Project Title	Civil Cyber Range Platform for a novel approach to cybersecurity threats simulation and professional training
Project Acronym	CYBERWISER.EU
Project Number	786668
Type of instrument	Innovation Action
Topic	DS-07-2017 Cybersecurity PPP: Addressing Advanced Cyber Security Threats and Threat Actors
Starting date of Project	01/09/2018
Duration of the project	30
Website	www.cyberwiser.eu

D4.4 Training Material, Final Version

Work Package	WP4 Training material, scenarios and evaluation
Lead author	Gencer Erdogan (SINTEF)
Contributors	Simeon Tverdal (SINTEF), Åsmund Hugo (SINTEF), Aida Omerovic (SINTEF), Ketil Stølen (SINTEF), Dario Varano (UNIPI), Gianluca Dini (UNIPI), Gigliola Vaglini (UNIPI), Pericle Perazzo (UNIPI), Ioannis Kechaoglou (RHEA), Consuelo Colabuono (RHEA), Anže Žitnik (XLAB), Antonio Álvarez (ATOS), Liliana Ribeiro (EDP), José Ferreira Lourenço (EDP), Niccolò Zazzeri (TRUST-IT), Cristina Mancarella (TRUST-IT)
Peer reviewers	Antonio Álvarez (ATOS), Valerio Vitangeli (FFSS)
Version	0.23
Due Date	29/05/2020
Submission Date	18/06/2020

Dissemination Level:

X	PU: Public
	CO: Confidential, only for members of the consortium (including the Commission)
	EU-RES. Classified Information: RESTREINT UE (Commission Decision 2005/444/EC)
	EU-CON. Classified Information: CONFIDENTIEL UE (Commission Decision 2005/444/EC)
	EU-SEC. Classified Information: SECRET UE (Commission Decision 2005/444/EC)

The work described in this document has been conducted within the CYBERWISER project. This project has received funding by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 786668.

Version History

Revision	Date	Editor	Comments
0.1	18/03/2020	Gencer Erdogan (SINTEF)	Initial version including sections and subsections as well as comments about the expected input.
0.2	19/03/2020	Gencer Erdogan (SINTEF)	Included templates for all courses and modules at Intermediate and Advanced offering levels in Sections 5.4 and 5.5.
0.3	27/04/2020	Gencer Erdogan (SINTEF)	Included courses/modules in Section 5.4.2.
0.4	29/04/2020	Gencer Erdogan (SINTEF)	Included courses/modules in Sections 5.4.4, 5.5.1, 5.5.2.
0.5	08/05/2020	Dario Varano (UNIPI)	Included courses/modules in Section 5.5.3.
0.6	11/05/2020	Simeon Tverdal (SINTEF)	Included courses/modules in Sections 5.4.1, 5.4.3, 5.4.5, 5.5.4, and 5.5.5.
0.7	13/05/2020	Ioannis Kechaoglou (RHEA)	Included courses/modules in Sections 5.4.1 and 5.4.3.
0.8	15/05/2020	Anže Žitnik (XLAB)	Included courses/modules in Section 5.4.3.
0.9	19/05/2020	Åsmund Hugo (SINTEF)	Included courses/modules in Section 5.4.3.
0.10	21/05/2020	Antonio Álvarez (ATOS)	Included courses/modules in Sections 5.4.2 and 5.5.5.
0.11	21/05/2020	José Ferreira Lourenço (EDP)	Included courses/modules in Section 5.5.3.
0.12	24/05/2020	Gencer Erdogan (SINTEF)	Update and consolidation of description of all modules and courses for Intermediate and Advanced offering level. Update of description of all courses and modules in terms of supporting training material, as well as restructuring of courses based on final list of courses.
0.13	25/05/2020	Ioannis Kechaoglou (RHEA)	Updates on intermediate course description tables in Sections 5.4.1 and 5.4.3.
0.14	25/05/2020	Gencer Erdogan (SINTEF)	Update and consolidation of Sections 1, 2, 3, 4, 6, and 7.
0.15	26/05/2020	Niccolò Zazzeri (TRUST-IT)	Update of Section 6.2.
0.16	26/05/2020	Anže Žitnik (XLAB)	Update of course and module description in Section 5.4.3.
0.17	27/05/2020	Gencer Erdogan (SINTEF)	Update of course and module descriptions in Sections 5.4 and 5.5. Final update of Section 1. Report ready for internal review.
0.18	28/05/2020	Antonio Álvarez (ATOS), Gencer Erdogan (SINTEF)	Internal review by ATOS. Updated the deliverable according to all comments and corrections.
0.19	29/05/2020	María Teresa García (ATOS), Gencer Erdogan (SINTEF)	Quality check performed. Report ready for submission.
0.20	01/06/2020	Valerio Vitangeli (FFSS)	Internal review by FFSS.
0.21	04/06/2020	Gencer Erdogan (SINTEF)	Included figures illustrating predefined training paths in Sections 5.2, 5.3, 5.4, and 5.5.

Revision	Date	Editor	Comments
0.22	15.06.2020	Antonio Álvarez (ATOS), Simeon Tverdal (SINTEF), Gencer Erdogan (SINTEF)	Correction of some of the course names in Section 5.5.
0.23	18.06.2020	María Teresa García (ATOS), Gencer Erdogan (SINTEF)	Quality check performed. Deliverable ready for submission.

List of Contributors

The list of contributors to this deliverable are presented in the following table:

Section	Author(s)
1 Introduction	Gencer Erdogan (SINTEF), Aida Omerovic (SINTEF), Åsmund Hugo (SINTEF), Ketil Stølen (SINTEF)
2 Method for the development of curriculum, courses, and training material	Gencer Erdogan (SINTEF), Aida Omerovic (SINTEF), Åsmund Hugo (SINTEF), Dario Varano (UNIPI)
3 Target-user cybersecurity roles and skills selected for CYBERWISER.eu	Gencer Erdogan (SINTEF), Åsmund Hugo (SINTEF), Dario Varano (UNIPI), Gianluca Dini (UNIPI), Niccolò Zazzeri (TRUST-IT), Ioannis Kechaoglou (RHEA), Consuelo Colabuono (RHEA), José Ferreira Lourenço (EDP)
4 The overall learning path of CYBERWISER.eu	Gencer Erdogan (SINTEF), Aida Omerovic (SINTEF), Åsmund Hugo (SINTEF), Niccolò Zazzeri (TRUST-IT), Cristina Mancarella (TRUST-IT), Ioannis Kechaoglou (RHEA), Consuelo Colabuono (RHEA), Liliana Ribeiro (EDP)
5 Courses offered by CYBERWISER.eu	Gencer Erdogan (SINTEF), Simeon Tverdal (SINTEF), Åsmund Hugo (SINTEF), Aida Omerovic (SINTEF), Ketil Stølen (SINTEF), Dario Varano (UNIPI), Gianluca Dini (UNIPI), Gigliola Vaglini (UNIPI), Niccolò Zazzeri (TRUST-IT), Cristina Mancarella (TRUST-IT), Ioannis Kechaoglou (RHEA), Consuelo Colabuono (RHEA), Anže Žitnik (XLAB), Antonio Álvarez (ATOS), Liliana Ribeiro (EDP), José Ferreira Lourenço (EDP)
6 Accessing and editing training material in the platform	Niccolò Zazzeri (TRUST-IT), Cristina Mancarella (TRUST-IT), Gencer Erdogan (SINTEF), Aida Omerovic (SINTEF), Åsmund Hugo (SINTEF)
7 Conclusions	Gencer Erdogan (SINTEF), Aida Omerovic (SINTEF), Ketil Stølen (SINTEF), Åsmund Hugo (SINTEF), Niccolò Zazzeri (TRUST-IT), Cristina Mancarella (TRUST-IT)

Keywords

Training material, curriculum, courses, risk management, cybersecurity, awareness, security roles, security skills, risk-centric learning path, cyber range.

Disclaimer

This document contains information which is proprietary to the CYBERWISER.eu consortium. Neither this document nor the information contained herein shall be used, duplicated, or communicated by any means to any third party, in whole or parts, except with the prior written consent of the CYBERWISER.eu consortium.

Table of Contents

List of figures

List of tables

Executive Summary

This deliverable presents the final version of the training material provided in CYBERWISER.eu. This deliverable describes our systematic approach to develop the curriculum, courses including course templates, as well as the training material. The method consists of four main steps:

- Step 1: Identify target-user roles and skills to be trained via CYBERWISER.eu
- Step 2: Map the roles and their expected skills to the learning path of CYBERWISER.eu
- Step 3: Describe courses using predefined templates
- Step 4: Develop training material for the courses

In Step 1, we identify the target-user cybersecurity roles relevant to CYBERWISER.eu and describe the skills required by the roles as well as the expected skill level for each skill. In Step 2, we describe the learning path of CYBERWISER.eu and map the cybersecurity roles identified in Step 1 to the learning path. In Step 3, we describe courses offered by CYBERWISER.eu in line with the learning path and considering the roles and skills addressed in the learning path. The courses are described using predefined course templates. Finally, having identified and described a set of courses in Step 3, next we develop training material for the courses in Step 4.

The learning path consists of four main parts:

- Cybersecurity and risk awareness
- Context establishment
- Cyber-risk assessment
- Cyber-risk treatment and cost/benefit analysis

The learning path is carefully constructed to be in line with ISO 27001 [9] and ISO 27005 [10], which are security standards known globally and used both in industry and academia.

As a result of applying the above method, we have developed in total seven courses for the Primer offering level, five courses for the Basic offering level, five courses for the Intermediate offering level, and five courses for the Advanced offering level. Some of the courses are divided in two or more modules. In total there are 24 modules. This deliverable describes the complete set of courses in CYBERWISER.eu. Table 1 gives an overview of these courses. Each course has training material in terms of PowerPoint presentations, supporting literature including references to external sources and for further reading (compendium), audio support, and questionnaires (exam quizzes). The courses are primarily developed for self-study and collaborative training via training exercises provided in the cyber range. However, the training material of the courses act also as a basis for lecturers to prepare traditional classroom courses.

Course ID	Course name	Offering level	Overall learning path
P-01	Introduction to cyber-risk analysis and cybersecurity	Primer	Cybersecurity and cyber-risk awareness
P-02	Awareness of Phishing	Primer	Cybersecurity and cyber-risk awareness
P-03	Awareness of Password Weaknesses	Primer	Cybersecurity and cyber-risk awareness
P-04	Awareness of Ransomware	Primer	Cybersecurity and cyber-risk awareness
P-05	Awareness of Data Leakage	Primer	Cybersecurity and cyber-risk awareness
P-06	Awareness of Insider Threat	Primer	Cybersecurity and cyber-risk awareness

Course ID	Course name	Offering level	Overall learning path
P-07	Introduction to cyber-risk assessment	Primer	Cybersecurity and cyber-risk awareness
B-01	Describe target of analysis, level 1	Basic	Context establishment
B-02	Identify and describe security assets, level 1	Basic	Context establishment
B-03	Identify and describe threat profiles and high-level risks, level 1	Basic	Context establishment
B-04	Identify risks, level 1	Basic	Cyber-risk assessment
B-05	Awareness of Password Weakness with hands-on training	Basic	Cybersecurity and cyber-risk awareness
I-01	Describe target of analysis, level 2	Intermediate	Context establishment
I-02	Identify risk criteria	Intermediate	Context establishment, Cyber-risk assessment
I-03	Identify risks, level 2	Intermediate	Cyber-risk assessment
I-04	Estimate risks	Intermediate	Cyber-risk assessment
I-05	Treat risks, level 1	Intermediate	Cyber-risk treatment and cost/benefit analysis
A-01	Identify and describe security assets, level 2	Advanced	Context establishment
A-02	Identify and describe threat profiles and high-level risks, level 2	Advanced	Context establishment
A-03	Identify risks, level 3	Advanced	Cyber-risk assessment, Cyber-risk treatment and cost/benefit analysis
A-04	Evaluate risks	Advanced	Cyber-risk assessment
A-05	Treat risks, level 2	Advanced	Cyber-risk treatment and cost/benefit analysis

Table 1. Table of course names

Finally, the deliverable outlines how the training material should be accessed by course participants and edited by course organizers (teachers) within the CYBERWISER.eu Platform.

The contents of this deliverable, in particular the course descriptions, will act as input to the rest of work package 4, particularly Task 4.2 (cyber-training scenarios and scenario development method), which will develop scenarios to support the training of the security roles and skills considered. The deliverable is also related to WP5 in the sense that we have mainly considered the requests of the pilots when we shaped the awareness courses as well as the risk assessment courses including exercises on the cyber range. Thus, the awareness courses and hands-on risk assessment courses are shaped to accommodate the needs of the pilots. The deliverable is also related to the work carried out in WP6 in terms of the various offering levels. That is, the courses have been shaped with respect to the learning path, but also considering the technical aspects available in each offering level of CYBERWISER.eu. This has helped in shaping business and sustainability models in WP6. Finally, the deliverable is related to WP2 in the sense that the training material developed in Task 4.1 has helped the shaping of relevant risk-model templates (patterns) in Task 2.3 (model adaptation and development).

1. Introduction

This section describes the purpose of this deliverable, provides the structure of the document, and relates the work reported in this deliverable to other work in the project.

1.1 Purpose

The purpose of this deliverable is to document the final version of the training material to be provided in CYBERWISER.eu. This includes identifying target-user roles and skills to be trained via CYBERWISER.eu, describing the learning path of CYBERWISER.eu and mapping the roles and skills to the learning path, describing relevant courses using predefined course templates, and developing training material in terms of PowerPoint slides, supporting literature (compendium) including references to external sources, audio support for the PowerPoint slides, and questionnaires testing the participants (exam quizzes). We carry out these activities systematically following a four-step method described in Section 2. The learning material is made available to participants via the cross-learning facilities of CYBERWISER.eu.

With respect to the learning path, CYBERWISER.eu facilitates a risk-centric approach. By risk-centric, we mean that cyber-risk related activities are used as means to train the participants within cybersecurity. Moreover, the learning path also includes an awareness part with the aim of raising awareness on cybersecurity as well as introduce more complex concepts that will be further considered in the advanced offering levels of CYBERWISER.eu.

In relation to the offering levels, this deliverable provides courses and supporting training material for all offering levels of CYBERWISER.eu, namely the Primer, Basic, Intermediate and Advanced offering levels. Note that offering levels represent different delivery modes of the CYBERWISER.eu platform containing different level of capabilities as documented in Deliverable D6.4 [22]. Primer is the first offering level and will be accessible free of charge from the CYBERWISER.eu website. Primer will offer basic functionalities with the aim of raising awareness and introduce cybersecurity and cyber-risk assessment and related concepts. The Basic offering level is targeting users that are familiar with the basics cybersecurity and are interested in testing and improving their skills on a more practical level (basic risk modelling and hands-on training in the cyber range). The Intermediate and Advanced offering levels provide the full capabilities of the CYBERWISER.eu platform and target participants who aim at undertaking complex risk assessments, including threat modelling, cyber-risk identification, estimation, and evaluation, as well as the selection of countermeasures based on cost/benefit analysis. The reader is referred to D6.4 [22] for further information about the various offering levels of CYBERWISER.eu.

This deliverable describes all courses provided by CYBERWISER.eu: seven courses for the Primer offering level, five courses for the Basic offering level, five courses for the Intermediate offering level, and five courses for the Advanced offering level. Five of the seven courses in the Primer level focus on awareness on five common cybersecurity risks, while the remaining two introduce cyber-risk analysis, cyber-risk assessment and cybersecurity. The courses for the Basic level focus on various aspects on context establishment and cybersecurity-risk identification. The courses for the Intermediate and Advanced levels focus on advanced aspects of cyber-risk assessment and cyber-risk treatment, as well as advanced training material such as hands-on complex cyber-range exercises (SQL injection, cross-site scripting, etc.). The training material are shaped according to the learning goals and objectives of the courses.

The courses are provided in the form of PowerPoint slide sets with supporting literature (compendium) including references to external sources, audio support for the slides and questionnaires testing the knowledge of the participants, and hands-on exercises on the cyber range. The training materials are made available via, and integrated in, the cross-learning facilities. The following documents, all of which are accompanied with this deliverable, represent one slide set each:

Accompanying slide set number	Document name
1	P-01-M-01 Conceptual clarification of cyber-risk analysis and cybersecurity. P-01-M-02 Overview of the overall cyber-risk analysis process.

