I)

Initiative	Description
ACM-Women	supporting the full engagement of women in all aspects of the computing field
Australian Women in Security Network (ASWN)	focused on organizing events to help women working in the cybersecurity industry
Code Like A Girl	social enterprise supporting girls and women to enter in the world of coding
Codess	community for female coders
CybHer	it encourages girls to enter the cybersecurity field
ECSO Women4Cyber	non-profit foundation with the aim to promote, encourage and support the participation of women in the field of cybersecurity
European Association for Women in STEM	it promotes studies and activities related to empowering women in the field of STEM
Executive Women's Forum (EWF)	organization for women in positions of influence in the information security industry
IEEE Women in Engineering (WIE)	professional organizations dedicated to promoting women engineers and scientists
Inspiring Fifty	non-profit organization that aims to increase diversity in tech by making female role models more visible
Int. Consortium Of Minority Cybersecurity Professionals (ICMCP)	non-profit association empowering women and minorities to succeed in the cybersecurity industry
LATAM Women in Cybersecurity (WomCy)	Latin American organization dedicated to increasing the number of women in cybersecurity
OWASP Women in AppSec	OWASP division dedicated to women in application security
She Secures	initiative to raise awareness about cybersecurity and get more women involved in the field at a younger age
TechWomen	it connects, inspires and empowers the next generation of women leaders in STEM
WiCyS (Women in CyberSecurity)	a nonprofit organization that aims to bring together women in cybersecurity to share experience and knowledge, and provide mentoring and networking opportunities
WoSec (Women of Cybersecurity)	focused on the social aspect of women in cybersecurity
Women in Informatics Research and Education (WIRE)	it promotes actions that help improve gender balance at all stages of the career path in Informatics
Women in Science	global network to advance women in STEM
Women in Security and Privacy (WISP)	it helps women to succeed in privacy and security industries
Women in Tech Network	it promotes gender diversity in tech industries
Womenâ€™s Society of Cyberjutsu (WSC)	focused on raising awareness of cybersecurity women career opportunities
Women in Technology (WIT)	Technology Special Interest Group for broadening opportunities for girls and women in information security and technology

Figure 2: List of initiatives promoting gender equality in STEM, ICT and Cybersecurity (II)

and girls, where the pandemic could roll back the recent progress in gender equality. Overall, women's jobs are more vulnerable to the COVID-19 pandemic, with the estimation of women job loss rates due to COVID-19, 1.8 times higher than male job loss.[17] Even if not at risk, during the lockdown, women's work productivity has been penalized by children out of school and intensified care required by ill family members. As an example, if we consider the research field, several recent studies show the impact of COVID-19 on women productivity in terms of publications (e.g., [6],[7], [8]). As pointed out by several institutions, EIGE[18] and Union Nation[19], now more than ever, there is the need for immediate reactions to push for greater gender equality.

By encouraging women and young girls to approach and consider a career in the cybersecurity field, CONCORDIA with T4.5 wishes to contribute to gender equality in an area with critical strategic priority in all organizations, where women have to be present.

[17] https://www.mckinsey.com/featured-insights/future-of-work/covid-19-and-gender-equality-countering-the-regressive-effects

[18] EIGE, Covid-19 and gender equality, https://eige.europa.eu/topics/health/covid-19-and-gender-equality

[19] UN women, Policy Brief: The Impact of COVID-19 on Women, https://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2020/policy-brief-the-impact-of-covid-19-on-women-en.pdf?la=envs=1406

2 CONCORDIA's objectives for women inclusion

Task 4.5 aims at implementing concrete actions to encourage the involvement of women in Cybersecurity. Towards this goal, as a first step, we identified a set of objectives that our actions should target.

In identifying the objectives, we have taken into account three main principles, briefly summarized as follows:

1. **Holistic approach**. Addressing the gender gap requires considering the problem from different perspectives. For example, the problems that a young researcher faces at the beginning of her academic life are different from those of a young entrepreneur at the start of her own business. Even if they share some common barriers, each situation has its own peculiarities. This also holds for the cybersecurity field. To cope with this aspect, we have identified and analyzed different areas of cybersecurity to help us understand the specific issues and limiting factors that prevent women to pursue a career in that specific area. These separate analysis will allow us to ensure a holistic approach in defining common objectives while also paying attention to the specificities of the selected areas.

2. **Objectives validation**. Once identified, the objectives have to be validated by relevant stakeholders from the different cybersecurity areas. This validation helps to ensure that we have considered all aspects of the different contexts.

3. **Openness**. CONCORDIA's objectives have to be available and shared with the cybersecurity community.

Following principle (3), during the first year of the CONCORDIA project we worked for the creation of a document stating the CONCORDIA objectives for women inclusion. The result is the so called Women in Cyber - A Manifesto for TODAY document, hereafter referred to as the Manifesto.

In the following sections, we describe the Manifesto generation and the approach for its validation.

2.1 Manifesto preparation

In preparing the manifesto, we considered it was relevant to collaborate with ECSO Women4Cyber initiative[20]. The link between CONCORDIA and ECSO Women4Cyber is strong, having Prof. Gabi Dreo (CONCORDIA's project coordinator) be one of the founding members of Women4Cyber. As natural, CONCORDIA and ECSO Women4Cyber have joined the force to prepare the Manifesto.

