Joint Action Plan Implementation

Measure A3 – Ensure that ICT Security competences are provided to meet the needs and requirements of industry through Education & Training

A3.1B: ICT Security Skills Gap:

List of ICT security courses offered in each Be Wiser partner region

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Preface

"Building Enterprises – Wireless and Internet Security in European Regions" (Be Wiser) is a FP7 Region of Knowledge project.

Be Wiser Goals

- Helping companies become more competitive by enhancing access to research excellence, funding mechanisms and innovation through the improved interconnection of the actors in the field of Wireless and Internet Security ;
- Promoting the collaboration, exchange and dissemination of policy initiatives and best industry and policy practices at European level and beyond;
- Sharing knowledge between the different regions through inter-clustering;
- Developing targeted actions for cluster actors especially for SMEs (via support to open innovation, commercialisation, internationalisation and technology partnering);
- Implementing targeted internationalisation strategies and pilot actions to demonstrate their feasibility and impacts;
- Preparing Be Wiser clusters' members to exploit opportunities offered by EU-framework programmes such as H2020 and COSME.

Be Wiser Partners

The Be Wiser Consortium partners consist of seven ICT Triple Helix Clusters (THCs), drawn from different EU members states, namely:

- Systematic – Lead partner, and the Paris Region (France) ICT Triple Helix cluster
- Cork, Ireland – it@cork with its business membership plus relationships with the Cork Institute of Technology (including the NIMBUS Centre) and Cork County Council, form the Irish Triple Helix Cluster.
- Invest NI and CSIT in Queens University combine to form the Northern Ireland Triple Helix Cluster
- CyberForum Germany – the Baden-Württemberg (Germany) ICT Triple Helix cluster
- Eurecat – the Catalonia (Spain) ICT Triple Helix cluster
- ICT Technology Network – the Slovenian ICT Triple Helix cluster
- Cyprus Computer Society (CCS) – a developing ICT Triple Helix cluster (Cyprus)

THCs support and animate a network of businesses, regional centres of research & technology, and public authorities responsible for investment in economic development.

These clusters share a common objective of stimulating ICT and Wireless and Internet Security innovation, but operate in different ways, bringing together different strengths and expertise. Through this project, the clusters can offer a greater breadth of competence to the marketplace and can exchange successful practices. They can also achieve a critical mass to attract additional ICT clusters into the network. The internationalisation aspect of the project will identify links with expert clusters which are already in place, with the goal of further developing these linkages during the Be Wiser project.

In addition to the Be Wiser technical THCs the Inno Group provides benchmarking analysis support.

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Overview

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1. Introduction to Measure A3 – Ensure that ICT Security competences are provided to meet the needs and requirements of industry through Education & Training

The measure A.3 of the JAP is part of the objective A: **Raise awareness and improve cybersecurity practice of citizens, and fill gaps relating to the cybersecurity skills needs of industry.**

Indeed, the Global Information Workforce Study found an ever widening gap between the supply of qualified information security professionals and the demand for skilled workers to secure critical information and the cyber world. The study found that the workforce will grow at a compound annual growth rate of 11.3% globally up to 2017, calling for an additional 2 million new workers.

Cybersecurity has become an increasingly important aspect of public policy as internet traffic increases and mounting cyber-threats affect the operation of governments and businesses as well as the everyday life of citizens. Cybersecurity policy-making is at a turning point, becoming a national policy priority with explicit strategies in several countries.

Understanding and interacting within a secure and trustworthy digital environment is of benefit to all European citizens, and in this regard a plan must be articulated to educate and develop awareness of safe practices when online at an early age. Providing awareness and training for citizens may also help citizens to engage with technology and use it to their advantage earlier, with a potential effect of sparking interest in ICT and cybersecurity related careers.

Thus, 3 measures will be proposed under the Objective A:

- Measure A.1: Increase awareness of the importance of a secure and trustworthy digital environment for the benefit of all EU citizens.
- Measure A.2: Develop channels at pre-tertiary education levels to enrich cybersecurity awareness.
- **Measure A.3: Ensure that ICT Security competences are provided to meet the needs and requirements of industry through Education & Training.**

Even though the availability of high-level ICT security skills would significantly contribute in leveraging the economic growth of companies, still there is a lack of ICT security skills in Europe. As described below, there is an ever widening gap between the supply of qualified information security professionals and the demand for skilled workers to secure critical information and the cyber world (an additional 2 million new workers until 2017). As a result, several hundred thousand ICT-related job vacancies remain unfulfilled. The educational sector and industry have to closely collaborate to satisfy security demands in this rapidly changing field. Thus, the goal of the action A.3 is to identify measures that the educational sector and the industrial sector could take to provide the required ICT security competences.