Accompanying slide set number	Document name
2	P-02 Awareness of Phishing.
3	P-03 Awareness of Password Weaknesses.
4	P-04 Awareness of Ransomware.
5	P-05 Awareness of Data Leakage.
6	P-06 Awareness of Insider Threat.
7	P-07 Introduction to cyber-risk assessment.
8	B-01-M-01 Describe scope and focus of analysis, what is included and what is excluded? B-01-M-02 Model the target of analysis.
9	B-02 Identify and describe security assets, level 1.
10	B-03 Identify and describe threat profiles and high-level risks, level 1.
11	B-04-M-01 Example-driven introduction to CORAS. B-04-M-02 Identify risks using the CORAS risk modelling language with respect to simulated scenarios.
12	B-05 Awareness of password weaknesses with hands-on training.
13	I-01 Describe target of analysis, level 2.
14	I-02-M-01 Define likelihood scales. I-02-M-02 Define consequence scales for each information security asset. I-02-M-03 Define risk evaluation criteria and corresponding risk evaluation matrix. I-02-M-04 Cyber-risk reports on CYBERWISER.eu.
15	I-03-M-01 Identify risk indicators. I-03-M-02 Obtaining indicator values in CYBERWISER.eu. I-03-M-03 Cyber-risk models in support of cybersecurity training and evaluation.
16	I-04-M-01 Likelihood and consequence estimation. I-04-M-02 How to update risk assessment algorithms?
17	I-05 Treat risks, level 1.
18	A-01 Identify and describe security assets, level 2.
19	A-02 Identify and describe threat profiles and high-level risks, level 2.
20	A-03-M-01 SQL injection. A-03-M-02 Cross-site scripting. A-03-M-03 Session hijacking. A-03-M-04 Firewall attack and network filtering. A-03-M-05 Targeted malware. A-03-M-06 Broken access control. A-03-M-07 Phishing.
21	A-04 Evaluate risks.
22	A-05-M-01 Cost-benefit analysis in the context of cyber-risk assessment A-05-M-02 How to use countermeasures in CYBERWISER.eu – the Countermeasures Simulator

Table 2. Table of slide set numbers to document names

1.2 Structure of the document

Section 2 describes the steps we carried out to systematically develop the curriculum, courses, and training material. Section 3 describes the target-user cybersecurity roles and skills selected for CYBERWISER.eu. Section 4 explains in detail the overall cyber-risk centric learning path of CYBERWISER.eu, including cybersecurity and risk awareness, context establishment, cyber-risk assessment, and cyber-risk treatment and cost/benefit analysis. In addition, Section 4 relates the security roles and skills to the learning path, as well as the learning path to the offering levels in CYBERWISER.eu. Section 5 provides a description of all the courses that will be provided in the Primer, Basic, Intermediate, and Advanced offering levels. Section 6 provides a high-level explanation of how the courses and training material may be accessed and edited in the CYBERWISER.eu platform, the interactive and engagement features, as well as how the CYBERWISER.eu platform may contribute in developing soft skills. Finally, in Section 7, we conclude the deliverable by highlighting the main contributions of the deliverable and the next steps to be taken.

1.3 Relation to other work in the project

The contents of this deliverable, in particular the course descriptions, act as input to rest of work package 4, particularly Task 4.2 (cyber-training scenarios and scenario development method), which will develop scenarios to support the training.

The deliverable is also related to WP5 in the sense that we have mainly considered the requests of the pilots when we shaped the awareness courses as well as the cyber-risk assessment courses including exercises on the cyber range. Thus, the awareness courses and hands-on risk assessment courses are shaped to accommodate the needs of the pilots.

As indicated in the above sub-sections, the deliverable is also related to the work carried out in WP6 in terms of the various offering levels. That is, the courses have been shaped with respect to the learning path considering the relevant roles and skills selected, but also considering the technical aspects available in each offering level of CYBERWISER.eu. Moreover, the courses provided in each offering level is a basis for the business model and commercialization strategy developed in WP6.

Finally, the deliverable is related to WP2 in the sense that the training material developed in Task 4.1 has helped the shaping of relevant risk-model templates (patterns) in Task 2.3 (model adaptation and development).

1.4 Relation between D4.4 and D4.1

Section in 4.4	Section in D4.1	What is new?
1. Introduction	1. Introduction	Several updates in the section
1.1 Purpose	1.1 Purpose	The section has been updated
1.2 Structure of the document	1.2 Structure of the document	The section has been updated
1.3 Relation to other work in the project	1.3 Relation to other work in the project	The section has been updated
1.4 Relation between D4.4 and D4.1	-	The section has been slightly updated
1.5 Glossary of Acronyms	1.4 Glossary of Acronyms	Same as in D4.1
2. Method for the development of curriculum, courses, and training material	2. Method for the development of curriculum, courses, and training material	The section has been updated to be aligned with the new content in Section 5
2.1 Course and module templates	2.1 Course and module templates	Same as in D4.1
3. Target-user cybersecurity roles and skills selected for CYBERWISER.eu	3. Target-user cybersecurity roles and skills selected for CYBERWISER.eu	Minor grammatical corrections
3.1 CIISec skills framework	3.1 CIISec skills framework	Minor grammatical corrections
3.2 CIISec roles framework	3.2 CIISec roles framework	Minor grammatical corrections
3.3 Roles and skills selected for CYBERWISER.eu	3.3 Roles and skills selected for CYBERWISER.eu	Minor updates of content and grammatical corrections in Section 3.3.1
4. The overall learning path of CYBERWISER.eu	4. The overall learning path of CYBERWISER.eu	The section has been updated to be aligned with the new content in Section 5
4.1 Cyber-risk centric learning path	4.1 Cyber-risk centric learning path	The section has been updated
4.2 Cybersecurity and risk awareness	4.2 Cybersecurity and risk awareness	Same as in D4.1
4.3 Cyber-risk analysis	4.3 Cyber-risk analysis	The section has been updated to be aligned with the new content in Section 5. The role of courses specifically aimed at the CYBERWISER.eu platform is also discussed.
4.4 Relating the learning path to the offering levels in CYBERWISER.eu	4.4 Relating the learning path to the offering levels in CYBERWISER.eu	The section has been updated to be aligned with the new content in Section 5
5. Courses offered by CYBERWISER.eu	5. Courses for the primer and basic offering levels in CYBERWISER.eu	The section has been significantly updated
5.1 Overview of the courses	5.1 Overview of the courses	The section has been significantly updated
5.2 Courses for the primer offering level	5.2 Courses for the primer offering level	The section has been slightly updated

Section in 4.4	Section in D4.1	What is new?
5.3 Courses for the basic offering level	5.3 Courses for the basic offering level	The section has been slightly updated
5.4 Courses for the intermediate offering level	-	New section in D4.4
5.5 Courses for the advanced offering level	-	New section in D4.4
5.6 The usage environment of the courses	5.4 The usage environment of the courses	The section has been slightly updated
6. Accessing and editing training material in the platform	6. Accessing and editing training material in the platform	Same as in D4.1
6.1 Logging into the CYBERWISER.eu platform	6.1 Logging into the CYBERWISER.eu platform	Same as in D4.1
6.2 Accessing the courses – from a student (trainee) perspective	6.2 Accessing the courses – from a student (trainee) perspective	The section has been updated (text and new Figure 15)
6.3 Editing the courses – from a teacher (trainer) perspective	6.3 Editing the courses – from a teacher (trainer) perspective	Same as in D4.1
6.4 Interactive and engagement features	6.4 Interactive and engagement features	Same as in D4.1
6.5 Developing soft skills using the CYBERWISER.eu platform	6.5 Developing soft skills using the CYBERWISER.eu platform	The section has been slightly updated
7. Conclusion	7. Conclusion	The section has been updated

Table 3. Relation between D4.4 and D4.1

1.5 Glossary of Acronyms

Acronym	Description
CIISec	Chartered Institute of Information Security
CISO	Chief Information Security Officer
CISSP	Certified Information System Security Professionals
CORAS	A Model-Driven Method for Conducting Security Risk Analysis
CREST	CREST is an international not-for-profit accreditation and certification body that represents and supports the technical information security market.
ECSO	European Cybersecurity Organization
ENISA	European Union Agency for Cybersecurity
GDPR	The General Data Protection Regulation 2016/679
GIAC	Global Information Assurance Certification
ISO	International Organization for Standardization
MITRE	The MITRE Corporation
OWASP	The Open Web Application Security Project
R	R is a free software environment for statistical computing and graphics.
SANS	The SANS Institute is a private U.S. for-profit company founded in 1989 that specializes in information security, cybersecurity training and selling certificates.

Acronym	Description
SCORM	Sharable Content Object Reference Model. SCORM defines a specific way of constructing Learning Management Systems (LMSs) and training content so that they work well with other SCORM conformant systems. SCORM provides the communication method and data models that allow eLearning content and LMSs to work together. It tells programmers how to write code so that what they build will "play well" with other eLearning software. SCORM is the most widely used eLearning standard available [36].
UML	Unified Modelling Language
WISER	Wide-Impact cyber SEcurity Risk framework
WP	Work Package

Table 4. Table of acronyms

2. Method for the development of curriculum, courses, and training material

This section describes the steps we carried out to systematically develop the curriculum, courses, and training material. As illustrated in Figure 1, our method consists of four main steps. In Step 1, we identify the target-user cybersecurity roles relevant to CYBERWISER.eu and describe the skills required by the roles as well as the expected level of advancement for each skill. The identified roles and skills are described in detail in Section 3.

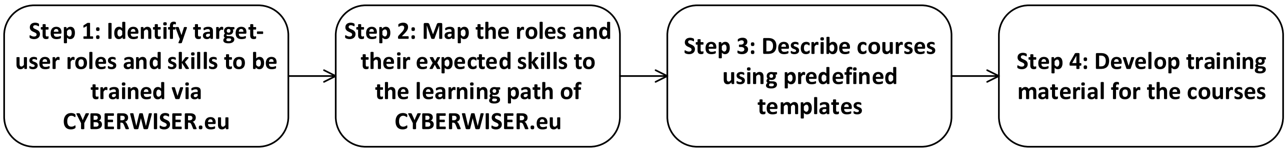

Step 1: Identify target-user roles and skills to be trained via CYBERWISER.eu
Step 2: Map the roles and their expected skills to the learning path of CYBERWISER.eu
Step 3: Describe courses using predefined templates
Step 4: Develop training material for the courses

Figure 1. Method for systematically developing the curriculum, courses, and training material

In Step 2, we describe the learning path of CYBERWISER.eu and map the cybersecurity roles identified in Step 1 to the learning path. The learning path of CYBERWISER.eu is mainly defined to support the expected outcomes of the project. Some of the main outcomes of CYBERWISER.eu are the following:

- Training materials for creation of cyber-risk models for cyber-risk assessment, as well as training materials for the identification and suggestion of countermeasures for the identified cyber-risks.
- Simulation of a variety of attacks and countermeasures concerning the digital assets characterized in the scenario object of the training.
- A set of innovative and highly descriptive economic risk models for cyber-risk assessment and countermeasure suggestion, to boost user training and performance evaluation.
- Pedagogic presentation of the cyber-risk assessment method inspired by the WISER project [35] supported by extensive examples and guidelines.

Thus, the CYBERWISER.eu approach consists of cyber-risk assessment activities including the establishment and understanding of the target of analysis, as well as the consideration of cyber-risk treatments (countermeasures). This means that CYBERWISER.eu facilitates a cyber-risk centric approach and we will therefore structure a cyber-risk centric learning path. By cyber-risk centric learning path, we mean that cyber-risk related activities are used as means to train the participants within cybersecurity. The learning path is described in detail in Section 4.

In Step 3, we describe courses offered by CYBERWISER.eu in line with the learning path and considering the roles and skills associated to the learning path. The courses are described using course templates that are presented in Section 2.1. The courses are defined first and foremost to be in line with the learning path of CYBERWISER.eu including relevant roles and skills. However, we also relate the learning path to the four offering levels (Primer, Basic, Intermediate and Advanced) of CYBERWISER.eu as well as the technical capabilities available in each offering level. In addition, we also considered for each course the difficulty level and the estimated time needed as shown in the templates in Section 2.1. All courses provided in CYBERWISER.eu are documented in Section 5.

Finally, having identified and described a set of courses in Step 3, next we develop training material for the courses in Step 4. The training material was developed with respect to the learning goals and learning objectives defined for each course also considering the cybersecurity roles and skills. This procedure is recommended by standard course design guidelines, such as the Bloom's Taxonomy [15], [16], which is also the framework we used to define learning goals and objectives. In this deliverable, we provide the learning material in terms of PowerPoint slides, supporting literature (compendium) including references to external sources, audio support for the PowerPoint slides, and questionnaires testing the participants (exam quizzes). A series of additional training material may be added considering the capabilities of Moodle. These can include, video tutorials on how to deploy a scenario, video tutorials on how to perform a simple exercise in the cyber range, webinars on security topics, use of game-based quizzes. Some examples of these features are reported in Section 6.4. The output of Step 4 is thus a set of training material for the courses offered in CYBERWISER.eu to educate and train the target-user cybersecurity roles.

2.1 Course and module templates

The development of the course template started with an intensive research of the existing institutes providing Cybersecurity courses. The identified institutes were: SANS, InfoSec, Offensive-Security and Kaspersky. The selection of one of the approaches provided by these institutes was done considering the following features: 1) popularity, i.e. how much the institute is spread and well-known; 2) whether they give a certification; and 3) range of topics covered. Based on this activity, the most appropriate framework to organize courses in CYBERWISER.eu is the approach provided by the SANS institute [17]. SANS is well-known for serving many military forces, along with more than 165.000 security professionals in more than 90 cities around the world. It provides certification in many fields like Cyber Defence, Penetration Testing, Management, Legal, Incident Response, Forensic and many others. The SANS institute was established in 1989 as a cooperative research and education organization. SANS is the most trusted and by far largest source for information security training and security certification in the world. The starting point for the development of the course template was the analysis of the framework employed by SANS for organizing courses. The SANS framework to organize a curriculum is shown in Figure 2.

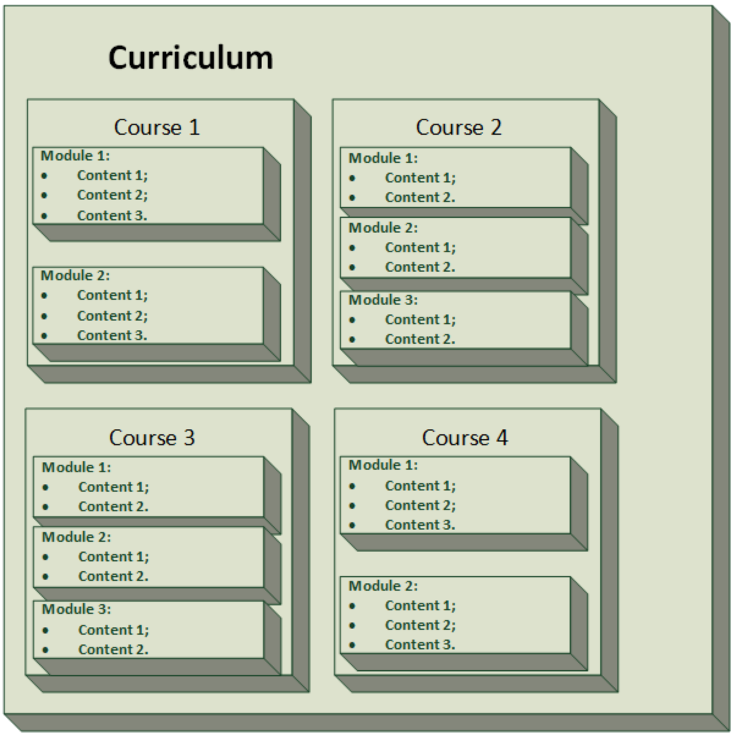


Figure 2. SANS Framework

By using the structure shown in Figure 2 as basis, we chose in CYBERWISER.eu to structure the courses in two main layers, namely *course* and *module*. A course contains a hierarchy of modules. A module may be a part of one or more courses. The idea behind this separation is to shape more complex courses using simpler modules, each of them bringing smaller contributions. The latter will facilitate trainees to increase their skills by progressing step by step in the learning path. The following sections present the templates for courses and modules. The course organization for the CYBERWISER.eu project is shown in Figure 3.

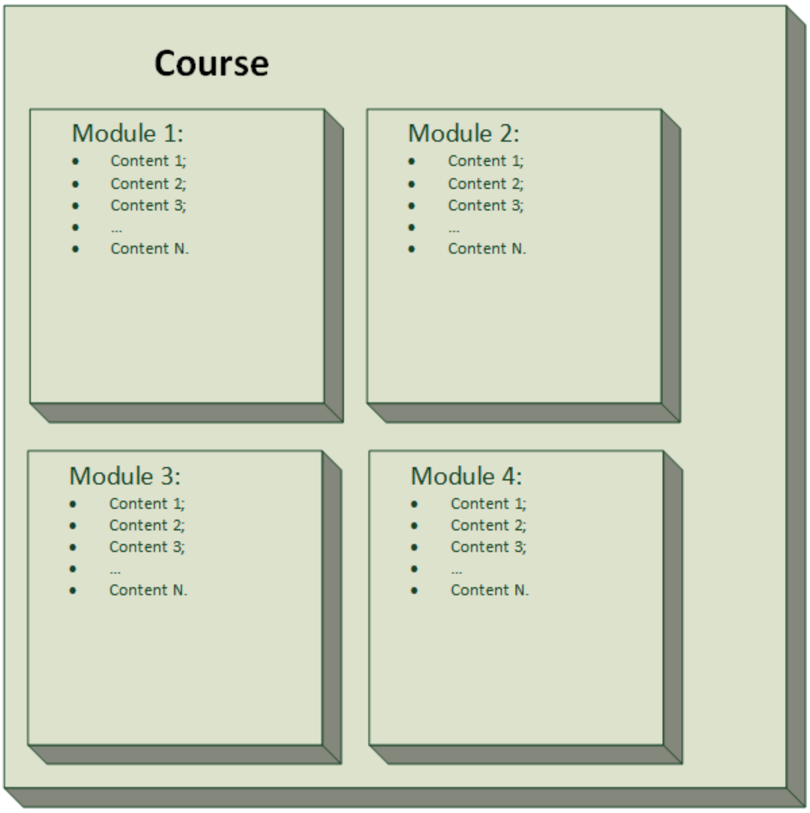


Figure 3. CYBERWISER.eu Framework

2.1.1 Course template

The course templates used to describe a course in CYBERWISER.eu is presented in Table 5. The description for each of the course feature presented in the template is embedded in the table. To complete a course, trainees need to complete all the modules related to it.