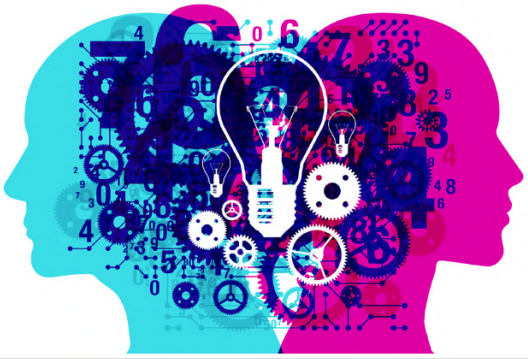
[20] https://women4cyber.eu/

CONCORDIA
Cyber security cOmpeteNCe fOr Research anD InnovAtion

WOMEN 4CYBER
EUROPEAN CYBER SECURITY ORGANISATION

WOMEN IN CYBER

A MANIFESTO FOR TODAY



Currently, women represent only a minority of the workforce in the cybersecurity domain. The figures have increased over the years, but they are still far from reflecting a balanced representation of both genders. There are several reasons behind this lack of female presence. In addition to those in common with other STEM fields, we have to face the widespread perception of the cybersecurity as a male-dominated and highly specialised IT field, thus, not an appropriate field for women to enter into. This situation calls for actions to contribute towards a cultural shift in favour of a more inclusive approach that would be beneficial for the cybersecurity market and of the society as a whole.

On a broader perspective, the issue of diversity, also with respect to the particular domain of cybersecurity, pertains to the overarching issue of gender equality. Gender equality has been identified as one of the seventeen (17) Sustainable Development Goals (SDGs) included in the 2030 Agenda for Sustainable Development, which was adopted by world leaders in 2015. Gender equality has been ranked as the 5th SDG and it is considered to be integral to the entire set of the SDGs identified.

CONCORDIA project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 830927.

Figure 3: Women in Cyber - A Manifesto for TODAY

The Manifesto has been developed following the holistic approach (1). To this aim, we identified six domains, namely: education/skills, entrepreneurship, industry, investment, legal/strategy, and research. For each domain, we invited an expert to examine and briefly summarize the state of women's inclusion in that specific domain. We also invited them to identify some actions to be accomplished in that specific domain. In the following, we report the description of each area.

Education/Skills

Contributor: Nina Hasratyan - Policy Manager at ECSO Women4Cyber.

Description: Cybersecurity is a field that requires not only technical experts but proactive people with strong managerial and soft skills. This is where we can best engage with and attract girls and women to the profession and how we can ultimately fill the skills gap and ensure fair and equal representation in cybersecurity. There is an urgent need to ensure that we are educating and training enough skilled experts to meet the demand. In addition to introducing cybersecurity as a multidisciplinary topic across education programmes, we need to attract more young people, girls in particular, to cybersecurity by demonstrating the multifaceted nature of the profession.

Actions: Remove the misconception that cybersecurity is just a technical issue – it is about people and processes too.

Entrepreneurship

Contributor: Felicia Cutas EIT Digital.

Description: According to the information encoded in the dealroom.co, out of almost 1600 startups and scaleups registered on the platform and acting in the cybersecurity field, one-third of them have their HQ registered in Europe, and a similar number is to be found in the US. Out of the 510 European cybersecurity companies, only 12 of them are led by women, four times less than in the US. Most of the 12 women-led cyber startups were setup in the last 15 years and are in the early growth stage.

Actions: Create a community of European women-led startups and innovations, by fostering the entrepreneurial spirit, best practices, and networking to reach of women in cyber-security today.

Industry

Contributor: Charlotte Graire – Airbus Cybersecurity GmbH.

Description: One of the main challenges of the industry is the hiring of cyber resources. The demand for cyber specialists and experts is greater than the supply, and this is making society and organisations increasingly vulnerable. Cyber industrials are finding more and more difficult to recruit in sufficient numbers, but also in quality, the talents. Talents needed to develop out the cyber offers essential to their resilience of the private sector and society and the emergence of European industrial champions able to develop the European competitiveness. From a social standpoint, industrials cannot bear that the cyber sector, whose impacts on our

daily lives are increasing, to be thought, developed and governed only by men. Actions: Implementation of concrete actions to support a more inclusive, open and female-friendly environment in cybersecurity industries.

Investment

Contributor: Regina LLopis Rivas – Women Angels for STEAM (WA4STEAM).

Description: PitchBook Data[21] stated that since the beginning of 2016 companies with women founders had received only 4.4% of venture capital deals. Those companies have garnered only about 2% of all capital invested in the US. In Europe, the statistics are better but do not surpass 7%. There is a gender gap in the investments on women-led startups, in spite of the fact that all the data shows these startups, on average, have better ROI when invested and better performance in innovation and other variables. This figure is even more alarming if we consider that, according to Strategic Cyber Ventures,[22] in 2018 we saw the record of $5.3 billion in cybersecurity venture capital funding, an increase above 20% from 2017 ($4.4 billion) and double that of 2016.

Actions: Raise awareness on the great opportunity to invest in women-led cybersecurity startups. Create women-led business angels groups and networking infrastructure for investing in STEM and in Cybersecurity women-led startups. Facilitation of capital access in early stages.

Legal/Strategy

Contributor: Dimitra Stefanatou – Arthur's Legal.

Description: The European Charter of Fundamental Rights explicitly provides for the principle of equality between men and women in all areas including employment, work and pay; the Charter, also, provides for the "maintenance or adoption of measures providing for specific advantages in favour of the under-represented sex". In light of these regulatory obligations relevant for all Member States, employers are expected to take measures for equality to be ensured in reality, including, with respect to professions such as cybersecurity where the gender quotas are far from being balanced.