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To reach this objective, Be Wiser partners will work together through a three steps process:

- Identify missing ICT security competences for the industry at national/regional level, and highlight recurring shortcomings across Be Wiser regions
- **Create a directory of ICT security courses offered in each Be Wiser partner region to include: Degree / Master courses and modules offered by HEIs and Training and Certification courses offered by professional associations/institutes and industry.**
- Encourage engagement between HEIs and cybersecurity professionals from industry for course review and curriculum development.

The current document corresponds to the second step: Create a directory of ICT security courses offered in each Be Wiser partner region. The objective is not to conduct an in-depth analysis of the various degrees and courses offered in Europe but rather compile a simple list of the options that are available within the Be Wiser region. The quality of the programs and courses are not evaluated in this report, however only accredited (by the state where they are offered) programs and courses are listed.

As part of the European Cyber Security Month (ECSM), a web portal was developed where Universities could announce their courses and/or programs that are related to security [3]. Currently (Nov. 2015), 417 courses are registered from 22 different countries.

2 ICT Curricula Guidelines

There are three major global professional organizations that are representing the computing interests of their members, namely: ACM (Association for Computing Machinery), IEEE[1] (Institute of Electrical and Electronics Engineers), and AIS (Association for Information Systems). There are numerous other local or regional organizations/societies, like BSC (British Computing Society), and CCS (Cyprus Computer Society). The two first societies (ACM and IEEE Computer Society) are targeting the Computer Science domain, while AIS is targeting the Information Systems domain. There is collaboration among these societies and their curricula committees regularly release curricula guidelines to programs in the ICT domain for higher education institutions. Universities are free to follow the recommendations and it is highly recommended to take them into consideration when programs and/or courses are developed/upgraded. In addition, textbooks often follow the recommendations proposed by the societies for a specific course.

2.1 Current Curricula Recommendations

[1] Under the umbrella of IEEE there exists IEEE Computer Society

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Following is a list of the latest curricula guidelines for the specific fields that fall within the ICT umbrella [1]. The different organizations collaborate on their development with the ACM/IEEE Computer Society being the most active collaboration.

The ACM and IEEE Computer Society have collaborated (since 1968) in developing the following curriculum guidelines:

- **Computer Science 2013**: Curriculum Guidelines for *Undergraduate Programs* in Computer Science
- **Computer Engineering 2004**: Curriculum Guidelines for *Undergraduate Degree Programs* in Computer Engineering
- **Software Engineering 2014**: Curriculum Guidelines for *Undergraduate Degree Programs* in Software Engineering
- **Information Technology 2008**: Curriculum Guidelines for *Undergraduate Degree Programs* in Information Technology.

The International Council on Systems Engineering (INCOSE) and the U.S. National Defense Industrial Association (NDIA), with ACM and IEEE Computer Society that joined at a later time, proceeded with the development of the following recommendation:

- **Software Engineering (GSwE)2009:** Curriculum Guidelines for *Graduate Degree Programs* in Software Engineering

The ACM and AIS have also collaborated in developing the following curriculum guidelines:

- **Information Systems 2010:** The Curriculum Guidelines for *Undergraduate Degree Programs* in Information Systems.

One major change in the latest iteration of the recommendation for the Computer Science (CS2013) undergraduate recommendation was the inclusion of a new knowledge area (KA). The new KA is named ***Information Assurance and Security***, which indicates the importance of security in education for the next generation of ICT professionals. In [2], Ronald C. Dodge gives a detailed explanation of the inclusion of this new KA into the curricula recommendation.

3 State Recommendation

In the last couple of years, states have also realized the need for a workforce with knowledge and skills in the Security area. In the US, an example of this is the National Initiative for Cybersecurity Education [5] which is funded by various federal agencies with the mission to “Bolster formal cybersecurity education programs”. In EU, there are various programs related to the boosting of awareness for security in education. ENISA (European Union Agency for Network and Information Security) has played an active part in raising awareness for the lack of opportunity for formal education in the area of Security and Privacy. In [4], ENISA is investigating the lack of formal education in the Privacy area. This is a serious deficiency in the European landscape especially as EC’s

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GDPR [6] is planned to be adapted in early 2016. The GDPR also explicitly states that training and education is needed when the GDPR will take effect, which is two years after it is being adapted. As was stated above the European Cyber Security Month also is raising awareness of the current state of the formal training availability [3]. However, as this list is entered voluntarily by the institutions, there may be many more that did not go through the effort of entering their institution.