Course ID	Unique ID of the course
Name	Name of the course.
Cybersecurity role	The cybersecurity role relevant to the course. These roles are based on the roles described by the CIISec Roles Framework [23]. The roles are described in detail in Section 3.
Skill and expected skill level to be trained	The skill and the expected level of advancement of the skill for the abovementioned role. These skills are based on the skills described by the CIISec Skills Framework [24]. The skills are described in detail in Section 3.
Offering Level	The name of the CYBERWISER.eu offering level in which the course is provided. Possible options are {Primer, Basic, Intermediate, Advanced}.
Difficulty	Difficulty level of the course. Possible options are {Easy, Medium, Hard, Challenging}
Course Duration	Time needed to carry out the course in minutes. If the course contains several modules, then the duration of the course is the sum of the duration of the modules.
Learning Goals	Learning goals of the course, written using the Bloom's Taxonomy [15], [16] indicating the broad learning outcome trainees will acquire at the end of the course.
Learning Objectives	Measurable objectives written in the Bloom Taxonomy [15], [16].

Course ID	Unique ID of the course
Prerequisites	List of prerequisites for the trainee attending the course, they may be degree level or skills. (e.g. bachelor's degree or fulfil the following: Good knowledge of …)
Module list	List here all the modules related to this course. The modules should reveal the list of argument composing the course learning path: • Module 1 • Module 2 • … • Module N

Table 5. Course template

2.1.2 Module template

The structure for each single module is presented in Table 6. Modules are split in several contents. The latter can help trainees to have a more complete view of the purpose of a single module.

Module ID	Unique ID of the module
Name	Name of the module
Learning Objectives	Specify what the trainee will learn after completing the module dividing it into multiple, specific, and measurable objectives. These learning objectives can be considered as sub tasks of the course learning objectives.
Module Duration	Time needed to carry out the module in minutes.
Prerequisites	List of the module(s) that needs to be attended before this module. If no other modules are needed before this one, fill this field with "None"
Content list	List here all the contents related to this module. Contents will show a more granular division in the module's topic: • Content 1 • Content 2 • … • Content N

Table 6. Module template

3. Target-user cybersecurity roles and skills selected for CYBERWISER.eu

As explained in Section 2, the first step of our method to systematically develop the curriculum, courses, and training material for CYBERWISER.eu is to identify the target-user cybersecurity roles and skills to be trained via CYBERWISER.eu. There exist several cybersecurity communities that may provide guidelines to help identify and select cybersecurity roles and skills, such as MITRE [25], OWASP [26], CREST [27], CIISec [23], [24], SANS [17] and CISSP [28] to mention a few. For CYBERWISER.eu, we chose to use the CIISec Roles Framework and the CIISec Skills Framework. The rationales for this selection are:

- The CIISec Roles Framework and the CIISec Skills Framework are considering roles and skills that are well aligned with the risk-centric approach of CYBERWISER.eu. For example, the role Information Security Risk Officer and the associated skills Risk Assessment and Information Risk Management.
- Each role defined in the CIISec Roles Framework are associated to certain skills and expected skill level, which aligns well with the courses provided by CYBERWISER.eu in terms of course difficulty (level of advancement).
- The CIISec Skills Framework describes six skill levels {Knowledge (level 1), Knowledge and Understanding (level 2), Apply (level 3), Enable (level 4), Advice (level 5), Initiate, Enable and Ensure (level 6)}. These six levels align well with the six levels of advancement in learning skills provided by the Bloom's taxonomy [15], [16] {Remembering (level 1), Understanding (level 2), Applying (level 3), Analysing (level 4), Evaluating (level 5), Creating (level 6)}. As best practice, we use the action verbs provided by Bloom's taxonomy to help describe the learning goals and objectives of the courses in CYBERWISER.eu.
- The cyber-risk related roles and skills described in the CIISec framework support the risk-centric learning path of CYBERWISER.eu, which is in line with ISO 27005 [10] as described in Section 4.

In addition, the CIISec Roles and Skills frameworks are "developed through collaboration between both private and public sector organisations and world-renowned academics and security leaders" [24] and are therefore representative of the current landscape of cybersecurity roles and skills.

In the following sections, we first describe the CIISec Skills Framework, CIISec Roles Framework, and finally, the roles and skills selected from these frameworks for CYBERWISER.eu.

3.1 CIISec Skills Framework

According to the Chartered Institute of Information Security (CIISec), the CIISec Skills Framework describes the range of competencies expected of Information Security and Information Assurance Professionals in the effective performance of their roles. The framework may be used as a basis to assess the knowledge of certain security roles as well as to define skills expected of the security roles in practice.

The largest part of the framework is dedicated to describing a wide range of technical and domain specific skills and what is required for each skill-advancement level. The technical and domain specific skills may be grouped into the following topics:

- Information Security Governance and Management
- Threat Assessment and Information Risk Management
- Implementing Secure Systems
- Assurance: Audit, Compliance and Testing
- Operational Security Management
- Incident Management, Investigation and Digital Forensics
- Data Protection, Privacy, and Identity Management
- Business Resilience
- Information Security Research

However, the framework also points out the multi-disciplinary nature of security professionals and therefore includes a set of interpersonal and collegial skills needed to work effectively (Management, Leadership, Business and Communications) as well as skills required to support personal career development (Contributions to the Information Security Profession and Professional Development). Table 7 provides an overview of all skills addressed by the CIISec Skills Framework according to the abovementioned categories as provide by the framework [24].

Skill group	Skill
Information Security Governance and Management	A1 – Governance
	A2 – Policy and Standards
	A3 – Information Security Strategy
	A4 – Innovation and Business Improvement
	A5 – Behavioural Change
	A6 – Legal & Regulatory Environment and Compliance
	A7 – Third Party Management
Threat Assessment and Information Risk Management	B1 – Threat Intelligence, Assessment and Threat Modelling
	B2 – Risk Assessment
	B3 – Information Risk Management
Implementing Secure Systems	C1 – Enterprise Security Architecture
	C2 – Technical Security Architecture
	C3 – Secure Development
Assurance: Audit, Compliance and Testing	D1 – Internal and Statutory Audit
	D2 – Compliance Monitoring and Controls Testing
	D3 – Security Evaluation and Functionality Testing
	D4 – Penetration Testing and conducting Simulated Attack Exercises
Operational Security Management	E1 – Secure Operations Management
	E2 – Secure Operations and Service Delivery
Incident Management, Investigation and Digital Forensics	F1 – Intrusion Detection and Analysis
	F2 – Incident Management, Incident Investigation and Response
	F3 – Forensics
Data Protection, Privacy and Identity Management	G1 – Data Protection
	G2 – Privacy
	G3 – Identity and Access Management (IAM/IdM)
Business Resilience	H1 – Business Continuity and Disaster Recovery Planning
	H2 – Business Continuity and Disaster Recovery Management
	H3 – Cyber Resilience
Information Security Research	I1 – Research
	I2 – Applied Research
Management, Leadership, Business and Communications	J1 – Management, Leadership and Influence
	J2 – Business Skills
	J3 – Communication and Knowledge Sharing
	K1 – Contributions to the Community

Skill group	Skill
Contributions to the Information Security Profession and Professional Development	K2 – Contributions to the IS Profession K3 – Professional Development

Table 7. CIISec skills

As mentioned above, the CIISec Skills Framework also provides a scale to indicate skill levels for each skill listed in Table 7. Figure 4 illustrates the six skill levels provided by the framework.

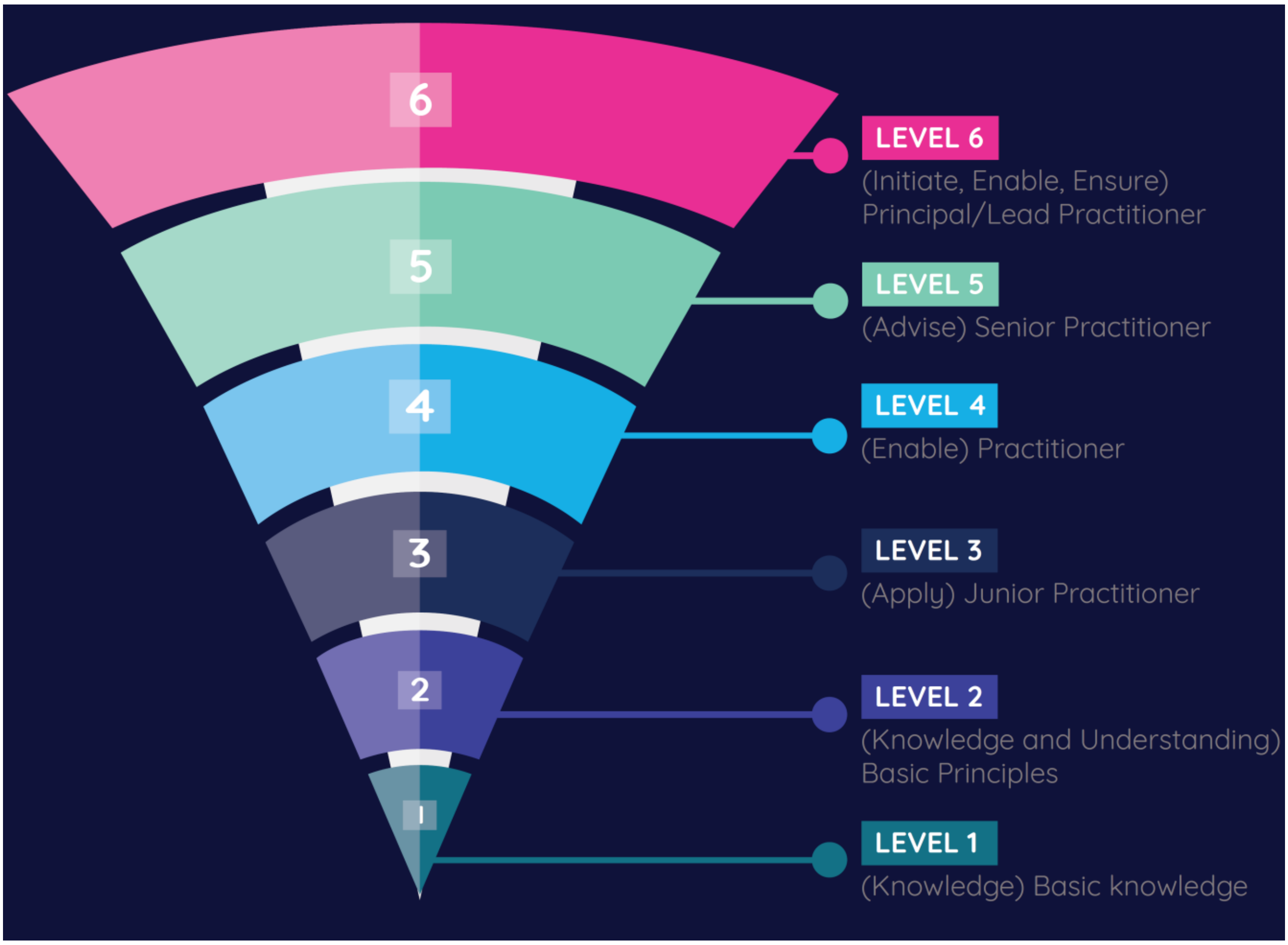

6
5
4
3
2
1
LEVEL 6
(Initiate, Enable, Ensure) Principal/Lead Practitioner
LEVEL 5
(Advise) Senior Practitioner
LEVEL 4
(Enable) Practitioner
LEVEL 3
(Apply) Junior Practitioner
LEVEL 2
(Knowledge and Understanding) Basic Principles
LEVEL 1
(Knowledge) Basic knowledge

Figure 4. CIISec Skills Framework skill levels (adopted from CIISec [24])

Table 8 described each skill level as given by the framework in terms of required knowledge and practical experience. These skill levels are used in the course descriptions of CYBERWISER.eu to reflect the skill level to be trained in the course. As CYBERWISER.eu mainly aims to educate and train people that are either new to the field or have certain experience, most of the courses offered by CYBERWISER.eu will target skill levels 1 to 4. However, courses that target skill levels 5-6 may also be later added. For example, courses aimed at Trainers to create new courses and exercises. Thus, in this respect, CYBERWISER.eu is flexible and may include courses both for beginners but also for advanced and experienced people.

Skill level	Knowledge	Practice
Level 1: (Knowledge) Basic knowledge of principles/follow good user practice.	Has acquired and can demonstrate basic knowledge associated with the skill, e.g. through training or self-tuition.	
Level 2: (Knowledge and Understanding) Knowledge and Understanding of basic principles. Understands the skill and its application.	Has acquired and can demonstrate the basic knowledge associated with the skill, for example has attended a training course or completed an academic module in the skill. Understands how the skill should be applied.	Can explain the principles of the skill and how it should be applied. This might include experience of applying the skill to basic tasks in a training or academic environment, for example through participation in syndicate exercises, undertaking practical exercises in using the skill, and/or passing a test or examination. Should be aware of recent developments in the skill.
Level 3: (Apply) Junior Practitioner. Understands the skill and applies it to basic tasks with some supervision.	Has acquired a good understanding of the knowledge associated with the skill and understands how the skill should be applied.	Has experience of applying the skill to a variety of basic tasks. Can work as an effective member of a team. Contributes ideas in the application of the skill. Demonstrates awareness of recent developments in the skill. Has experience of training potential and actual IS practitioners in the basics of the skill. Demonstrates awareness of recent developments in the skill.
Level 4: (Enable) Practitioner. Understands the skill and applies it to basic tasks with minimal supervision and to complex tasks with some supervision. Normally operates as a member of a team in a project/programme or system environment.	Has acquired a deep understanding of the knowledge associated with the skill. Understands how the skill should be applied.	Has experience of applying the skill to a variety of tasks, including some complex tasks under supervision. Contributes ideas in the application of the skill. Demonstrates awareness of recent developments in the skill. Contributes ideas for technical development and new areas for application of the skill. Has experience of training IS professionals in the skill above an introductory level. Demonstrates awareness of recent developments in the skill. Contributes ideas for technical development and new areas for application of the skill.
Level 5: (Advise) Senior Practitioner. Understands the skill and applies it to complex tasks with no supervision. Leads teams in a project/programme or system environment. Operates at a corporate level.	Has acquired a deep understanding of the knowledge associated with the skill. Understands how the skill should be applied across a number of projects in different client environments and/or within a large corporate organisation.	Has experience of applying the skill to a variety of complex tasks. Demonstrates significant personal responsibility or autonomy, with little need for escalation. Contributes ideas in the application of the skill. Demonstrates awareness of recent developments in the skill. Contributes ideas for technical development and new areas for application of the skill and contributes to public discussion debate on the skill. Has effective leadership and management skills. Has experience of training Information Security professionals in the skill at an advanced level or as a university lecturer. Demonstrates awareness of recent developments in the skill. Contributes ideas for technical development and new areas for application of the skill.
Level 6: (Initiate, Enable, Ensure) Principal/Lead	As for level 5.	Has oversight responsibility for overall application of the skill across a range of

Skill level	Knowledge	Practice
Practitioner. An authority who leads implementation of the skill. Is an acknowledged expert by peers in the skill.		customers or within a large corporate organisation, often reporting at Board level. Recognised as a Subject Matter Expert within a large organisation. Has experience of applying the skill in circumstances without precedence. Proposes, conducts, and/or leads innovative work to enhance the skill. Is approached to provide keynote presentations or papers on the skill. Develops and leads programmes of advanced training in the skill. A Professor or Senior Lecturer contributing sessions on the skill at MSc level.

Table 8. CIISec skill levels described

3.2 CIISec Roles Framework

The CIISec Roles Framework by the Chartered Institute of Information Security [23] provides a list of security roles and associates these roles to certain skills and expected skill levels (described in Section 3.1). The framework is mainly intended for organizations when they are looking to recruit into a role. However, in CYBERWISER.eu we use these roles in combination with the skills described in Section 3.1 to systematically identify the target users as well as to shape the curriculum of CYBERWISER.eu.