Actions: European and the national policy makers should take the necessary strategic decisions that will actually incentivise effective compliance with existing rules, thus, going beyond mere "box ticking".

Research

Contributor: Tatjana Welzer Družovec – University of Maribor.

Description: According to data collected by the UNESCO Institute of Statistics (UIS), less than 30% of the world's researchers are women.[23] Data shows a clear leaky pipeline, with a growing number of women pursuing bachelor's and master's

[21] https://pitchbook.com/

[22] 2018-cybersecurity-venture-capital-investment/

[23] https://en.unesco.org/news/just-30-world%E2%80%99s-researchers-are-women-whats-situation-your-country

degrees, but many opt-outs at PhD level, a required title for a research career. In computer science, this is even more alarming as data shows a regular decrease in female graduates since 2000, particularly evident in high-income countries. This trend accordingly appears in the cybersecurity field. This leaky pipeline impacts several research decision-making processes, with women being underrepresented as peer reviewers on editorial boards and research councils, and in having fewer leader positions in tertiary education and R&D.

Actions: Raise awareness on the importance of involving women in project and research teams. Recognise and praise the effort and good results of women.

Analyzing these descriptions and discussing with their contributors, we realized that they share a common problem, that is, a wrong perception of the cybersecurity field. In a simplistic view, cybersecurity is perceived as an IT field only, with few very highly specialized males technicians. The complex and multi-disciplinary nature of cybersecurity, as well as the roles of women working in the field, is not recognized by our society. To cope with this problem, we had identified the following three main CONCORDIA objectives that our actions should target:

- **(O1) Reinforce the importance of cybersecurity culture**: Raise awareness about the cybersecurity culture, stressing its impact on society and state sovereignty and, as a result, its profound influence on everyday life. Similar as other professions, young women should perceive cybersecurity as a career option with a concrete social impact and role.
- **(O2) Consider the multidisciplinary nature of cybersecurity**: Increase awareness of the multidisciplinary nature of cybersecurity, which requires complementing skills and expertise, including the utilization of both hard skills and soft skills, and the cooperation between experts with different knowledge backgrounds, such as IT, economics and social sciences.
- **(O3) Promote positive role models**: Increase the visibility of positive role models, putting forward in a pragmatic manner how family life and a career in cybersecurity can be combined, thus, encouraging women towards a career in cybersecurity or allowing for a career reorientation.

Table 2 shows how the domains are covered by the three identified objectives. Raising awareness of the cybersecurity culture (O1), of its multidisciplinary nature (O2), as well as promoting positive role models (O3) will have the benefit of attracting more young girls to the cybersecurity field. This will be in turn a benefit for the education domain and, in the pipeline, for the entrepreneurship, the industry and research ones. Both investment and entrepreneurship domains will benefit from actions targeting O3. Indeed, to create a community of cybersecurity entrepreneurs, on the one hand, we need to give them a proper visibility. On the other hand, to highlight the great opportunity of investments, we have to provide visibility to women-led cybersecurity startups, showing their successful stories. Finally,

	O1 Cybersecurity culture	**O2 Multidisciplinary nature**	**O3 Positive role models**
Education/Skills	×	×	×
Entrepreneurship	×	×	×
Industry	×	×	×
Investment		×	×
Legal/Strategy	×		
Research	×	×	×

Table 2: Domains coverage by identified objectives

actions raising the importance and impact of cybersecurity on our society (O1) will not only influence citizens but will also provide an incentive for policymakers to support effective implementation of the equality principle in the cybersecurity.

In the following section, we discuss the manners of validating the Manifesto.

2.2 Manifesto validation

To validate the manifesto, we decided it would be most beneficial to get engaged with women active in European cybersecurity scene in the framework of a dedicated event. The event was intended to provide a supportive environment to fertilize the collaboration among relevant stakeholders, present the manifesto, and develop a shared vision to support women's engagement with cybersecurity.

To engage with a broader community, the event was co-located with the "ACM Celebration of Women in Computing: womENcourage". It is an annual conference organized every by ACM-W Europe[24], a chapter of ACM-W, Association for Computing Machinery's Council on Women. The aim of womENcourage is to facilitate women's connection from diverse technical disciplines and to encourage them to pursue their education and profession in computing. womENcourage brings together undergraduate and graduate students, researchers, academics, and practitioners to present and share their achievements and experiences and discuss issues of women in the computing profession. ACM WomENcourage offered the suitable platform for validating the Manifesto as its "raison d'etre" was in line with the workshop objectives. It brought together all the stakeholders categories targeted by the Manifesto.

Thus, in collaboration with ECSO Women4Cyber, we organized the workshop "Women in Cyber - a Manifesto for TODAY", collocated with the 6th ACM Celebration of Women in Computing: womENcourage 2019 conference, 17th September in Rome.[25]

[24] https://acmweurope.acm.org/

[25] https://www.concordia-h2020.eu/workshops/women-in-cyber/

Table 3: "Women in Cyber- a Manifesto for TODAY" workshop: agenda

Time	**Activity**	**Outcome**
14.00-14.30	Introduction	CONCORDIA & ECSO introduction, Manifesto Presentation
14.30-15.15	Focus group discussion	Feedback from participants
15.15-16.00	Round table	Manifesto revision, actions identification

Table 4: "Women in Cyber- a Manifesto for TODAY" workshop: focus groups and moderators

Focus group	**Moderator**
Education/Skills	Nina Hasratyan, ECSO Women4Cyber
Entrepreneurship	Sara Colnago, Sawscan
Industry	Madalina Baltatu, Telecom Italia
Investment	Regina Llopis, Women Angels for STEAM
Legal/Strategy	Dimitra Stefanatou, Arthur's Legal
Research	Tatjana Welzer Druzovec, University of Maribor

Workshop organization

The workshop format was constructed to promote engagement of stakeholders and other workshop participants, stimulating them to share their experiences, existing initiatives, and adopted gender-gap resolution strategies. The ultimate goal was to collect from the audience relevant comments and suggestions to be integrated into the Manifesto's final version. About 40 representatives of the cybersecurity industry, education, research, entrepreneurship, and investment areas joined the workshop and contributed to the discussion with real cases.