At the state level various mechanisms have been deployed to strengthen the states' formal training in the security and privacy area. One of the latest is in the UK where University of Southampton was awarded £500,000 to provide students with the skills to help protecting the state against cyber-attacks.

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4 Cyprus

On the island of Cyprus there are three public Universities and five private Universities. In addition, there are numerous colleges which are offering tertiary education some with collaboration of foreign universities, some are accredited, while some are not. Only the accredited programs that have courses and/or programs which is related to Security is listed. More information about the accreditation of higher education in Cyprus can be found in [7].

4.1 Post Graduate Level

Institution Name	Degree Code	Degree Name	Direction and/or Courses
University Of Nicosia	MSc	Computer Science	Offers a concentration on *Cyber Security*
Frederic University	MSc	Web and Mobile Systems	Required course named *Network Security*
Neapolis University Pafos	MSc	Information Systems	Offers a concentration on *Security*
University of Central Lancashire, Cyprus (UCLan Cyprus)	MSc	Computing	Offers a concentration on *IT Security & Networking*
University of Central Lancashire, Cyprus (UCLan Cyprus)	MSc	Cybersecurity	
Open University of Cyprus	MSc	Computer and Network Security	
University of Cyprus	MSc	Computer Science	Course named (required in some directions) *System and Network Security*

4.2 Undergraduate Level

Institution Name	Degree Code	Degree Name	Direction and/or Courses

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University Of Nicosia	BSc	Computer Science	Required course named *Computer Security* and elective courses named *Network Security* and *Ethical Hacking*
University of Nicosia	BSc	Management Information Systems	Required course named *Principles of Information Security*
Frederic University	BSc	Computer Science	Elective course named *Network and System Security*
Neapolis University Pafos	BSc	Bachelor in Applied Informatics	One of the orientations (i.e. directions) contains the following course: *Protection and Security of Information Systems*
European University Cyprus	BSc	Computer Science	Elective course named *Network Security*
University of Central Lancashire, Cyprus (UCLan Cyprus)	BSc(Hons)	Computing	Required course (in some directions) named *Computer Security* and elective course named *Penetration Testing*
University of Cyprus	BSc	Computer Systems and Networks Programme	Elective named *Network and Information Security*
Cyprus University of Technology	BA	Communication and Internet Studies	

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5 France

In the Paris region, 70 universities / schools have ICT related departments / degrees, representing 20 200 students.

- Master degree from Universities (University of Paris 6, University of Paris Diderot, University of Paris 8, University of Paris-Est creteil, University of Versailles Saint-Quentin)
- Master degree from Engineering School (Telecom Sud Paris, Telecom Paristech, ENSTA Paristech, ESGI,) from Business School (IONIS-STM)
- Engineering diploma from Engineering School (Telecom Sud Paris, EPITA, ESAIP, ETNA-Alternance, ESIGELEC and EPSI)
- ANSSI (National Agency)
  - Training center in the security of information systems (CFSSI)
  - Mapping of training cybersecurity related in France, from higher school **(table below focused on Cybersecutity)**
  - Training session dedicated to the staff for the French administration and military

5.1 Post Graduate Level

Institution Name	Degree Code	Degree Name	Direction and/or Courses
Université de Paris 8, en partenariat avec Paris Nord (Paris 13)	Master	Master « Mathématiques fondamentales et protection de l'information »	Description
Université de Paris-Diderot (Paris 7) - en partenariat avec Paris 8	Master	Master « Mathématiques, Informatique et applications à la Cryptologie - MIC »	Description
Université de Paris-Est Créteil (Paris 12)	Master	Master « Sécurité des systèmes informatiques »	Description
Université de Rennes 1, Université de Bretagne Sud, Université de Bretagne Occidentale, ENS Rennes, ENIB, ENSTA Bretagne, INSA Rennes, CentraleSupélec, Télécom	Master	Master « Sécurité des contenus et des infrastructures informatiques »	Description