It is acknowledged by the framework that while the roles described in the framework may correspond to representative security roles currently considered in the industry, there may be variations in terms of what is expected from the roles. Each role will differ according to the organisation, sector, and size of the organisation. These variations will therefore impact on the types of skills required. For example, an Information Security Risk Manager may have more specific responsibilities in a large organization, while the same role in a smaller organization may have a wider range of responsibilities. Moreover, the framework points out that there is no exact description of a role because of all the possible variations of an organization and that the suggested list of roles and their descriptions are based on a more general view. In addition to role descriptions, association to skills and skill levels, the framework relates also roles to certain "responsibilities" (Identify, Protect, Detect, Respond, Recover) based on the NIST Framework for Improving Critical Infrastructure Cybersecurity [29]. The following are the roles described by the CIISec Roles Framework:

- Chief Information Security Officer (CISO)
- Head of Cyber/Information Security
- Information Security Risk Manager
- Information Security Risk Officer
- System Security Manager
- ComSec Manager
- Senior Security Architect
- Technical Security Architect
- Pen tester
- Threat Analyst
- Vulnerability analyst

Before describing these roles in detail (as provided by the framework), we first select the skills relevant for CYBERWISER.eu and then describe the roles relevant for CYBERWISER.eu. This process is carried out and documented in Section 3.3.

3.3 Roles and skills selected for CYBERWISER.eu

In the following Sections 3.3.1 – 3.3.4, we describe the skills selected for CYBERWISER.eu, while in Sections 3.3.5 – 3.3.10, we describe the roles selected for CYBERWISER.eu.

3.3.1 Overview of selected skills

As explained in Section 3.1, there is a large variety of security-specific skills identified by the CIISec Skills Framework. It is not the goal of CYBERWISER.eu to cover all skills listed in Section 3.1. The skills that are most relevant for the successful fulfilment of the objectives of CYBERWISER.eu are those that align with the risk-centric approach of CYBERWISER.eu. Taking this into consideration, we select to focus on the skills related to Threat Assessment and Information Risk Management:

- B1 – Threat Intelligence, Assessment and Threat Modelling
- B2 – Risk Assessment
- B3 – Information Risk Management

According to Task T4.3 of the CYBERWISER.eu Grant Agreement [33], "*the strong focus on training in the CYBERWISER.eu project implies that we need a proper baseline for performance evaluation. We therefore need clear criteria for evaluating the real-time response of students during cyber-range exercises, as well as the degree to which risk models and algorithms selected and/or developed by the students reflect the cyber-risk posture of the (simulated) target system and provide support for real-time response. This task will establish such criteria, emphasising aspects such as relevance, coverage, correctness, and response preparedness support.*" The resulting evaluation criteria documented in Deliverable D4.2 [37](Real-time performance and evaluation criteria) are therefore oriented towards technical skills. The courses developed in T4.1 reported in this document have a technical orientation to accommodate these evaluation criteria. Thus, CYBERWISER.eu in general focus mainly on technical skills. The explicit training of soft skills (courses teaching about e.g. communication) is outside the scope of CYBERWISER.eu. However, to support a holistic approach to cybersecurity training, we do address the participants' development of soft skills as a result of participating CYBERWISER.eu courses. The relevant soft skills are addressed in context of the cross-learning facilities of CYBERWISER.eu described in Section 6.

In the following, we describe the abovementioned technical skills according to their description in the CIISec Skills Framework [24] for completeness. The reader is referred to the CIISec Skills Framework [24] for further details on the remaining skills listed in Section 3.1.

3.3.2 Description of skill Threat Intelligence, Assessment and Threat Modelling

Table 9 describes the skill Threat Intelligence, Assessment and Threat Modelling as provided by the CIISec Skills Framework [24]. As pointed out by the CIISec Skills Framework, the principles and example skills described in the following table are meant to be used as high-level guidelines and not as "blueprint". Not all security roles require detailed experience in all competency areas as this may vary depending on the organisation, sector, and size of the organisation.

Skill	Principles	Example Skills
B1 – Threat Intelligence, Assessment and Threat Modelling	Assesses and validates information from several sources on current and potential Cyber and Information Security threats to the business, analysing trends, and highlighting Information Security issues relevant to the organisation, including Security Analytics for Big Data. Processes, collates, and exploits data, taking into account its relevance and reliability to develop and maintain "situational awareness". Predicts and prioritises threats to an organisation and their methods of attack. Analyses the significance and implication of processed intelligence to identify significant trends, potential threat agents and their capabilities. Predicts and prioritises threats to an organisation and their methods of attack. Uses human factor analysis in the assessment of threats. Uses threat intelligence to develop attack trees. Prepares and disseminates intelligence reports providing threat indicators and warnings.	**Level 1**: Can describe the principles of threat intelligence, modelling, and assessment.
		Level 2: Can explain the principles of threat intelligence, modelling, and assessment. This might include experience of applying threat intelligence, modelling, and assessment principles in a training or academic environment, for example through participation in syndicate exercises, undertaking practical exercises, and/or passing a test or examination.
		Level 3: Undertakes/assesses routine threat intelligence/modelling tasks or threat assessments under supervision. Appropriate and relevant certifications include CREST Practitioner Threat Intelligence Analyst, SANS GIAC Cyber Threat Intelligence.
		Level 4: Undertakes routine threat intelligence/modelling tasks or threat assessments without close supervision. Undertakes complex threat intelligence tasks or threat assessments under supervision. Appropriate and relevant certifications include CREST Registered Threat Intelligence Analyst.
		Level 5: Undertakes complex threat intelligence/modelling tasks or threat assessments without supervision. Manages threat intelligence/assessment teams. Appropriate and relevant certifications include CREST Certified Threat Intelligence Manager.
		Level 6: Leads corporate threat intelligence processes, reporting to the Board.

Table 9. Description of skill Threat Intelligence, Assessment and Threat Modelling

3.3.3 Description of skill Risk Assessment

Table 10 describes the skill Risk Assessment as provided by the CIISec Skills Framework [24]. As pointed out by the CIISec Skills Framework, the principles and example skills described in the following table are meant to be used as high-level guidelines and not as "blueprint". Not all security roles require detailed experience in all competency areas as this may vary depending on the organisation, sector, and size of the organisation.

Skill	Principles	Example Skills
B2 – Risk Assessment	Identifies and assesses information assets; uses this information and relevant threat assessments, business impacts, business benefits and costs to conduct risk assessments and identify and assess potential vulnerabilities.	**Level 1**: Can describe the concepts and principles of risk assessment.
		Level 2: Can explain the principles of risk assessment. This might include experience of applying risk assessment principles in a training or academic environment, for example through participation in syndicate exercises, undertaking practical exercises, and/or passing a test or examination.
		Level 3: Undertakes basic risk assessments with some supervision.
		Level 4: Undertakes complex risk assessments with supervision, either as an individual or a member of a team.
		Level 5: Leads complex risk assessments, interfacing routinely with senior management.
		Level 6: A recognised authority on risk assessment within a major organisation or across a range of clients or within an industry sector.

Table 10. Description of skill Risk Assessment

3.3.4 Description of skill Information Risk Management

Table 11 describes the skill Information Risk Management as provided by the CIISec Skills Framework [24]. As pointed out by the CIISec Skills Framework, the principles and example skills described in the following table are meant to be used as high-level guidelines and not as "blueprint". Not all security roles require detailed experience in all competency areas as this may vary depending on the organisation, sector, and size of the organisation.

Skill	Principles	Example Skills
B3 – Information Risk Management	Develops Cyber and Information Security risk management strategies and controls, taking into account business needs and risk assessments, and balancing technical, physical, procedural and personnel controls.	**Level 1**: Can describe the concepts and principles of Information Security risk management.
		Level 2: Can explain the principles of information risk management. This might include experience of applying risk management principles in a training or academic environment, for example through participation in syndicate exercises, undertaking practical exercises, and/or passing a test or examination.
		Level 3: Develops basic information risk management plans with some supervision.
		Level 4: Develops complex and innovative information risk management plans under supervision.
		Level 5: Develops complex and innovative information risk management plans either as an individual or leading a team.

Skill	Principles	Example Skills
		Level 6: A recognised authority on Cyber and Information risk management within a major organisation or across a range of clients.

Table 11. Description of skill Information Risk Management

3.3.5 Overview of selected roles

Based on the list of roles in Section 3.2, we select roles appropriate for CYBERWISER.eu. Each of these roles are assigned a set of *primary skills* and *secondary skills* (based on the CIISec Skills Framework described in Section 3.1). To make the selection of roles more focused and appropriate for CYBERWISER.eu, we considered two selection criteria:

- We select roles considering only their primary skills relevant for CYBERWISER.eu.
- We select roles that require skills necessary for the cyber-risk centric learning path of CYBERWISER.eu. That is, roles that require one or more of the skills B1, B2, or B3 described in Section 3.3.2, 3.3.3, and 3.3.4, respectively.

Based on these criteria, we selected the following roles:

- R1: Head of Information/Cyber Security
- R2: Information Security Risk Manager
- R3: Information Security Risk Officer
- R4: Threat Analyst
- R5: Vulnerability Assessment Analyst

In the following sections, we describe each of the above roles as provided by the CIISec Roles Framework [23] followed by a table summarizing the primary skill suggested by CIISec and that is also addressed by CYBERWISER.eu, as well as a suggested level for the skill.

3.3.6 Description of role Head of Information/Cyber Security

The post holder would typically be of senior management level with a high level of responsibility and accountability according to the agreed acceptable levels of risk assigned to that role (including legal and regulatory compliance obligations). This can include the management of several security function/elements. However, in smaller organisations the level and spread of knowledge, skills and experience may widen as fewer separate roles focussing on individual discipline areas may exist. This wider skill set would also be likely to be at a lesser skill level. May be a required regulatory role in some sectors [23].

The primary aim of a Head of Information/Cyber Security would be to enable the business to achieve its objectives in a safe and secure manner within an appropriate and proportionate set of controls, policies, and procedures. The level of proportionality would depend on the value to which certain assets are viewed within the organization and their appetite to exploit opportunities with a degree of acceptance of risk whilst being prepared to respond to any adverse consequences [23].

Table 12 summarizes the primary skills for the role Head of Information/Cyber Security suggested by CIISec and that is also addressed by CYBERWISER.eu, as well as suggested levels for the skills. Note that not all primary skills suggested by CIISec are included. The skills not included in the table are outside the scope of CYBERWISER.eu. The reader is referred to the CIISec Roles Framework for details on other skills for this role.

Role name	Primary skill suggested by CIISec (and addressed by CYBERWISER.eu)	Suggested skill level
R1: Head of Information/Cyber Security	B2 - Risk Assessment	Level 4: Undertakes complex risk assessments with supervision, either as an individual or a member of a team.

Role name	Primary skill suggested by CIISec (and addressed by CYBERWISER.eu)	Suggested skill level
	B3 - Information Risk Management	Level 5: Develops complex and innovative information risk management plans either as an individual or leading a team.

Table 12. Primary skill and skill level for the role Head of Information/Cyber Security

3.3.7 Description of role Information Security Risk Manager

The post holder would typically be of middle management level with a level of responsibility and accountability according to the agreed acceptable levels of risk assigned to that role (including legal and regulatory compliance obligations). Primarily focused on information security risk assessment and management within the organisation. However, in smaller organisations the level and spread of knowledge, skills and experience may widen as fewer separate roles focussing on individual discipline areas may exist. This wider skill set would also be likely to be at a lesser skill level. May be part a required regulatory role/function in some sectors [23].

Information Security Risk Managers are tasked to ensure that information security risks are identified and assessed, making appropriate recommendations. They would typically provide advice and guidance to stakeholders relating to the process and outcome of risk assessments. They may well support the organization’s information 'risk appetite' through their assessments and advice. They would identify mitigations to information security risk and likely to be involved in monitoring and assessing the effectiveness of such measures [23].

Table 13 summarizes the primary skills for the role Security Risk Manager suggested by CIISec and that is also addressed by CYBERWISER.eu, as well as suggested levels for the skills. Note that not all primary skills suggested by CIISec are included. The skills not included in the table are outside the scope of CYBERWISER.eu. The reader is referred to the CIISec Roles Framework for details on other skills for this role.

Role name	Primary skill suggested by CIISec (and addressed by CYBERWISER.eu)	Suggested skill level
R2: Information Security Risk Manager	B2 - Risk Assessment	Level 5: Leads complex risk assessments, interfacing routinely with senior management.
	B3 - Information Risk Management	Level 5: Develops complex and innovative information risk management plans either as an individual or leading a team.

Table 13. Primary skill and skill level for the role Information Security Risk Manager

3.3.8 Description of role Information Security Risk Officer

The post holder would typically be of junior management level with a level of responsibility and accountability according to the agreed acceptable levels of risk assigned to that role (including legal and regulatory compliance obligations). However, in smaller organisations the level and spread of knowledge, skills and experience may widen as fewer separate roles focussing on individual discipline areas may exist. This wider skill set would also be likely to be at a lesser skill level. They may support a required regulatory role in some sectors [23].

Information Security Risk Officers are tasked to ensure that information security risks are identified and assessed, making appropriate recommendations. They would typically provide advice and guidance to other areas of the business relating to the process and outcome of risk assessments. They may well support the organization’s information 'risk appetite' through their assessments and advice. They would identify mitigations to information security risks and likely to be involved in monitoring and assessing the effectiveness of such measures [23].

Table 14 summarizes the primary skills for the role Information Security Risk Officer suggested by CIISec and that is also addressed by CYBERWISER.eu, as well as suggested levels for the skills. Note that not all primary skills suggested by CIISec are included. The skills not included in the table are outside the scope of CYBERWISER.eu. The reader is referred to the CIISec Roles Framework for details on other skills for this role.

Role name	Primary skill suggested by CIISec (and addressed by CYBERWISER.eu)	Suggested skill level
R3: Information Security Risk Officer	B2 – Risk Assessment	Level 3: Undertakes basic risk assessments with some supervision.
	B3 - Information Risk Management	Level 3: Develops basic information risk management plans with some supervision.

Table 14. Primary skill and skill level for the role Information Security Risk Officer

3.3.9 Description of role Threat Analyst

The primary role of Threat Analysts is to analyse intelligence and open source information in order to identify, monitor, assess and counter generic and more specific threats posed by threat actors against an organisation or sector [23].

The primary aim of Threat Analysts would be to develop indicators to identify and maintain awareness of the operating environment which can often be a changing and evolving one. They would collect, process, analyse and disseminate threat assessments and indicators. They would be mapping threats against the threat assessment relative to their organisation or business sector [23].

Table 15 summarizes the primary skills for the role Threat Analyst suggested by CIISec and that is also addressed by CYBERWISER.eu, as well as suggested levels for the skills. Note that not all primary skills suggested by CIISec are included. The skills not included in the table are outside the scope of CYBERWISER.eu. The reader is referred to the CIISec Roles Framework for details on other skills for this role.

Role name	Primary skill suggested by CIISec (and addressed by CYBERWISER.eu)	Suggested skill level
R4: Threat Analyst	B1 - Threat Intelligence, Assessment and Threat Modelling	Level 2: Can explain the principles of threat intelligence, modelling, and assessment. This might include experience of applying threat intelligence, modelling, and assessment principles in a training or academic environment, for example through participation in syndicate exercises, undertaking practical exercises, and/or passing a test or examination.
		Level 3: Undertakes/assesses routine threat intelligence/modelling tasks or threat assessments under supervision. Appropriate and relevant certifications include CREST Practitioner Threat Intelligence Analyst, SANS GIAC Cyber Threat Intelligence.
		Level 4: Undertakes routine threat intelligence/modelling tasks or threat assessments without close supervision. Undertakes complex threat intelligence tasks or threat assessments under supervision. Appropriate and relevant certifications include CREST Registered Threat Intelligence Analyst.
		Level 5: Undertakes complex threat intelligence/modelling tasks or threat assessments without supervision. Manages threat intelligence/assessment teams. Appropriate and relevant certifications include CREST Certified Threat Intelligence Manager.

Table 15. Primary skill and skill level for the role Threat Analyst

3.3.10 Description of role Vulnerability Assessment Analyst

The post holder would typically be a skilled individual. They analyse and test infrastructures, systems, websites and apps are correctly implemented and offering the levels of protection intended. To provide additional assurance independent penetration testing may still be required, even by organisations that employ their own testing teams, as this may be a regulatory requirement. Identifying assessing and prioritizing threats vulnerabilities that have been identified in an organisations infrastructures systems, apps and websites [23].

The primary aim of Vulnerability Assessment Analysts would be to test perform assessments of systems, infrastructures, networks website and apps to identify where they deviate from acceptable configurations or where their version or patch levels are not meeting accepted configuration tolerances. They would also measure the effectiveness of systems against known vulnerabilities. Through identifying any weaknesses using known vulnerabilities and common configuration faults they would provide a report to the business on their findings. This report should be written to enable a clear understanding of any vulnerabilities found together with an assessment of the level of any attacker's skills required to exploit them. They should offer recommendations based on severity to enable the business to set a remediation plan and prioritization of any actions based on their business need and levels of accepted risk [23].