As reported in Table 3, the workshop began with a brief welcome and introduction given by Prof. Gabi Dreo (CONCORDIA's coordinator), who acted as a moderator of the workshop. In her welcome speech, she overviewed the workshop objectives and the Manifesto contents. Then, Nina Hasratyan (Policy Manager at ECSO) presented the Women4cyber initiative.

After the introduction, the workshop continued with parallel focus groups, one for each domain discussed in the Manifesto, to maximize the time at our disposal. The audience has been required to choose a topic of interest and joined the corresponding focus group discussion. Each group had associated a moderator, properly selected among experts for that area, which guided the group discussion. Table 4 reports the list of focus groups and corresponding moderators. During a final round table, moderators presented the collected inputs also with respect to the Manifesto contents. At the end of the discussion, the objectives identified in the Manifesto

were confirmed formally, allowing for the final version of the Manifesto to be released[26] and officially launched during the CONCORDIA Opendoor 2019 event.[27]

[26] link manifesto

[27] https://www.concordia-h2020.eu/concordia-open-door-event/

W1	Women do not see security as a viable career path because they considered it as a **'man's job'**. Clients, customers, recruiters display this preconception as well.
W2	Girls more than men **need mentors and family support** in choosing a cybersecurity profession
W3	**Lack of visibility** of cybersecurity women entrepreneurs, the same holds also in other fields, like research & industry.
W4	**Needs of a framework** to help women to start their own business in cybersecurity to learn needed skills, both technical and soft skills
W5	**Lacks of knowledge** of the benefits an investment in women-led startups might bring.
W6	Support **internships of women** in industry.
W7	Need of **mentoring activities**.
W8	Need for women to get **real equal opportunities**, on the basis of their own abilities and skills and not because they merely belong to the under-represented sex in the cybersecurity domain.
W9	Initiatives such as the 'Manifesto for Today' should clearly aim at **combining skills of both men and women** in order to unleash their full potential in their own interest and in the interest of society as a whole.
W10	Young girls would like to **hear the success stories** of other women to learn through their experiences and get more self-confident, as well as use the good career practices for their own development.
W11	Young girls expressed also the needs for some workshops and seminars to **be more educated** where they lack knowledge and would like to get more professional skills.
M1	Remove the **misconception** that cybersecurity is just a technical issue.
M2	**Create a community** of European women-led startups and innovations.
M3	Support a more inclusive, open and female-friendly environment in cybersecurity industries.
M4	Raise awareness on the great opportunity to **invest in women-led cybersecurity** startups
M5	Create **women-led business angels and networking** infrastructures.
M6	Incentivise **effective compliance** with existing gender equality rules.
M7	Raise awareness on the **importance of involving women in project and research** teams
M8	**Recognise and prise the efforts** and good results of women

Table 5: List of concerns emerged during the workshop focus groups (W) and the manifesto preparation (M)

3 CONCORDIA's actions for women inclusion

After the Manifesto validation, T4.5 activities focused on identifying a set of actions to achieve the Manifesto's objectives. To this aim, we thoroughly analyzed the outcome of the workshop discussion. In addition, we conducted several structured interviews with the focus group's moderators to highlight the main issues that were stated as preventing women from pursuing a cybersecurity career. These critical points have been integrated into the analysis done by experts during the Manifesto preparation. Table 5 summarizes the concerns emerged both during the workshop focus groups (W) and the Manifesto preparation (M). For each concern, we have identified a list of actions that would improve the current state. To select the subset of priority actions, we first grouped the actions based on the wrong stereotypes on cybersecurty they are targeting. This formed three main categories of ac-

tions:

C1- Removing stereotype of cybersecurity as a male job
Stereotype: Cybersecurity is a male job.
Action: Replacing this stereotype to help young girls and women to perceive cybersecurity as a possible career option.
Relation to: objectives O1 and O3.[28]

C2- Correct perception on cybersecurity
Stereotype: Cybersecurity is only an area of IT.
Action: Increasing awareness that cybersecurity is a multidisciplinary discipline, where IT experts have dialogue and collaborate with experts from economic, legal, and communication fields.
Relation to: objectives O2 and O3

C3 - Economic impacts of gender equality
Stereotype: Gender equality does not provide benefits on business.
Action: Increasing awareness on business advantages of introducing diversity into the cybersecurity field. Several studies show that improving gender equality has strong and positive impacts on economic growth [29]. The goal is to boost the implementation of a gender equality plans in industries and research institutions.
Relation to: objective O3.

As the second step, we selected the types of actions that are present in more categories. The selected actions are: "Women in Cyber role models" , "Contest for Women in Cyber", and "Diversity & Cybersecurity webinars". In the following, we briefly introduce each action. As summarized in Table 6, these actions provide complete coverage on the concerns that have emerged during the workshop focus groups and the Manifesto preparation (see Table 5).