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Bretagne			
Université de Versailles-Saint-Quentin	Master	Master « Sécurité des contenus, des réseaux, des télécommunications et des systèmes - SeCReTS »	Description
Université Pierre et Marie Curie (Paris 6) - avec l'AFTI	Master	Master « Informatique, spécialité SFPN, filière sécurité informatique - MSI »	Description
EPITA	Eng	Ingénieur « Systèmes, réseaux et sécurité - SRS »	Description
EPSI	Eng	Programme Ingénierie informatique - option Sécurité Informatique	Description
ESAIP	Eng	Ingénieur « Informatique et réseaux, spécialité cybersécurité »	Description
ESGI	Master	Mastère « Sécurité informatique »	Description
ESIEA	Eng	Ingénieur parcours « Fundamentals of Security (SEC) »	Description
ESIGELEC	Eng	Ingénieur « Architecture et sécurité des réseaux - ASR »	Description
ETNA-Alternance	Eng	Ingénieur « Architecte système réseaux et sécurité »	Description
EURECOM	Eng	Ingénieur de spécialisation en « sécurité des systèmes informatiques et des communications »	Description
IONIS-STM	Master	Master « Ingénierie informatique & Management : Sécurité informatique »	Description
ISIMA-Université Blaise Pascal	Eng	Ingénieur « Réseaux et	Description

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		Sécurité Informatique »	
Télécom SudParis	Eng	Ingénieur « Sécurité des systèmes et des réseaux »	Description

5.2 Undergraduate Level

Institution Name	Degree Code	Degree Name	Direction and/or Courses
Université Paris Est Créteil Val de Marne	Licence	Licence Pro « Réseaux Sans Fil et Sécurité » Licence Pro « Administration et Sécurité des Réseaux »	Description
Université Paris 13	Licence	Licence Pro - R&T - « Administration et Sécurité en Réseaux »	Description
Université de Paris Sud	Licence	Licence Pro - R&T - « Administration et Sécurité en Réseaux »	Description
Université de Versailles Saint-Quentin	Licence	Licence Pro - R&T - « Administration et Sécurité en Réseaux »	Description

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6 Germany

The Karlsruhe region is economically dominated by ICT and other high-tech industries which is caused by the strong focus on ICT, natural sciences and engineering sciences of the main HEIs in this region. There are nine HEIs in the region, comprising e.g. Conservatory Karlsruhe, Art College Karlsruhe or Karlsruhe College of Education, but the three main institutions with the highest number of students are Karlsruhe Institute of Technology (KIT), University of Applied Sciences Karlsruhe, and Cooperative State University Baden-Wuerttemberg (federal state). All degrees listed below belong to these main HEIs. The topic IT security is integrated in the different study courses by single modules, seminars or lectures. In some master study courses, the students have the possibility to focus on this topic by choosing appropriate modules, seminars and lectures.

6.1 Post Graduate Level

Institution Name	Degree Code	Degree Name	Direction and/or Courses
Karlsruhe Institute of Technology	MSc	Informatics	Optional modules "Security", "Selected chapters of cryptography", "Symmetric encryption methods", "IT security management for networked systems", "Asymmetric encryption methods", "Digital signatures", "Provable security in cryptography", "Cryptographic voting procedures", "Network security: architectures and protocols" "Complexity theory applied to cryptography"
Karlsruhe Institute of Technology	MSc	Business Informatics	Optional modules "Security", "IT security management for networked systems", "Asymmetric encryption methods",

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			"Digital signatures", "Provable security in cryptography", "Selected chapters of cryptography", "Symmetric encryption methods", "Network security: architectures and protocols"
Karlsruhe Institute of Technology	BSc	Industrial Engineering	Optional Modules "Business information systems: data protection and IT security", "Smart home security"
University of Applied Sciences Karlsruhe	MSc	Informatics	Fields of study: "Software Engineering" & "Interactive systems"=> module "Secure systems"
University of Applied Sciences Karlsruhe	MSc	Business Informatics	Module "Information security"
Cooperative State University Baden-Wuerttemberg	MSc	Informatics	Field of study: "IT Service Management" => Optional module: "IT Security"

6.2 Undergraduate Level

Institution Name	Degree Code	Degree Name	Direction and/or Courses
Karlsruhe Institute of Technology	BSc	Informatics	Optional modules "Security", "IT security management for networked systems", "Network security: architectures and

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			protocols”
Karlsruhe Institute of Technology	BSc	Business Informatics	Optional modules “Security”, “IT security management for networked systems”
University of Applied Sciences Karlsruhe	BSc	Informatics	Optional module “IT security”
University of Applied Sciences Karlsruhe	BSc	Business Informatics	Module “IT security and operating systems”
Cooperative State University Baden-Wuerttemberg	BSc	Informatics	Field of study: “Information Technology” => module “Communication and network technology II” (lecture “IT security”); module “Technical informatics II” (lecture “Security of file systems”); optional module “Selected topics of IT security” Field of study: “Applied Informatics” => module “E-Business” (lecture “Security”); optional modules “CCNA security”, “Selected topics of IT security”

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7 Ireland

In the Cork region, the following institutions offers degrees/courses in the area of Cybersecurity.