Table 16 summarizes the primary skill for the role Vulnerability Assessment Analyst suggested by CIISec and that is also addressed by CYBERWISER.eu, as well as suggested level for the skill. Note that not all primary skills suggested by CIISec are included. The skills not included in the table are outside the scope of CYBERWISER.eu. The reader is referred to the CIISec Roles Framework for details on other skills for this role.

Role name	Primary skill suggested by CIISec (and addressed by CYBERWISER.eu)	Suggested skill level
R5: Vulnerability Assessment Analyst	B1 - Threat Intelligence, Assessment and Threat Modelling	Level 3: Undertakes/assesses routine threat intelligence/modelling tasks or threat assessments under supervision. Appropriate and relevant certifications include CREST Practitioner Threat Intelligence Analyst, SANS GIAC Cyber Threat Intelligence.

Table 16. Primary skill and skill level for the role Vulnerability Assessment Analyst

4. The overall learning path of CYBERWISER.eu

From a competence and cybersecurity culture point of view, one of the main outcomes of CYBERWISER.eu is training materials to support the training of the selected skills and profiles described in Section 3. This includes training material for creating cyber-risk models for assessment and countermeasure suggestion to support the fulfilment of Objective 2 of CYBERWISER.eu. Objective 2 states [33]: "Development of innovative tools with complete training material for the provision of cybersecurity training scenarios and exercises, simulation of cyberattacks and defence mechanisms, exercise progress monitoring and measurement of user performance."

Moreover, from the capacity building environment point of view, one of the main outcomes is a set of innovative and highly descriptive economic risk models for cyber-risk assessment and countermeasure suggestion, to boost user training and performance evaluation. This outcome supports the fulfilment of Objective 3 of CYBERWISER.eu, which states: "Create robust and insightful economic models for monetary exposure assessment to risk in virulent cyber climates, thereby boosting user training and performance evaluation."

In addition, from an innovation stream point of view, some of the contributions brought by CYBERWISER.eu are:

- Simulation of a wide variety of attacks and countermeasures concerning the digital assets characterized in the scenario object of the training.
- Advanced economic risk models and algorithms for an estimation of the money being at risk due to the cyber landscape to which the company is exposed.

Thus, the CYBERWISER.eu approach is a cyber-risk centric approach in which risk is used to guide and support training in cybersecurity. In addition, to boost cybersecurity awareness, the CYBERWISER.eu approach is supported by cybersecurity-awareness training provided in the Primer offering level.

This document is the final deliverable related to courses and supporting training material that will be available in the CYBERWISER.eu platform. However, to provide a holistic picture, we first explain in this section the overall learning path of CYBERWISER.eu and how the learning path is related to the roles (and skills) described in Section 3, as well as the four offering levels (Primer, Basic, Intermediate, Advanced), before we describe the courses and training material offered at all offering levels in Sections 5 and 6.

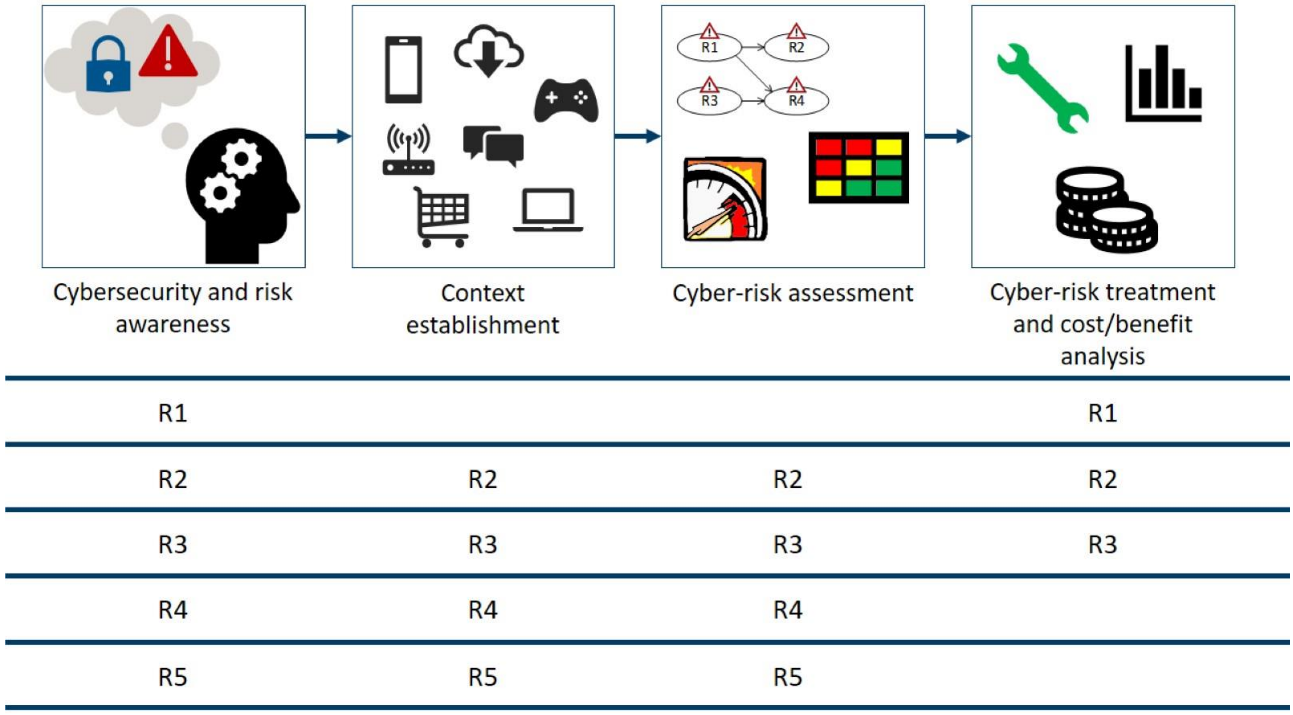
Section 4.1 provides a high-level explanation of the cyber-risk centric learning path, while Sections 4.2 and 4.3 go more into the details of the awareness and cyber-risk analysis parts, respectively, which together make up the learning path. Finally, Section 4.4 relates the learning path to the offering levels as well as the technical assets in CYBERWISER.eu.

4.1 Cyber-risk centric learning path

As illustrated in Figure 5 the learning path consists of four main parts:

- Cybersecurity and risk awareness
- Context establishment
- Cyber-risk assessment
- Cyber-risk treatment and cost/benefit analysis

Although these parts are illustrated as consecutive steps, they do not have to be carried out consecutively. Depending on their previous knowledge and skills participants may choose to obtain training in one or more parts of the learning path by selecting appropriate courses. Some courses may also cover more than one part of the learning path.



Cybersecurity and risk awareness	Context establishment	Cyber-risk assessment	Cyber-risk treatment and cost/benefit analysis
R1			R1
R2	R2	R2	R2
R3	R3	R3	R3
R4	R4	R4	
R5	R5	R5	

Figure 5. The overall cyber-risk centric learning path and security roles mapped to the learning path

The learning path is constructed to be in line with ISO 27001 [9] and ISO 27005 [10], which are security standards known globally and used both in industry and academia. The goal of cybersecurity and risk awareness is to make participants aware of common cybersecurity risks as well as to teach cybersecurity concepts important for the rest of the learning path and in the CYBERWISER.eu platform in general. Context establishment, cyber-risk assessment, and cyber-risk treatment and cost/benefit analysis are in line with corresponding steps of ISO 27005 [10] and are typically collectively referred to as cyber-risk analysis. In CYBERWISER.eu, the goal of context establishment is to teach about defining and describing the target of analysis including its scope and focus. In the case of CYBERWISER.eu, the target of analysis is referring to the infrastructure simulated on the cyber range. The goal of cyber-risk assessment is to teach about risk identification including vulnerabilities and unwanted incidents, risk estimation, and risk evaluation, as well as risk modelling, while the goal of cyber-risk treatment and cost/benefit analysis is to teach about treatments/countermeasures and their economic effects as well as their impact on the cyber-risk picture.

Figure 5 also illustrates a mapping of security roles that require skills addressed in one or more parts of the learning path. The roles are those selected in Section 3.3:

- R1: Head of Information/Cyber Security (described in Section 3.3.6)
- R2: Information Security Risk Manager (described in Section 3.3.7)

- R3: Information Security Risk Officer (described in Section 3.3.8)
- R4: Threat Analyst (described in Section 3.3.9)
- R5: Vulnerability Assessment Analyst (described in Section 3.3.10)

The positioning of the roles in relation to the learning path is based on their description provided in Section 3.3, which is based on the CIISec Roles Framework [23]. As pointed out by the CIISec Roles Framework, the role descriptions, as well as the skills required by the roles, may vary because of factors such as the size of the organisation, complexity, sector, and business model. This means that the mapping above may also vary among different organizations. However, given that the above-mentioned CIISec frameworks have been "*developed through collaboration between both private and public sector organisations and world-renowned academics and security leaders [24]*" the mapping will apply in most cases.

All the above-mentioned roles need to be aware of the basics of cyber-risk such as domain specific concepts and processes, and well-known risks. All roles therefore fit under the first part of the learning path (cybersecurity and risk awareness).

Role R1 fit mainly under cyber-risk treatment and cost-benefit analysis because the role is typically at senior management level who makes decisions on, among other things, the value of certain security assets and whether certain risks that may harm the assets should be treated or not based on treatment cost.

The roles R2 and R3 fit in all parts of the learning path because they must ensure that cybersecurity risks are identified and assessed and based on risk assessment results make appropriate recommendations. These roles are also typically in charge of leading such cyber-risk assessment tasks.

The roles R4 and R5 are more technical in nature and collect, process, analyse and disseminate threat assessments and indicators. These roles also identify weaknesses using known vulnerabilities and common configuration faults to obtain a risk picture. Thus, roles R4 and R5 fit under the context establishment and the cyber-risk assessment parts of the learning path.

4.2 Cybersecurity and risk awareness

To make participants aware of common cybersecurity risks and to teach cybersecurity concepts important for the rest of the learning path, the cybersecurity and risk awareness part is supported by three main topics:

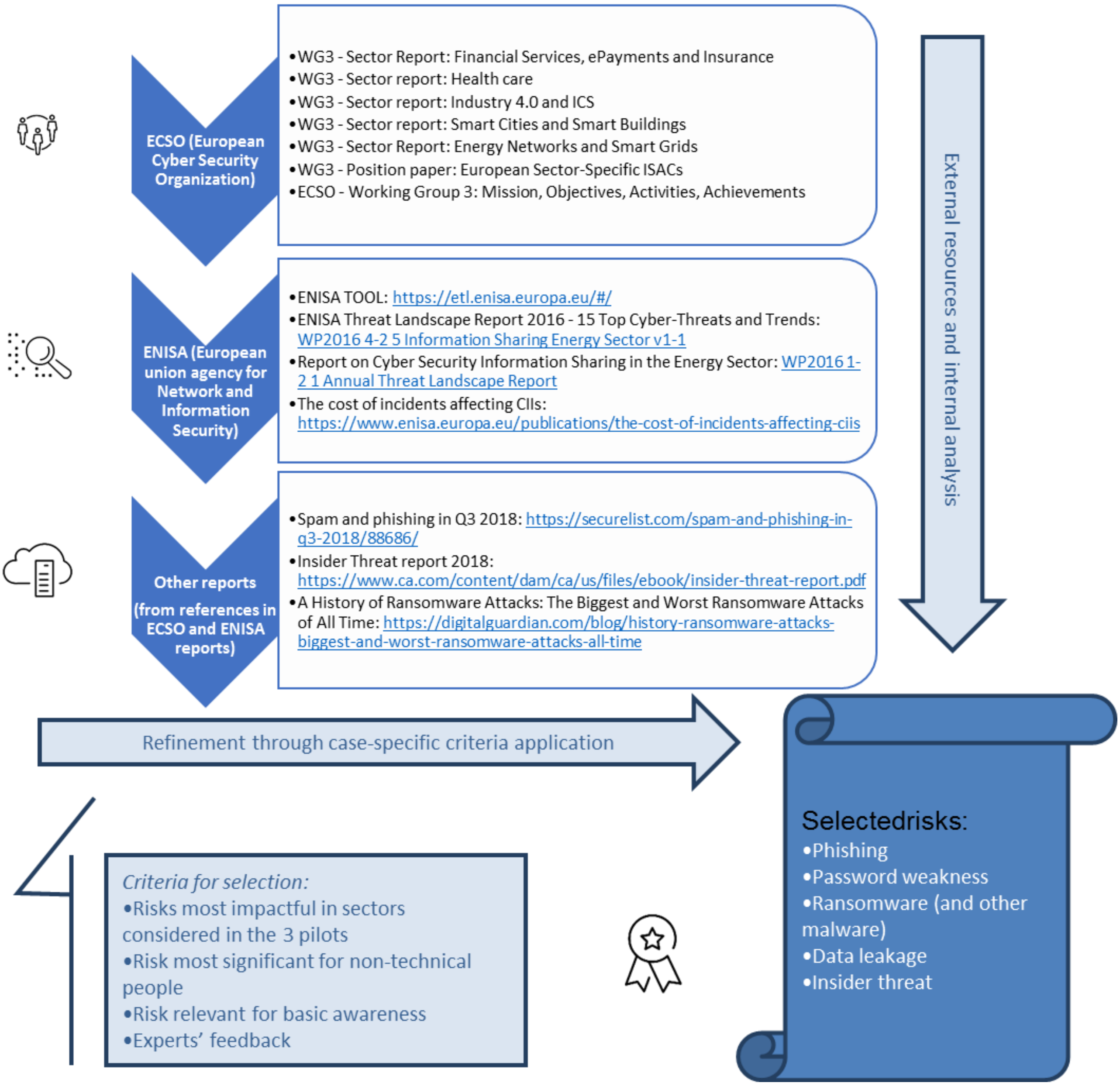
- Introduction to cyber-risk analysis and cybersecurity
- Awareness of five common cybersecurity risks
- Introduction to cyber-risk assessment

The first topic gives a basic introduction to cyber-risk analysis and cybersecurity as well as related concepts. The second topic presents five common cybersecurity risks for awareness purposes and teaches also how to protect oneself from these cybersecurity risks. While the first topic covers a high-level explanation about the cyber-risk analysis process, the third topic focuses on cyber-risk assessment and explains its purpose and the activities typically covered within cyber-risk assessment. These topics are further detailed in terms of courses in Section 5.

With respect to the second topic (awareness), it is necessary to explain the selection process of the five cybersecurity risks for the awareness training and the rationale behind the selection. As illustrated in Figure 6 we used, as a starting point, reports from recognized organizations/unions in the cybersecurity field including the European Cybersecurity Organization (ECSO) [30] and the European Union agency for Network and Information Security (ENISA) [2] exploiting their experience and research on the topic. Later we applied some criteria to make the selection more case specific for the needs of CYBERWISER.eu. The applied criteria were:

- Risks with high impact on the sectors represented by the three Full Scale Pilots in CYBERWISER.eu
- Risks that are most significant for non-technical people
- Risks that are relevant for basic awareness
- Feedback from experts in the consortium (made the list of five common cybersecurity risks available to the consortium and received feedback)

Initially, one of the five common risks selected was "web-based attacks and web application attacks", but this was later replaced with “password weakness” as this is one of the most commonly exploited vulnerabilities as discussed in Table 17, and because cyber-risks related to web-based attacks and web application attacks will be covered in detail in courses provided at Intermediate and Advanced offering levels. This decision is based on work carried out in Task 2.3 (model adaptation and development) in which a set of web-based attacks is selected as the most important cyber-risks to address in CYBERWISER.eu.


ECSO (European Cyber Security Organization)
ENISA (European union agency for Network and Information Security)
Other reports (from references in ECSO and ENISA reports)
External resources and internal analysis
Refinement through case-specific criteria application

- WG3 - Sector Report: Financial Services, ePayments and Insurance
- WG3 - Sector report: Health care
- WG3 - Sector report: Industry 4.0 and ICS
- WG3 - Sector report: Smart Cities and Smart Buildings
- WG3 - Sector Report: Energy Networks and Smart Grids
- WG3 - Position paper: European Sector-Specific ISACs
- ECSO - Working Group 3: Mission, Objectives, Activities, Achievements

- ENISA TOOL: https://etl.enisa.europa.eu/#/
- ENISA Threat Landscape Report 2016 - 15 Top Cyber-Threats and Trends: WP2016 4-2 5 Information Sharing Energy Sector v1-1
- Report on Cyber Security Information Sharing in the Energy Sector: WP2016 1-2 1 Annual Threat Landscape Report
- The cost of incidents affecting CIIs: https://www.enisa.europa.eu/publications/the-cost-of-incidents-affecting-ciis

- Spam and phishing in Q3 2018: https://securelist.com/spam-and-phishing-in-q3-2018/88686/
- Insider Threat report 2018: https://www.ca.com/content/dam/ca/us/files/ebook/insider-threat-report.pdf
- A History of Ransomware Attacks: The Biggest and Worst Ransomware Attacks of All Time: https://digitalguardian.com/blog/history-ransomware-attacks-biggest-and-worst-ransomware-attacks-all-time

Criteria for selection:
- Risks most impactful in sectors considered in the 3 pilots
- Risk most significant for non-technical people
- Risk relevant for basic awareness
- Experts’ feedback

Selectedrisks:
- Phishing
- Password weakness
- Ransomware (and other malware)
- Data leakage
- Insider threat

Figure 6. Selection process of the five common cybersecurity risks for awareness training

Table 17 provides an overview of the five common cybersecurity risks selected for the awareness training. The table provides a brief explanation for each cybersecurity risk and the rationale for inclusion in the awareness training.