3.1 Women in Cyber role model action

Several studies show the effectiveness of role modeling in fostering women's talent and encouraging young girls to pursue technical and scientific careers [9]. Similarly, giving visibility to women working in cybersecurity would show young girls that women are present in the field and that a career path in that direction is both realistic and attractive option. To implement a role model action in cybersecurity, we asked all women in the CONCORDIA consortium to step forward. We asked them to participate in a gallery of CONCORDIA's women postcards. In this gallery,

[28] Role model actions are included in all three categories. As such, all of them are related to O3.
[29] https://eige.europa.eu/gendermainstreaming/policyareas/economicandfinancialaffairs/economicbenefitsgenderequality

Concerns	Categories	Actions
W1, W3, W10 M1, M3	C1, C2	Women role model
W3, W6, W9 M1, M8	C1, C2	Women contest
W2, W3, W4, W5, W6, W7, W11 M1, M2, M3, M4, M5, M6, M7	C1, C2, C3	D&C webinars

Table 6: Impact of selected actions on concerns in Table 5

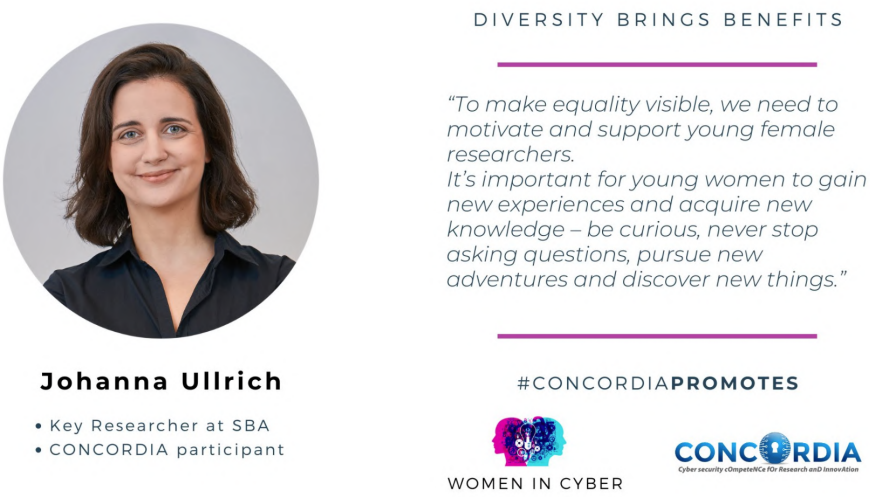


Figure 4: CONCORDIA women in cyber postcard

each woman introduces herself, her role in her organization and in CONCORDIA, and sends a personal message to incentivize other women to join cybersecurity.

Action impact. As depicted in Table 6, this action was listed among those in the first and second category, as postcards will not only present women but will also show their different roles. As this role is not necessarily achieved in the IT field, the action will help to remove the male job stereotype (C1) and pass a more realistic view of roles in cybersecurity (C2).

Current Status of action implementation. At the time of writing, we have collected input from more than 20 women, with different roles in cybersecurity (e.g., researcher, legal counsel, professor, project manager, cybersecurity officer) and different seniority levels (from PhD student to executive director). In collaboration with the CONCORDIA communication team, we prepared a postcard template (see Figure 4 as postcard example).[30] To give more visibility to this role

[30]We selected this postcard since, at time of writing, this is last one published in CONCORDIA social media.

model action, we decided to release a postcard every two weeks on CONCORDIA social media channels. The first postcard has been published on 15th April 2020, other 12 have followed during 2020 (refer to Annex C to see all published postcards).

3.2 Diversity & Cybersecurity Webinars

This action aims at providing a series of events dedicated to topics related to gender balance. In particular, we plan a webinar every two months. The purpose of the webinars is to provide insights from relevant and recognised experts, acting as speakers and moderators at the events. Moreover, the major goal is to facilitate stakeholder networking, with particular emphasis on women at career cross-roads and girls starting their careers. To support this idea, we aim to provide webinars organized in two phases: first, a panel with distinguished speakers (about 45 min), followed by a mentoring activity, implemented as private-calls between people from the audience and a speaker (45 mins).

The idea is to follow the Manifesto approach and select topics among the six areas identified in the Manifesto (i.e., entrepreneurship, industry, education, research, legal, investment).

Action impact. The Diversity & Cybersecurity webinar action is a generic container able to provide insights on specific gender-related topics and mentoring activities. The plan is to select topics to cover all domains. Moreover, in selecting speakers and moderators, we ensure the presence of both women and men. This will allow us to address the concerns in Table 5.

Current Status of action implementation. The first webinar addressed the topic of women entrepreneurship and was deployed on 14th December 2020 (see Appendix B for more details), 16.30-18.00, with the following speakers:

Louise Bautista[31] - Regional Sales Manager @TheGreenBow Secretary General @French Club of Cryptocurrency

Paola Bonomo[32] - Senior executive and Non Executive Director in Technology, Media and Telecommunications. Digital transformations evangelist and coach. Inspiring Fifty - one of the 50 most inspiring women in European Tech in 2015 and 2016. Golden Aurora for Europe's best woman business angel in 2017.

Sara Colnago[33] - Serial Entrepreneur - Forbes top 100 Tech Influencer - Innovation Manager

Aljosa Pasic[34] - Moderator ATOS - Leader of task T3.5 on Community Building, Support, and Incentive Models.