7.1 Post Graduate Level

Institution Name	Degree Code	Degree Name	Direction and/or Courses
Cork Institute of Technology (CIT)	MSc and Post Graduate Diploma	Networking and Security	Theoretical and practical skills and knowledge in Networking and Security
University College Dublin (UCD)	MSc	Digital Investigation and Forensic Computing	Skills for the prevention and investigation of computer-related incidents
Dublin City University (DCU)	MSc	Security and Forensic Computing	Computer security and the practical investigation of computer crime
Letterkenny Institute of Technology	MSc	Systems and Software Computing	Focus is on Computer systems and software security

7.2 Undergraduate Level

Institution Name	Degree Code	Degree Name	Direction and/or Courses
Letterkenny Institute of Technology	BSc	Computing with Computing Security and Digital Forensics	Focus on Securing computing systems, detect intruders, track intruders, analyse and identify intruders and build evidence against them

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Waterford Institute of Technology	BSc (Hons)	Computer Forensics and Security	Focus is to secure, monitor and examine electronic crime scenes and digital environments
Blanchardstown Institute of Technology	BSc	Computing and Digital Forensics and Cyber Security	

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8 Spain

In the Catalonia region there are 8 Universities with studies related to ICT (Computer Science, Informatics, Computer Engineering, etc.) and some of them also offer concrete studies on Cybersecurity:

- University Ramon Llull
- Politechnical University of Catalonia
- University Autonoma of Barcelona
- University Rovira and VIrgili
- Open University of Catalonia

8.1 Post Graduate Level

Institution Name	Degree Code	Degree Name	Direction and/or Courses
LaSalle. Universitat Ramon Llull	MSc	Master on Cybersecurity	It is oriented to Cybersecurity, with internship in companies
UOC/UAB/URiV	MSc	Security in ICT	It covers cybersecurity, management of security and computing It is performed by 3 Universities
UPC	MSc	Cybersecurity management	Includes the following certification: CISA (Certified Information Systems Auditor) and CSX (Cybersecurity Nexus)
URiV	MSc	Security on Informatics and Intelligent Services	

8.2 Undergraduate Level

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Institution Name	Degree Code	Degree Name	Direction and/or Courses
UB	Bsc	Informatics Engineering	Some optional subjects related to security
UPF	Bsc	Informatics Engineering	Security in networks and services

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9 UK

In the Northern Ireland region, the following institutions offers degrees/courses in the area of Cybersecurity.

9.1 Post Graduate Level

Institution Name	Degree Code	Degree Name	Direction and/or Courses
Queen's University Belfast	MSc	Cyber Security	To develop the next generation of industry leaders and address the shortage of cyber security professionals globally. The emphasis of the MSc is to provide graduates with a comprehensive understanding of the cyber security challenges facing industry and society, today and in the future, and equipping them with the skills necessary to address those challenges. Focus: • Applied Cryptography • Computer Forensics • Ethical and Legal Issues in Cyber Security • Intelligent Information

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			Systems • Malware • Media Security • Network Security and Monitoring • Software Assurance
The Open University	MSc and Post Graduate Diploma	Computing	Includes modules in Information Security and Digital Forensics.
The Open University	MSc and Post Graduate Diploma	Advanced Networking	Includes module in Network Security

9.2 Undergraduate Level

Institution Name	Degree Code	Degree Name	Direction and/or Courses
Queen's University Belfast	MEng	Software and Electronic Systems Engineering	The first three years of this 4-year course are focused on general software and systems engineering topics. Year 4 focusses on additional topics including Applied Cryptography, Intelligent Systems, Media Security, Systems and Computer Security.
Belfast Metropolitan College	CompTIA	Network+	An internationally recognised certification that provides the skills for working in the areas of network installation, network

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			security and troubleshooting.

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