Cybersecurity risk	Brief description	Rationale for inclusion
Phishing	Phishing is a cybercrime that aims to lure users to malicious sites to provide sensitive data such as personally identifiable information (PII), banking and credit card details, and passwords. The information is used to access important accounts and can result in identity theft and financial loss. It is a pervasive attack because it primarily uses social engineering to attack end users and it is becoming more sophisticated and targeted, which makes its detection difficult. Moreover, also low capability criminals can perform a phishing attack using frameworks of Phishing as a Service [2].	1) 85% of organizations have been and are targeted for phishing attacks. Moreover, phishing damages exceeds $1 billion [1]. 2) The European Cyber Security Organization (ECSO) reports that Phishing is one of the most common and impactful threats within Energy, Transportation and other specific sectors [18]. 3) The threat landscape tool by ENISA [2] reports that Phishing was one of top 15 cybersecurity risks in 2017 and 2018. 4) The target of a Phishing attack can be employees of every job level and job profile [2]. 5) Social engineering techniques are mostly unknown by employees [2]. 6) Phishing is the most successful attack vector for data breaches and security incidents and for most of the cyber threats [2].
Password weakness	Weak passwords are one of the most common vulnerabilities exploitable to access company infrastructure and facilitating more complex attacks. According to internet security threat reports by Symantec and WatchGuard, weak passwords are a major security threat [3][4].	1) Symantec reports that IoT devices experienced an average of 5200 attacks per month in 2018 and that 24.6% of passwords used in IoT attacks were "123456", while 17% were blank in the sense that there were no passwords [3]. 2) WatchGuard carried out an investigation of passwords used for 335,000+ government and military accounts and found that nearly half of all passwords associated with .gov and .mil email addresses are weak. As an example, they found 1700 cases where the password "123456" were used [4].
Ransomware (and other malware)	Ransomware is a type of malware that imprisons user data making them unavailable by encrypting in order to request a ransom to release them. While traditional malware requires cybercriminals to go through multiple steps before making profit, ransomware makes it an automated process. Moreover, also low capability criminals can spread a ransomware by using prepared frameworks (Ransomware as a Service).	1) The European Cyber Security Organization (ECSO) reports that Ransomware is one of the most common and impactful threats within Energy, Transportation and other specific sectors [18]. 2) The threat landscape tool by ENISA [2] reports that 60% of malware payloads were ransomware and this threat keeps growing. Ransomware was also one of top 15 cybersecurity risks in 2017 and 2018. 3) Real cases of financial loss because of ransomware [19]. 4) A series of "police" ransomware packages appeared, so called because they purported to be warnings from law enforcement about the victims' illicit activities and demanded payment of "fines"; they began to exploit the new generation of anonymous payment services to better harvest payments without getting caught [20].
Data leakage	Information leakage is a category of cyber threats exploiting weaknesses of run	1) The European Cyber Security Organization (ECSO) reports that data leakage is one of the most common and impactful threats within

Cybersecurity risk	Brief description	Rationale for inclusion
	time systems, of components configuration, programming mistakes and user behaviour in order to leak important information.	Energy, Transportation and other specific sectors [18]. 2) The threat landscape tool by ENISA [2] reports that data leakage is among top 15 cybersecurity risks in 2017 and 2018. Similar report is also given by OWASP [5]. 3) There exist many incidents causing data leakage, including employees. This means that employees in an organization must be aware of this cybersecurity risk. Data leakage is an issue both for organization and for users themselves because of identity theft. 4) The General Data Protection Regulation (GDPR) [6] poses possible administrative sanctions for data breaches, which are essentially data leakage of personal data. Sanctions are requested when the necessary security countermeasures (both technical and organizational) have not been put in place.
Insider threat	Insider threat is related to the use of authorized access, wittingly or unwittingly, that can result in a harm to the security of an organization. An insider threat can be a current or former employee, contractor or business partner, all those that can compromise the confidentiality, integrity and availability of the organization's network systems, data or premises. This type of threat can include fraud, theft of intellectual property, unauthorized trading, espionage and information technology infrastructure sabotage.	1) The European Cyber Security Organization (ECSO) reports that insider threat is one of the most common and impactful threats within Energy, Transportation and other specific sectors [18]. 2) The threat landscape tool by ENISA [2] reports that insider threat is among top 15 cybersecurity risks in 2017 and 2018. 3) ENISA reports that the most expensive attacks are insider threats, followed by DDoS and web-based attacks [7]. 4) According to a survey carried out by CA Technologies, 90% percent of organizations feel vulnerable to insider attacks. The main enabling risk factors include too many users with excessive access privileges (37%), an increasing number of devices with access to sensitive data (36%), and the increasing complexity of information technology (35%) [8].

Table 17. Overview of five common cybersecurity risks selected for the awareness training

4.3 Cyber-risk analysis

Figure 7 illustrates the relationship between the risk analysis process in ISO 27005 [10] (illustrated on the left-hand side) and the corresponding steps of the learning path described in Section 4.1 (illustrated on the right-hand side). This section describes the learning path in more detail with respect to the steps of the risk analysis process.

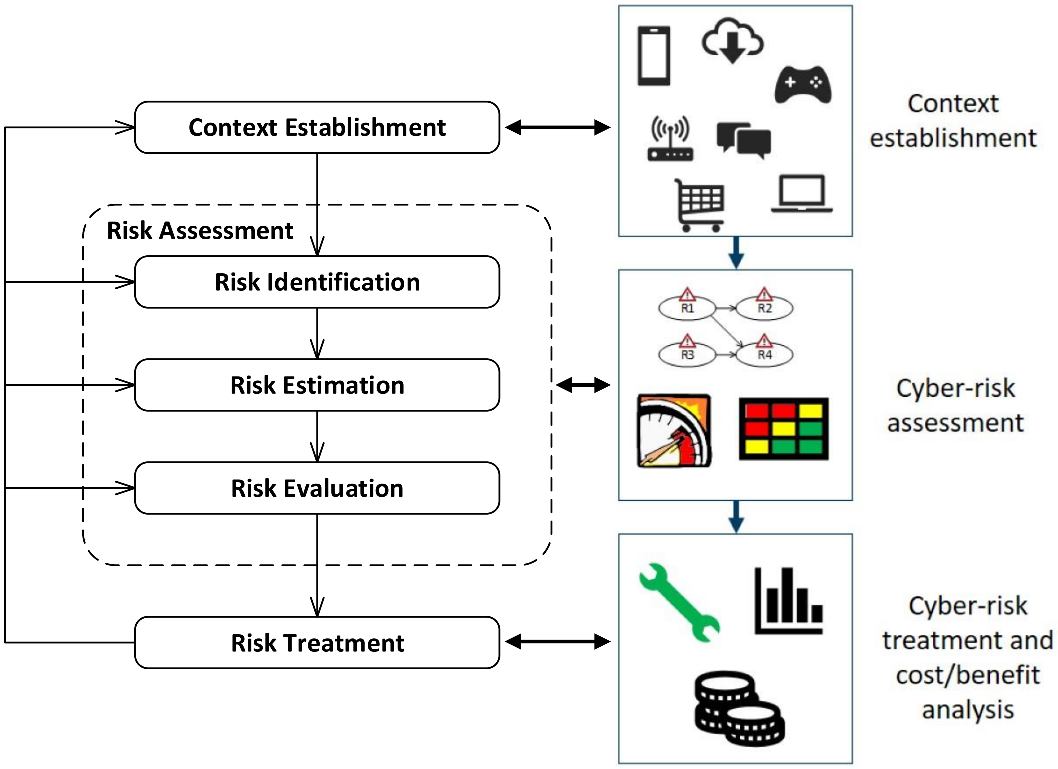


Figure 7. Relationship between the learning path and the risk analysis process

The purpose of the steps in the risk analysis process are as follows:

- The context establishment is the preparatory step for the subsequent activities and involves the documentation of both the external and the internal context of relevance for the assessment in question [12]. We do this by carrying out the following four sub-steps:
  - Describe target of analysis
  - Identify and describe security assets
  - Identify and describe threat profiles and high-level risks
  - Identify risk criteria
- The purpose of risk assessment is to identify, estimate, and evaluate risks. Each of these activities are carried out in their respective sub-steps:
  - Risk identification is an activity that aims to identify, describe, and document risks and possible causes of risks.
  - Risk estimation is an activity that aims to estimate and determine the level of the identified risks. The risk level is derived from the combination of the likelihood and consequence. In CYBERWISER.eu, we regard likelihood in terms of frequency and consequence in terms of economic impact. Thus, the risk level is given in terms of monetary loss.
  - Risk evaluation is an activity involving the comparison of the risk estimation results with the risk evaluation criteria to determine which risks should be considered for treatment.
- The purpose of risk treatment is to identify and select means for risk mitigation and reduction. The selection of which treatment to implement is based on an analysis of the costs and benefits of the identified treatments. The implementation of a treatment has in turn an effect on the risk picture as

illustrated by the arrows in Figure 7 going from risk treatment to context establishment, risk identification, estimation, and evaluation.

4.3.1 Context establishment

As mentioned above, and illustrated in Figure 8, context establishment consists of the following four main steps:

1. Describe target of analysis
2. Identify and describe security assets
3. Identify and describe threat profiles and high-level risks
4. Identify risk criteria

Each of these steps consists of their respective sub-steps as illustrates in Figure 8. Looking closer at the first step, we describe the target of analysis by first describing the scope and focus of the analysis (Step 1.1). The scope of the analysis is the extent or range of a risk assessment; it defines what is held inside and what is held outside of the assessment. The focus of the analysis is the main issue or central area of attention in a risk assessment; the focus is within the scope of the assessment. Typically, a risk analysis is carried out by an analysis team which consists of at least two persons where each person takes the role as risk analysis leader and risk analysis secretary, respectively. These roles are important to define early to carry out the assessment as smoothly as possible (Step 1.2). Finally, it is necessary to model the target of analysis (Step 1.3). In CYBERWISER.eu, we will do this by modelling the target using a (semi-) formal language, such as the Unified Modelling Language (UML), which is a specification defining a graphical language for visualizing, specifying, constructing, and documenting the artefacts of distributed object systems [13].

A crucial step in the context establishment, which also supports the further definition of the focus of the assessment, is the identification and documentation of the security assets, which brings us to the second step. First, we identify and describe information security assets based on target description to pinpoint the most important valuables to consider in the analysis. This is done using CORAS asset diagrams [11] (Step 2.1). The assets are the things or entities we want to protect and are the real motivation for conducting the risk assessment in the first place. Often there are multiple assets and limited resources to conduct the risk analysis, in such cases we need to rate all assets according to their importance to prioritize the risk assessment (Step 2.2). Finally, we need to identify and describe existing security controls and the information security assets they protect (Step 2.3).

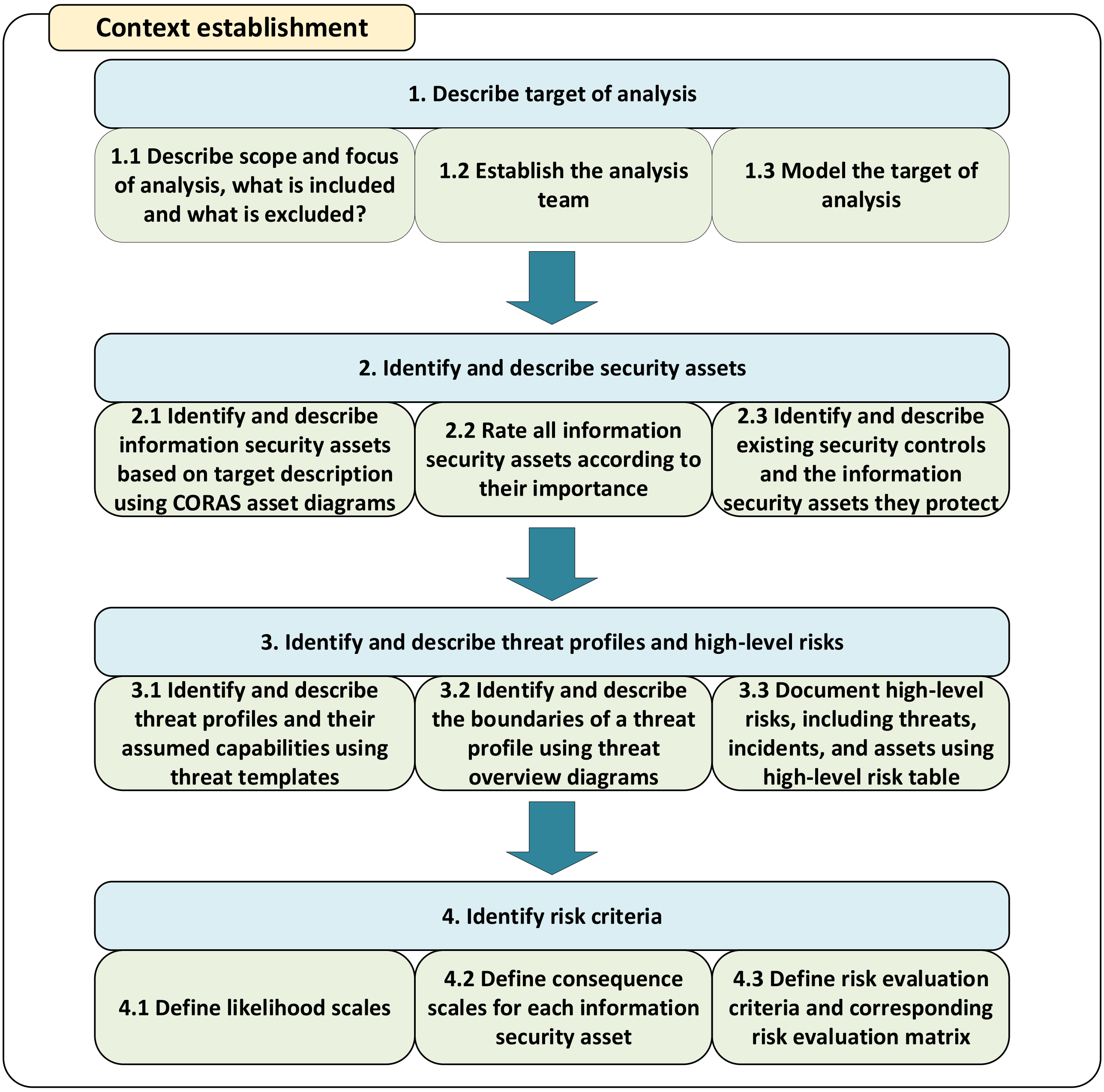

Context establishment
1. Describe target of analysis
1.1 Describe scope and focus of analysis, what is included and what is excluded?
1.2 Establish the analysis team
1.3 Model the target of analysis
2. Identify and describe security assets
2.1 Identify and describe information security assets based on target description using CORAS asset diagrams
2.2 Rate all information security assets according to their importance
2.3 Identify and describe existing security controls and the information security assets they protect
3. Identify and describe threat profiles and high-level risks
3.1 Identify and describe threat profiles and their assumed capabilities using threat templates
3.2 Identify and describe the boundaries of a threat profile using threat overview diagrams
3.3 Document high-level risks, including threats, incidents, and assets using high-level risk table
4. Identify risk criteria
4.1 Define likelihood scales
4.2 Define consequence scales for each information security asset
4.3 Define risk evaluation criteria and corresponding risk evaluation matrix

Figure 8. The steps related to context establishment

The identification and description of threat profiles is necessary to reason about attacker types and attacker motivation in relation to assets and the target description (Step 3.1). The documentation of threat profiles may be carried out using a template [14]. In order to easily obtain an overview of the boundaries of a threat profile we can identify and describe the boundaries of a threat profile using threat overview diagrams (Step 3.2) [14]. Finally, having documented the threat profiles and their boundaries, it is necessary to document a high-level risk picture using a high-level risk tables in which we capture threat sources, threats, vulnerabilities, unwanted incidents, and assets (Step 3.3) [11], which will function as a guiding basis when identifying risks in Step 5.

The identification of risk criteria is basically about defining likelihood scales (Step 4.1), consequence scales (Step 4.2), and risk evaluation criteria (Step 4.3). These scales will later be used to estimate and evaluate risks.