During the panel, the speakers discussed relevant questions. They expressed their views on the current situation of the cybersecurity startup ecosystem. They also analyzed how cybersecurity had moved from a technical domain to a topic

[31] https://www.linkedin.com/in/bonomo/?originalSubdomain=it
[32] https://www.linkedin.com/in/bonomo/?originalSubdomain=it
[33] https://www.linkedin.com/in/sara-colnago-8575a611/
[34] https://www.linkedin.com/in/aljosa-pasic-7b69a71/

raised to Boards of Directors in the largest companies. Finally, they advised girls and young women to learn and practice cybersecurity.

3.3 Contest for Women in Cyber

This action aims at organizing a contest to assign awards to women. Following the Manifesto view, we aim to set up specific recognition for each of the six different areas (research, education/skill, legal/strategy, industry, entrepreneurship, investment).

Action impact. This action represents an excellent opportunity to give visibility to women but also to other gender-balance initiatives in place in different organizations and industries. As we plan a different award for each domain, this action has good coverage on concerns in Table 6.

Current Status of action implementation. At the time of writing, we are working to identify, for each domain, the following aspects:
Target: the audience to which the award refers to;
Application: the type of application that applicants have to submit to the award committee;
Prize: the prize we will assign to the awardees. At this purpose, we are looking for sponsors to offer prizes. The plan is to launch this action at the beginning of 2021.

4 Conclusions

The deliverable presented the activities and progress of task T4.5, done during the first two years of the project. Initially, T4.5's efforts were devoted to analyzing the gender situation in the field of cybersecurity. We then identified three main objectives that T4.5 and the whole CONCORDIA consortium should target to address women's inclusion in cybersecurity. In particular, the objectives aims to reinforce the importance of cybersecurity culture, to increase awareness of the multidisciplinary nature of cybersecurity and to increase the visibility of positive role models. These were published in a document, i.e. Women in Cyber – A Manifesto for Today, and validated through a dedicated workshop.

These objectives support the "Union of Equality" vision, one of the major priorities of Ursula von der Leyen's Commission.[35] A priority that has resulted in the Gender Equality Strategy 2020-2025, which states the policy objectives and critical actions for achieving a gender-equal Europe.

CONCORDIA supports this equality strategy in several ways, having as the ultimate goal of task T4.5 to implement measures contributing to gender equality in the cybersecurity ecosystem. In particular, one of the key objectives of the Gender Equality Strategy is the removal of stereotypes (i.e., "Being free from violence and stereotypes"). In this respect, acknowledging the wrong perception of cybersecurity as a male-dominated and highly specialized IT field, CONCORDIA objectives have been indeed designed to remove false stereotypes on cybersecurity.

Another critical objective of the Gender Equality Strategy 2020-2025 is to increase a "gender-equal economy". The strategy demands actions aiming at: (1) closing gender gaps in the labour market, (2) achieving equal participation across different sectors of the economy, (3) addressing the gender pay, pension gap, and (4) closing the gender care gap. Among these, T4.5 supports goal (1), since activities carried out in T4.5 aim at encouraging women to join the cybersecurity field to have a more gender-equal workforce. Concerning (2), the Gender Equality Strategy emphasizes the importance of gender equality in the digital transition era. As cybersecurity plays a strategic role in digital transformation, T4.5 actions are crucial for (2).

The deliverable also discussed the process to identify the actions to implement the Manifesto objectives, namely: women in cyber role model; diversity & cybersecurity webinars; contest for women in cyber. For each of them, the deliverable presented the current status of implementation.

In the third year of CONCORDIA, T4.5 will continue to implement the actions described in this deliverable. The plan is to deliver a new Diversity & cybersecurity webinar and conclude part of the contest for women in Cyber in the first trimester. In doing that, we will ensure that our actions will not be perceived as targeting only women, as suggested in the 2nd Review. We will involve more men in the

[35] https://ec.europa.eu/commission/sites/beta-political/files/political-guidelines-next-commission_en.pdf

action implementation (as an example, as speakers/moderators in the webinars). In this direction, we are currently designing a set of CONCORDIA good practices for gender equality, that is, a list of actions (e.g., avoiding participation in all men panels) the whole consortium has to follow.

References

[1] Cedric Herring. Does diversity pay?: Race, gender, and the business case for diversity. American Sociological Review, 74(2):208–224, 2009.

[2] $(ISC)^2$. How views on cybersecurity professionals are changing and what hiring organizations need to know - the 2020 $(isc)^2$ cybersecurity perception study, sep 2020.

[3] Panagiota Fatourou, Yota Papageorgiou, and Vasiliki Petousi. Women are needed in stem: European policies and incentives. Commun. ACM, 62(4):52, March 2019.

[4] $(ISC)^2$. Cybersecurity workforce study: Women in cybersecurity, April 2019.

[5] T. Weil and S. Murugesan. It risk and resilience—cybersecurity response to covid-19. IT Professional, 22(3):4–10, 2020.

[6] Rebecca A Krukowski, Reshma Jagsi, and Michelle I Cardel. Academic productivity differences by gender and child age in science, technology, engineering, mathematics, and medicine faculty during the covid-19 pandemic. Journal of Women's Health, 2020.

[7] Jens Peter Andersen, Mathias Wullum Nielsen, Nicole L Simone, Resa E Lewiss, and Reshma Jagsi. Meta-research: Covid-19 medical papers have fewer women first authors than expected. Elife, 9:e58807, 2020.

[8] Brooke Peterson Gabster, Kim van Daalen, Roopa Dhatt, and Michele Barry. Challenges for the female academic during the covid-19 pandemic. The Lancet, 395(10242):1968–1970, 2020.

[9] Danielle M Young, Laurie A Rudman, Helen M Buettner, and Meghan C McLean. The influence of female role models on women's implicit science cognitions. Psychology of Women Quarterly, 37(3):283–292, 2013.

Appendices

A CONCORDIA gender distribution

The Appendix presents the updated statistics on women presence in CONCORDIA workforce, i.e., Figure 5, with respect to researchers in Figure 6, and other roles, except researchers, i.e., Figure 7.

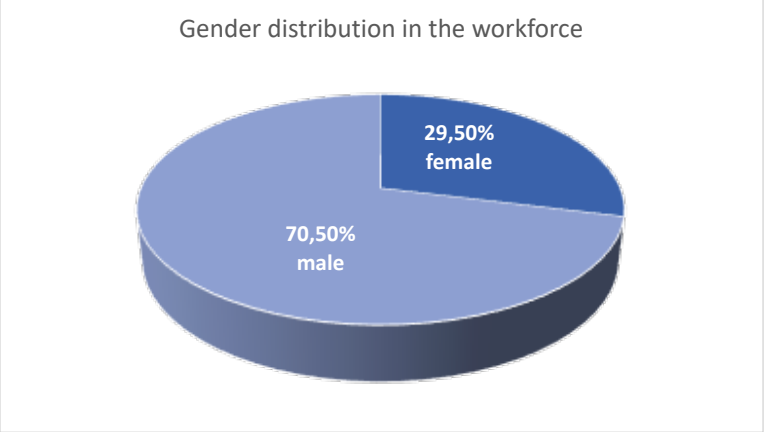


Figure 5: Gender distribution in CONCORDIA workforce

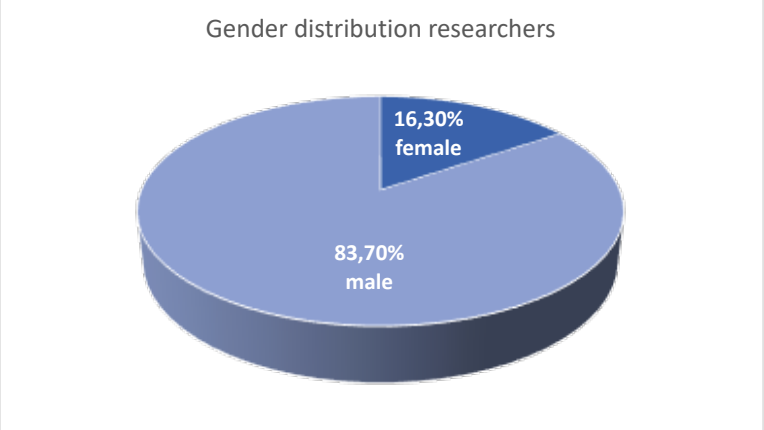


Figure 6: Gender distribution among CONCORDIA's researchers

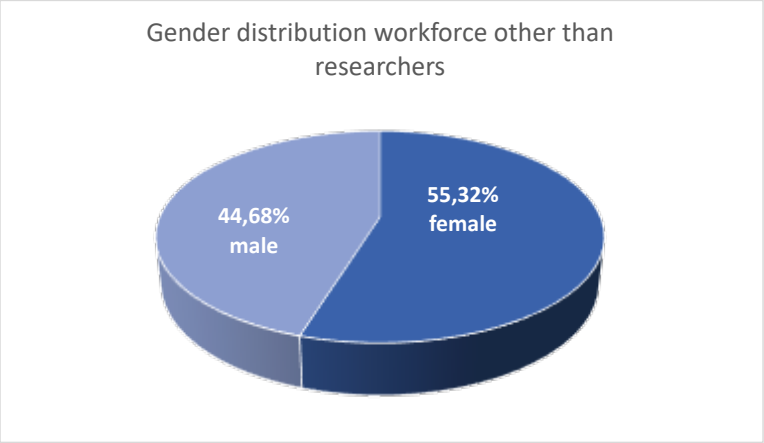


Figure 7: Gender distribution in CONCORDIA workforce, other than researchers

Time	Activity	
16.30-17.15	Welcome & Panel	Elena Ferrari, Aljosa Pasic, Louise Bautista,
		Paola Bonomo, Sara Colnago
17.15-18.00	Meet the Panelist	Louise Bautista, Paola Bonomo, Sara Colnago

Table 7: Diversity & Cybersecurity: Women entrepreneurship:agenda

B Diversity & Cybersecurity: Women entrepreneurship

The first webinar of Diversity & Cybersecurity series focused on the topic of women entrepreneurship. It was deployed on 14th December 2020 following the agenda depicted in Table 7. It has been hosted on Hopin platform,[36] and made it available at he following URL:

https://hopin.com/events/dc-women-entrepreneurship#top.

Figure 8 represents the homepage of event on Hopin.

The registration opened on the 23rd of November, preceded by an advertising campaign on CONCORDIA channel that lasted until the event. The webinar received 89 registrants from all over the world (see Figure 9) with a tornout of about 40%.