4.3.2 Cyber-risk assessment

The process for cyber-risk assessment in CYBERWISER.eu is mainly inspired by the corresponding process from the WISER project [35]. However, there is one substantial difference: while WISER provided a straightforward method-description aimed at experienced cyber-risk professionals, CYBERWISER.eu offers pedagogic courses for cyber-risk assessment and associated activities supported by examples, guidelines, and hands-on exercises on the cyber range. As illustrated in Figure 9, cyber-risk assessment consists of three main steps (the following numbering of the steps continues from the last step of context establishment):

5. Identify risks
6. Estimate risks
7. Evaluate risks

Risk identification is carried out using the CORAS risk modelling language to identify and document threat sources, threats, vulnerabilities, incidents, and security assets that may be harmed by incidents. In addition, indicators are also identified and included in the risk model to capture the dynamic behaviour of the target and to facilitate dynamic risk assessment (Step 5.1). Having identified risks and created risk models, next, we need to validate the model to make sure that the final risk model corresponds to the reality (Step 5.2). Finally, in order to be able to execute the risk model in the platform, we translate the risk model schematically into a script written in R (Step 5.3). This script is then fed to the Economic Risk Evaluator component (described in D2.5 Platform Design, final version [21]).

Risk estimation is carried out using empirical methods such as interviews and brainstorming sessions to gather expert opinions, inspection of logs or other statistical and historical data, and the use of available repositories. The purpose is to identify base line estimates for likelihood and consequence values of the risk assessment algorithm defined previously (Step 6.1). In CYBERWISER.eu, the courses related to risk assessment teach how to identify relevant risk-indicators to help dynamically assess the risk level in a simulated attack scenario. Such CYBERWISER.eu-specific courses are directed towards roles who will use the platform to develop/maintain training scenarios (such as the White and Green teams). Next, we need to validate the base line estimates integrated in the risk assessment algorithms to make sure that our base line estimates correspond to reality (Step 6.2).

Step 5.3 requires programming skills, while the steps 6.1 and 6.2 require a basic understanding of scripting languages when it is necessary to update baseline estimates in the risk assessment scripts. Considering the scope of CYBERWISER.eu, the courses provided in CYBERWISER.eu are not directed on how to program but is mainly about teaching cybersecurity in a risk-centric approach and provide courses to help future users to maintain the CYBERWISER.eu platform (White/Green teams). Thus, in CYBERWISER.eu, the courses will mainly cover the principles and activities in risk assessment properly equipping and preparing the relevant roles in Section 3 to carry out risk assessment, but provides also a course to teach about updating and maintaining the risk assessment scripts provided by CYBERWISER.eu. For a detailed technical explanation on how to program risk assessment algorithms, the reader is referred to the deliverables from the WISER project: D3.2 - Cyber risk modelling language and guidelines, preliminary version [31], and D3.4 - Cyber risk modelling language and guidelines, final version [32].

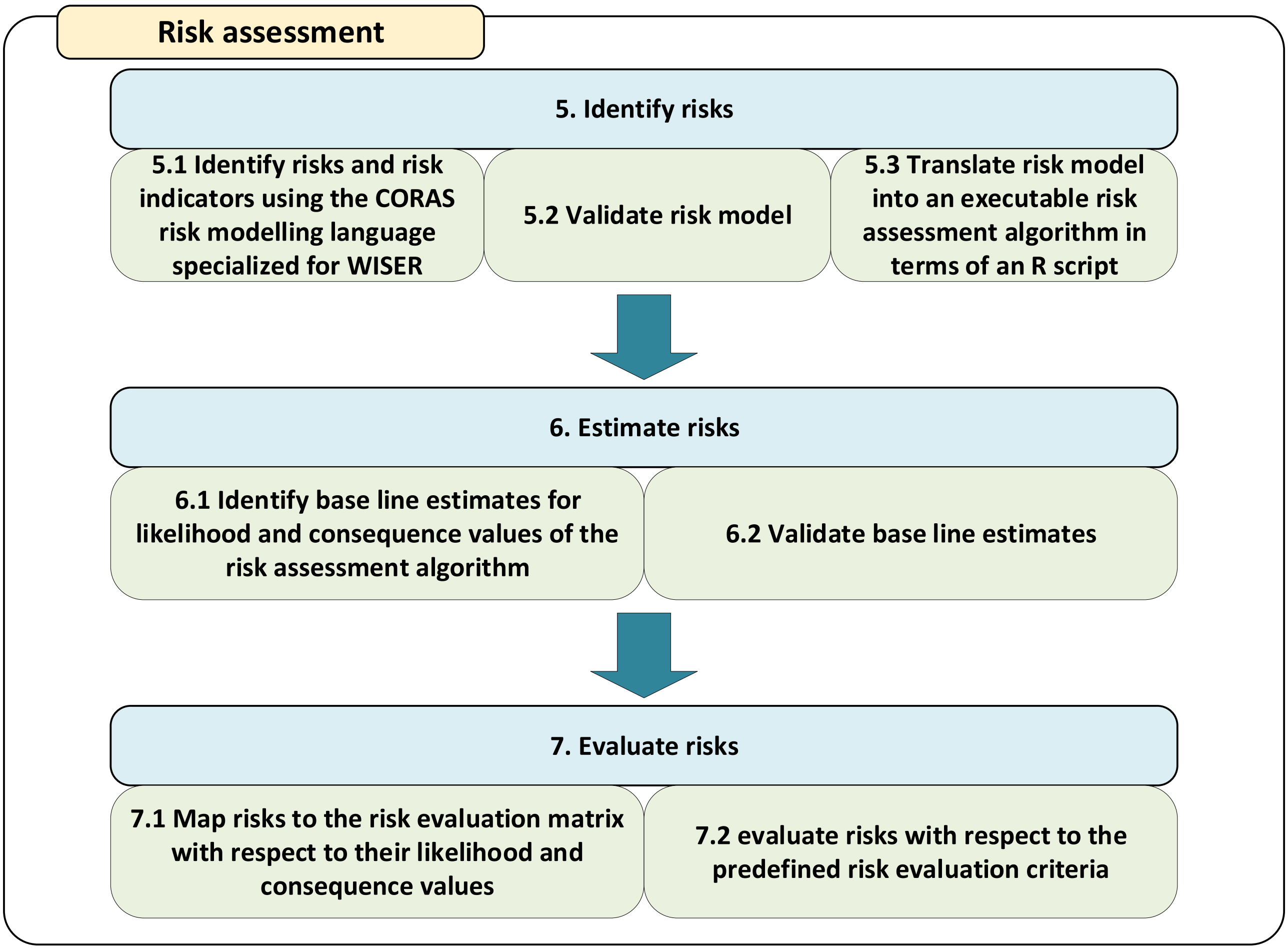

Risk assessment
5. Identify risks
5.1 Identify risks and risk indicators using the CORAS risk modelling language specialized for WISER
5.2 Validate risk model
5.3 Translate risk model into an executable risk assessment algorithm in terms of an R script
6. Estimate risks
6.1 Identify base line estimates for likelihood and consequence values of the risk assessment algorithm
6.2 Validate base line estimates
7. Evaluate risks
7.1 Map risks to the risk evaluation matrix with respect to their likelihood and consequence values
7.2 evaluate risks with respect to the predefined risk evaluation criteria

Figure 9. The steps related to cyber-risk assessment

Risk evaluation is typically carried out by mapping each risk into a predefined risk evaluation matrix (defined in Step 4 of the context establishment) with respect to its likelihood and consequence value to determine the risk level (Step 7.1). However, as risk evaluation is a decision point in the overall risk analysis process, we need to confirm the risk evaluation criteria and consolidate the risk estimates before commencing the evaluation of risks. Moreover, we need to investigate the identified risks to see whether certain sets of risks should be aggregated and evaluated as a single risk. This is done to avoid accepting risks that individually are non-critical, but unacceptable in combination. Finally, we also group risks that have elements in common because risks that share common elements such as threats and vulnerabilities may be treated by the same means (Step 7.2). CYBERWISER.eu provides courses that teaches both about the risk evaluation in general terms and also courses that teach how a user, be it participants from Blue/Red teams or someone maintaining/operating the platform from the White/Green teams, can use the components of the platform to interpret risk assessment values and based on that decide which risk to treat. The components we refer to here are mainly the Economic Risk Evaluator, Countermeasure Simulator, and Performance Evaluator.

4.3.3 Cyber-risk treatment and cost/benefit analysis

In CYBERWISER.eu, we focus on the identification of treatments for the purpose of reducing or removing risks. As illustrated in Figure 10, risk treatment consists of one main step (Step 8) with two sub-steps.

The risk treatment activity involves both the identification and the analysis of treatment. Treatment identification is done similarly to the risk identification, for example via brainstorming or by using available lists and repositories. Treatments are identified and documented using CORAS treatment diagrams (Step 8.1). The identified treatments are then included in the Countermeasure Simulator in CYBERWISER.eu, which in turn makes the treatments (risk countermeasures) available to the participants. The countermeasures are made available to the course participants at a stage where they need to select treatments, based on a cost/benefit analysis (Step 8.2).

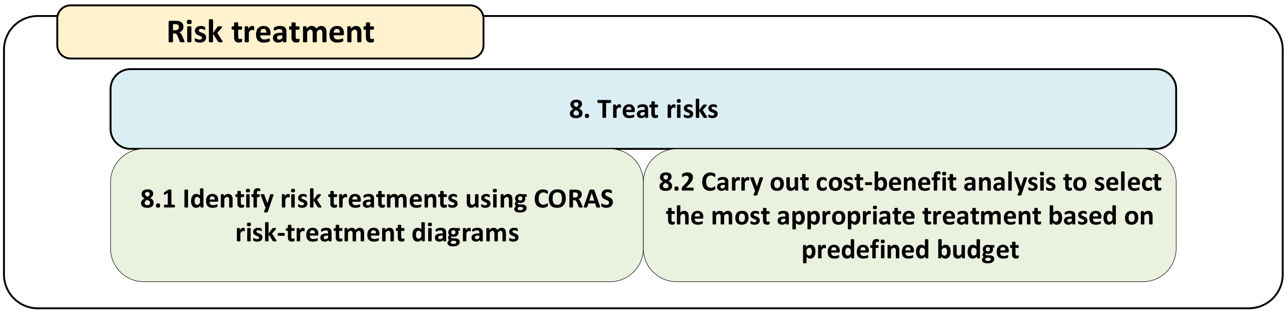

Risk treatment
8. Treat risks
8.1 Identify risk treatments using CORAS risk-treatment diagrams
8.2 Carry out cost-benefit analysis to select the most appropriate treatment based on predefined budget

Figure 10. The steps related to cyber-risk treatment

4.4 Relating the learning path to the offering levels in CYBERWISER.eu

As illustrated in Figure 11, the various offering levels of CYBERWISER.eu will support one or more parts of the learning path presented in the above sections. Cybersecurity and risk awareness will be covered in the Primer and Basic offering levels. As mentioned in Section 4.1, the courses in the cybersecurity and risk awareness part of the learning path not only have the goal to teach and make participants aware about common cybersecurity risks, but also to teach the cybersecurity concepts important for the rest of the learning path. The courses provided in the Primer and Basic offering levels are further described in Section 5.

In addition to cybersecurity and risk awareness, the Basic offering level covers both context establishment and cyber-risk assessment of the learning path. With respect to context establishment, the courses in the Basic offering level will mainly address the steps related to describing target of analysis; identifying and describing security assets; and identifying and describing threat profiles and high-level risks. With respect to cyber-risk assessment, the courses in the Basic offering level will mainly address the step related to risk identification. Thus, the courses in the Basic offering level do not address *all* aspects of context establishment and cyber-risk assessment. As illustrates in Figure 11, context establishment and cyber-risk assessment are also covered in the Intermediate and the Advanced offering levels.

The courses in the Intermediate offering level will address additional aspects of context establishment and cyber-risk assessment not covered by the courses in the Basic level. The courses in the Advances offering level will address all aspects of context establishment and cyber-risk assessment. In addition to context establishment and cyber-risk assessment, the courses in the Intermediate and Advanced offering levels will also address cyber-risk treatment and cost/benefit analysis. Moreover, the courses at Intermediate and Advanced offering levels will make use of the full capacity of the CYBERWISER.eu platform and provide complex cyber-risk assessment training scenarios (exercises) on the cyber range.

Each offering level includes the courses and training material of the previous offering level.

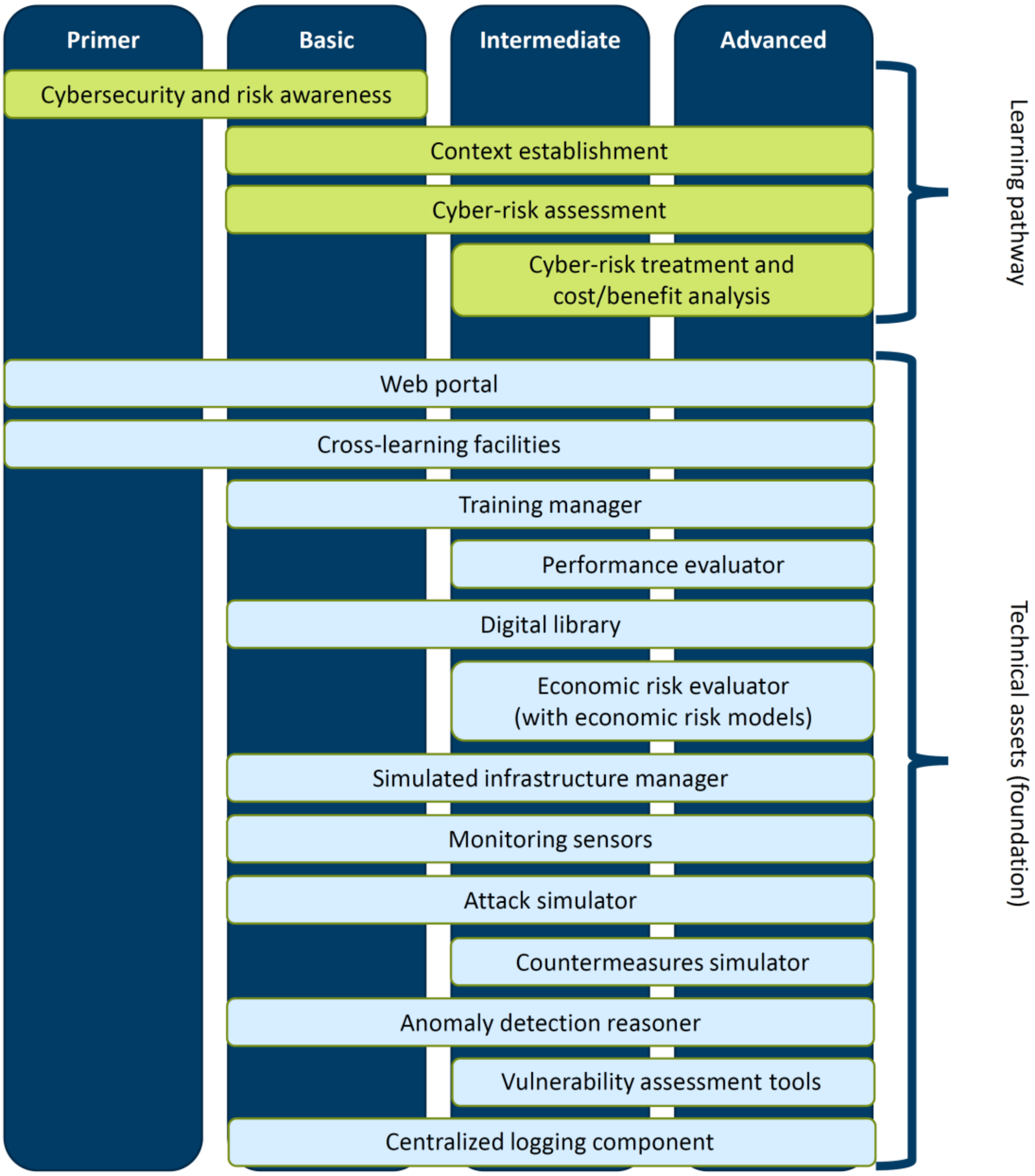

Primer
Basic
Intermediate
Advanced
Cybersecurity and risk awareness
Context establishment
Cyber-risk assessment
Cyber-risk treatment and cost/benefit analysis
Web portal
Cross-learning facilities
Training manager
Performance evaluator
Digital library
Economic risk evaluator (with economic risk models)
Simulated infrastructure manager
Monitoring sensors
Attack simulator
Countermeasures simulator
Anomaly detection reasoner
Vulnerability assessment tools
Centralized logging component
Learning pathway
Technical assets (foundation)

Figure 11. Relating the learning path to the offering levels

The final and third dimension we need to address to get a holistic picture of the relationship between the learning path and the offering levels is the technical aspects of CYBERWISER.eu. The technical assets are the technical foundation enabling the various courses and training material in the different offering levels. Thus, the courses will be shaped also considering the technical capabilities that are available in the various offering levels. The technical assets are described in detail in Deliverable D2.5 [21].

5. Courses offered by CYBERWISER.eu

This section describes all courses provided in the Primer, Basic Intermediate, and Advanced offering levels. Section 5.1 provides an overview of the courses, while Sections 5.2, 5.3, 5.4, and 5.5 describe the courses provided at the Primer, Basic, Intermediate, and Advanced offering levels, respectively. Finally, Section 5.6 provides high-level explanation of two main usage areas of the CYBERWISER.eu courses, namely using the courses for self-study and using the courses for classroom lectures.