During the panel, the panelists expressed their views on the current situation of the cybersecurity startup ecosystem and analyzed how cybersecurity had moved from a technical domain to a topic raised to Boards of Directors in the largest companies. Finally, they advised girls and young women to learn and practice cybersecurity. With the permissions for panelists and moderators, the panel has been recorded and made available at the following URL:

https://www.youtube.com/watch?v=M78OSYS9yWw&feature=youtu.be

[36] https://hopin.com/

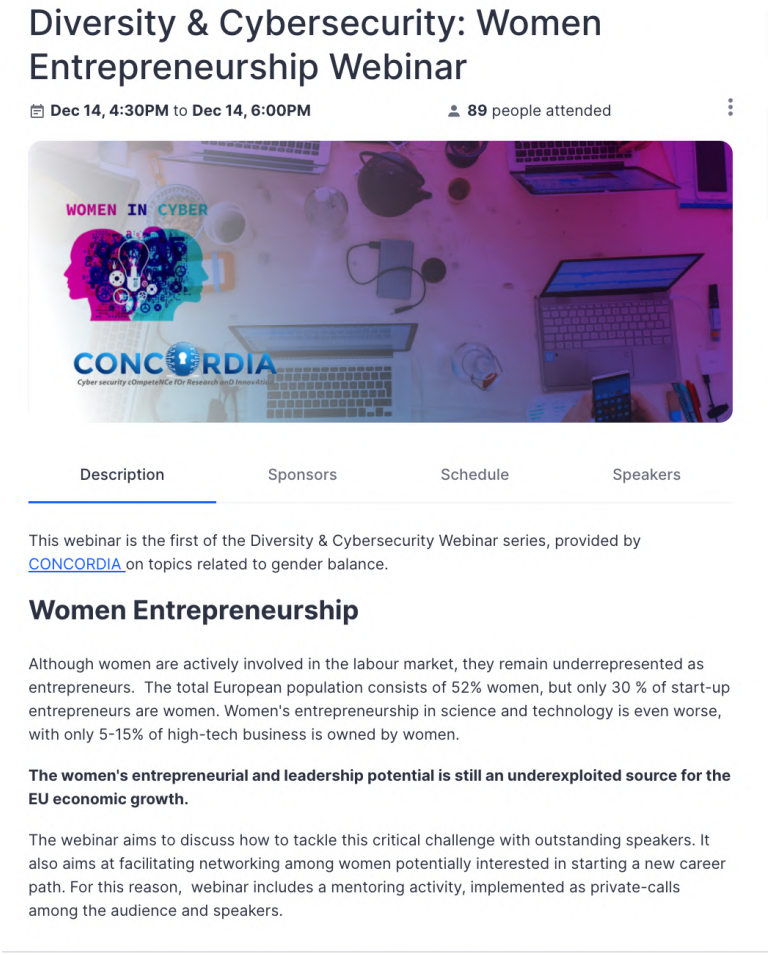


Figure 8: Webinar homepage

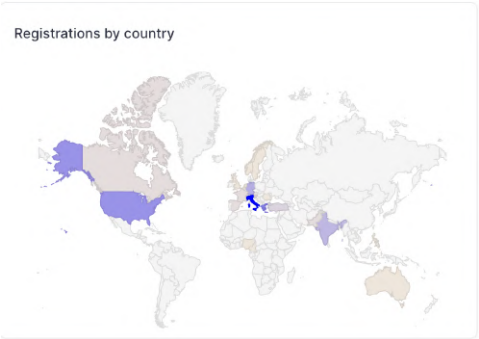


Figure 9: Registrants by country - Picture taken from Hopin dashboard

The panel has been followed by the mentoring activities, where about 11 connections have been established among panelists and participants.

C Gallery of CONCORDIA's women postcards

Figure 10: Elena Ferrari - UI

Figure 11: Anja Majstorovic - EESY

Figure 12: Despoina Antonakaki - FORTH

Figure 13: Georgia Anousaki - GSDP

Figure 14: Eygenia Tsaprali - GSDP

Figure 15: Denise Tsaouselou - GSDP

Figure 16: Chatzopoulou Argyro - TUVA

Figure 17: Lili Nemec Zlatolas - UM

Figure 18: Jihane Najar - TUBS

Figure 19: Cora Perner - ACS

Figure 20: Daniela Friedl - SBA

Figure 21: Stephanie Jakoubi - SBA

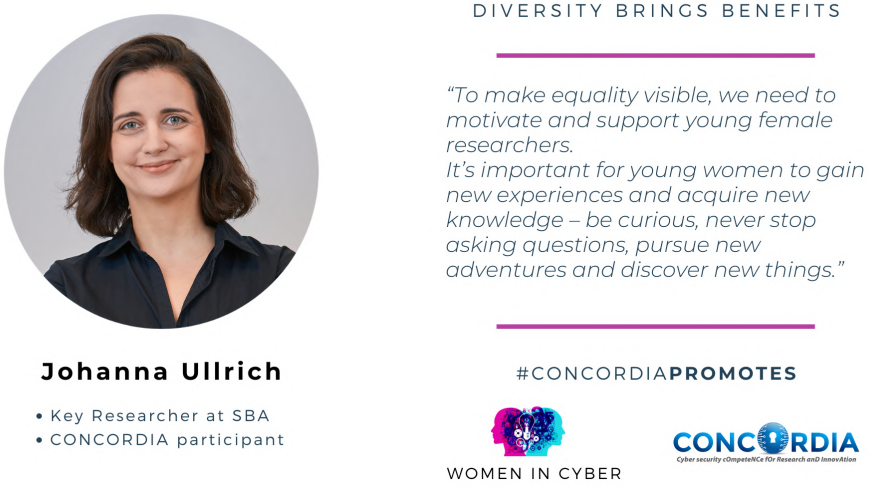


Figure 22: Johanna Ullrich -SBA