5.1 Overview of the courses

Table 18 shows an overview of the courses for the Primer, Basic, Intermediate, and Advanced offering levels and their relationship to the overall learning path. The following sections describe these courses in detail by using the course template outlined in Section 2.1.1. For the courses that have modules, we include module description immediately after the course description using the module template described in Section 2.1.2. There are in total seven courses for the Primer offering level (P-01 – P-07), five courses for the Basic offering level (B-01 – B-05), five courses for the Intermediate offering level (I-01 – I-05), and five courses for the Advanced offering level (A-01 – A-05). The letter "P" in the course ID means "Primer", the letter "B" means "Basic", the letter "I" means "Intermediate", and the letter "A" means "Advanced".

Course ID	Course name	Offering level	Overall learning path
P-01	Introduction to cyber-risk analysis and cybersecurity	Primer	Cybersecurity and cyber-risk awareness
P-02	Awareness of Phishing	Primer	Cybersecurity and cyber-risk awareness
P-03	Awareness of Password Weaknesses	Primer	Cybersecurity and cyber-risk awareness
P-04	Awareness of Ransomware	Primer	Cybersecurity and cyber-risk awareness
P-05	Awareness of Data Leakage	Primer	Cybersecurity and cyber-risk awareness
P-06	Awareness of Insider Threat	Primer	Cybersecurity and cyber-risk awareness
P-07	Introduction to cyber-risk assessment	Primer	Cybersecurity and cyber-risk awareness
B-01	Describe target of analysis, level 1	Basic	Context establishment
B-02	Identify and describe security assets, level 1	Basic	Context establishment
B-03	Identify and describe threat profiles and high-level risks, level 1	Basic	Context establishment
B-04	Identify risks, level 1	Basic	Cyber-risk assessment
B-05	Awareness of Password Weakness with hands-on training	Basic	Cybersecurity and cyber-risk awareness
I-01	Describe target of analysis, level 2	Intermediate	Context establishment
I-02	Identify risk criteria	Intermediate	Context establishment, Cyber-risk assessment
I-03	Identify risks, level 2	Intermediate	Cyber-risk assessment
I-04	Estimate risks	Intermediate	Cyber-risk assessment
I-05	Treat risks, level 1	Intermediate	Cyber-risk treatment and cost/benefit analysis

Course ID	Course name	Offering level	Overall learning path
A-01	Identify and describe security assets, level 2	Advanced	Context establishment
A-02	Identify and describe threat profiles and high-level risks, level 2	Advanced	Context establishment
A-03	Identify risks, level 3	Advanced	Cyber-risk assessment, Cyber-risk treatment and cost/benefit analysis
A-04	Evaluate risks	Advanced	Cyber-risk assessment
A-05	Treat risks, level 2	Advanced	Cyber-risk treatment and cost/benefit analysis

Table 18. Overview of the courses in CYBERWISER.eu

As shown in Table 18, the courses P-03 – P-06 are awareness courses addressing the selected five common cybersecurity risks described in Section 4.2. The course P-01 introduces basic concepts central to cybersecurity and cyber-risk analysis, which provides the conceptual framework important for the rest of CYBERWISER.eu, while the course P-07 goes more into the details of cyber-risk assessment and its main processes.

The courses B-01 – B-03 address mainly the context establishment part of the learning path, including describing the target of analysis, identifying security assets to protect, and identifying threat profiles. The course B-04 on the other hand focuses on the risk identification part of the learning path. These courses have been named as "level 1" courses to indicate that they intend to cover a "beginner level" of the topics related to context establishment and risk identification.

The course I-01 provides a more advanced course for describing the simulated target of analysis in terms of using UML diagrams to represent a target infrastructure and how this is done in the CYBERWISER.eu platform. The courses I-02 – I-05 cover mainly cyber-risk assessment in terms of identifying and estimating risks, as well as the basics of treating risks (identifying and associating countermeasures). The courses I-01 – I-04 are accompanied with exercises on the cyber range supporting hands-on training of the relevant topic covered by the course.

The courses A-01 and A-02 address context establishment in terms of detailed guidelines for identifying and describing security assets, threat profiles, and high-level risks using templates. The course A-03 is the most advanced course of CYBERWISER.eu in terms of cyber range training scenarios. The course A-03 covers the aspects of cyber-risk identification, estimation, evaluation, and treatment in all its seven modules. The seven modules provide training scenarios addressing the cyber-risks: SQL injection, cross-site scripting, session hijacking, firewall and network filtering, targeted malware, broken access control, and phishing. The courses A-04 and A-05 cover topics related to risk evaluation and risk treatment, respectively. Both courses complement the advanced training scenarios in Course A-03 in terms of interpreting risk assessment produced by the Economic Risk Evaluator and the risk-mitigations suggested by the Countermeasure Simulator. In addition, the course A-05 is accompanied with a training scenario on the cyber range for selecting and applying risk treatments.

In the following sections, we assign security roles to the courses indicating the target audience of the course and the overall skill addressed. The roles are those selected in Section 3.3:

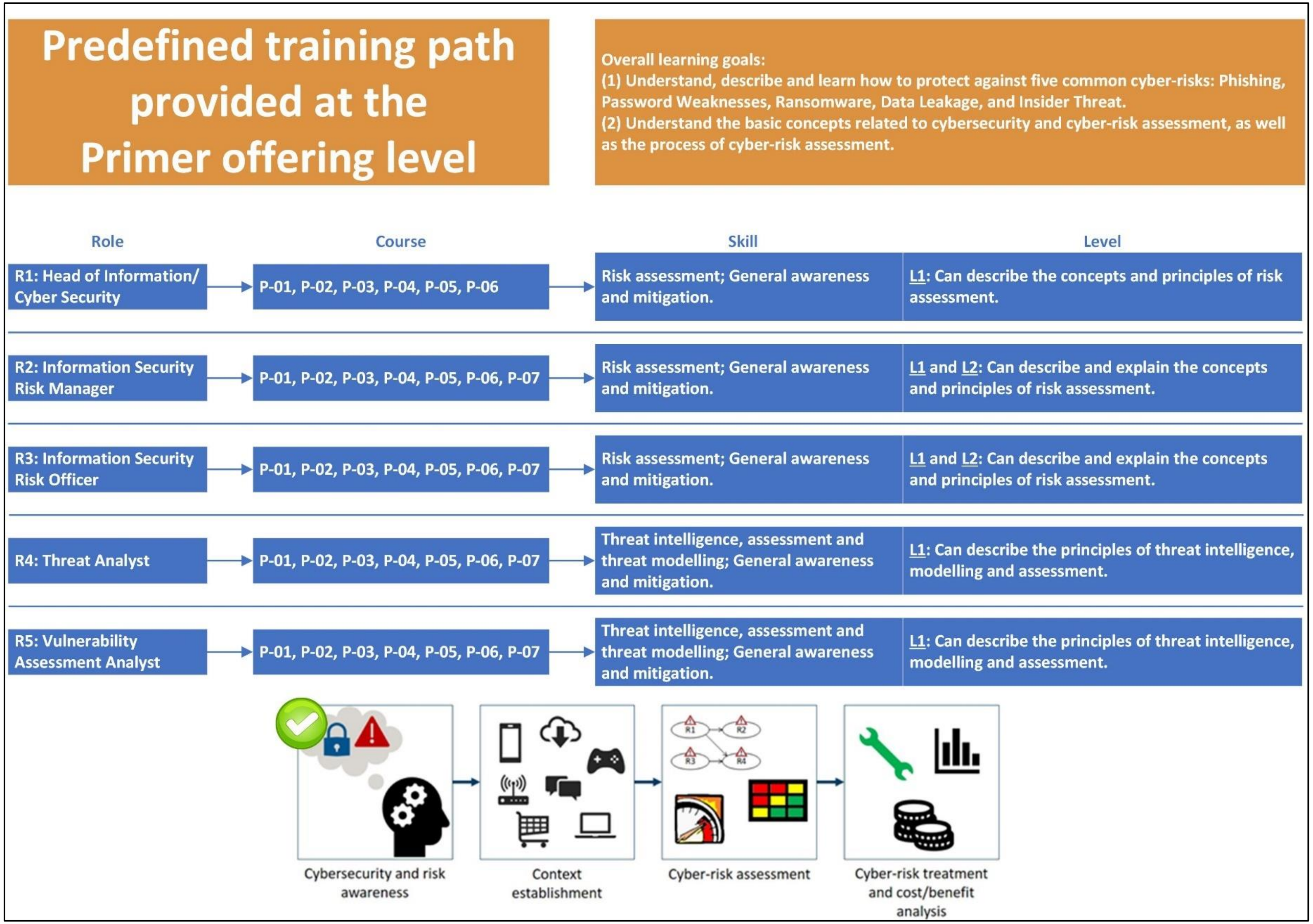
- R1: Head of Information/Cyber Security (described in Section 3.3.6)
- R2: Information Security Risk Manager (described in Section 3.3.7)
- R3: Information Security Risk Officer (described in Section 3.3.8)
- R4: Threat Analyst (described in Section 3.3.9)
- R5: Vulnerability Assessment Analyst (described in Section 3.3.10)

We also refer to skills (B1, B2, B3) as described in Section 3.3.

- B1: Threat Intelligence, Assessment and Threat Modelling
- B2: Risk Assessment
- B3: Information Risk Management

5.2 Courses for the primer offering level

This section describes the Courses P-01 – P-07 outlined in Table 18. Before describing all courses in detail, we illustrate in Figure 12 the predefined training path provided at the Primer offering level. This figure can be viewed as a high-level overview of the roles that may be trained by the courses provided at the Primer offering level, the courses to take, and skills (and skill levels) that are trained as a result of taking the indicated courses. Moreover, the figure also provides the overall learning goals as well as the part of the risk-centric learning path addressed by the Primer offering level (green check mark on the cybersecurity and risk awareness part). All courses referred to in Figure 12 are described in detail in the following sections.



Predefined training path provided at the Primer offering level

Overall learning goals:
(1) Understand, describe and learn how to protect against five common cyber-risks: Phishing, Password Weaknesses, Ransomware, Data Leakage, and Insider Threat.
(2) Understand the basic concepts related to cybersecurity and cyber-risk assessment, as well as the process of cyber-risk assessment.

Role	Course	Skill	Level
R1: Head of Information/ Cyber Security	P-01, P-02, P-03, P-04, P-05, P-06	Risk assessment; General awareness and mitigation.	L1: Can describe the concepts and principles of risk assessment.
R2: Information Security Risk Manager	P-01, P-02, P-03, P-04, P-05, P-06, P-07	Risk assessment; General awareness and mitigation.	L1 and L2: Can describe and explain the concepts and principles of risk assessment.
R3: Information Security Risk Officer	P-01, P-02, P-03, P-04, P-05, P-06, P-07	Risk assessment; General awareness and mitigation.	L1 and L2: Can describe and explain the concepts and principles of risk assessment.
R4: Threat Analyst	P-01, P-02, P-03, P-04, P-05, P-06, P-07	Threat intelligence, assessment and threat modelling; General awareness and mitigation.	L1: Can describe the principles of threat intelligence, modelling and assessment.
R5: Vulnerability Assessment Analyst	P-01, P-02, P-03, P-04, P-05, P-06, P-07	Threat intelligence, assessment and threat modelling; General awareness and mitigation.	L1: Can describe the principles of threat intelligence, modelling and assessment.

R1
R2
R3
R4
Cybersecurity and risk awareness
Context establishment
Cyber-risk assessment
Cyber-risk treatment and cost/benefit analysis

Figure 12. Predefined training path provided at the Primer offering level

5.2.1 Introduction to cyber-risk analysis and cybersecurity

The purpose of this course is to teach about basic concepts central within cybersecurity and cyber-risk analysis that are important to understand in context of CYBERWISER.eu. In other words, the course introduces and clarifies the concepts (related to cybersecurity and cyber-risk analysis) that will be used throughout the various courses in CYBERWISER.eu. This course also gives an overall introduction to the cyber-risk analysis process and how cybersecurity is considered within this process. By cyber-risk analysis, we mean the five-step process outlined in Section 4.3. Table 19 describes the course with respect to the course template described in Section 2.1.1.

ID	P-01
Name	Introduction to cyber-risk analysis and cybersecurity
Cybersecurity role	R1, R2, R3, R4, R5
Skill and expected skill level to be trained	• R1 – Skill B2, Level 1. • R2 – Skill B2, Level 1. • R3 – Skill B2, Level 1. • R4 – Skill B1, Level 1. • R5 – Skill B1, Level 1.
Offering Level	Primer
Difficulty	Easy
Course Duration	90 minutes (two modules, 45 minutes each module)
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand the basic concepts related to cyber-risk analysis and cybersecurity. 2. Understand the overall process of cyber-risk analysis and the relationship between cybersecurity and cyber-risk analysis.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Identify and describe basic concepts related to cyber-risk analysis and cybersecurity. 2. Name and describe the steps in the overall process of cyber-risk analysis.
Prerequisites	General knowledge within information technology is an advantage, but not a requirement.
Module list	• P-01-M-01: Conceptual clarification of cyber-risk analysis and cybersecurity. • P-01-M-02: Overview of the overall cyber-risk analysis process.

Table 19. Course: Introduction to cyber-risk analysis and cybersecurity (P-01)

As indicated above, the course consists of the two modules P-01-M-01 and P-01-M-02. These modules are described in Table 20 and Table 21, respectively.

ID	P-01-M-01; Accompanying slide set number: 1
Name	Conceptual clarification of cyber-risk analysis and cybersecurity
Learning Objectives	It is expected that by the end of this module, participants will be able to identify and describe basic concepts related to cyber-risk analysis and cybersecurity. This includes: 1. Describe and distinguish risk-related concepts: a. Risk b. Unwanted incident c. Asset d. Party e. Likelihood f. Conditional likelihood g. Consequence h. Risk level i. Target of analysis j. System k. Vulnerability l. Threat m. Threat source n. Treatment 2. Describe and distinguish cybersecurity-related concepts: a. Cyberspace b. Cyber-system c. Cyber-physical system d. Cybersecurity e. Cyber-threat f. Cyber-risk g. Information security h. Confidentiality i. Integrity j. Availability
Module Duration	45 minutes
Prerequisites	General knowledge within information technology is an advantage, but not a requirement.
Content list	The following training material explaining the risk-related concepts and the cybersecurity-related concepts listed above. • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 20. Module: Conceptual clarification of cybersecurity and risk analysis (P-01-M-01)

ID	P-01-M-02; Accompanying slide set number: 1
Name	Overview of the overall cyber-risk analysis process
Learning Objectives	It is expected that by the end of this module, participants will be able to name and describe the steps in the overall process of cyber-risk analysis. This includes: 1. Briefly describe the purpose of: a. Context establishment b. Risk identification c. Risk estimation d. Risk evaluation e. Risk treatment 2. Identify the differences of the above steps.
Module Duration	45 minutes
Prerequisites	General knowledge within information technology is an advantage, but not a requirement.
Content list	The following training material explaining the overall process of cyber-risk analysis. • PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 21. Module: Overview of the overall risk analysis process (P-01-M-02)

5.2.2 Awareness of five common cybersecurity risks

This section describes the five awareness courses provided in the Primer offering level. The five awareness courses are:

- Awareness of Phishing (see Table 22)
- Awareness of Password Weaknesses (see Table 23)
- Awareness of Ransomware (see Table 24)
- Awareness of Data Leakage (see Table 25)
- Awareness of Insider Threat (see Table 26)

Table 22 describes the course “Awareness of Phishing”. Upon completion of the course, the trainee will be able to define what phishing means, distinguishing between phishing and spear phishing. The trainee acquires understanding of social engineering techniques to defend against disclosing important information. The course aims also to raise personal commitment in security enhancement, teaching to signal phishing attempt.

ID	P-02; Accompanying slide set number: 2
Name	Awareness of Phishing
Cybersecurity role	R1, R2, R3, R4, R5
Skill and expected skill level to be trained	For all roles, the skill obtained is general awareness and mitigation of well-known Phishing attack they may be exposed to. This also implicitly trains them in the skills B1, B2, B3 by thinking about how such an attack may occur, what are the indicators, and how to mitigate such attacks.
Offering Level	Primer
Difficulty	Easy
Course Duration	15 minutes
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand what phishing is 2. Understand the phishing attack kill chain 3. Describe why phishing is so popular 4. Understand how to protect against phishing
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. For Learning Goal1: a. Remember what social engineering is and how it is used in phishing attacks b. Understand the categories of phishing 2. For Learning Goal 2: a. Remember the main stages of the phishing attack b. Understand the importance of social engineering in a phishing attack 3. For Learning Goal 3: a. Name who is using phishing b. Understand the need of attackers to use phishing c. Understand why phishing is still popular 4. For Learning Goal 4: a. Identify phishing indicators b. Distinguish phishing emails c. Estimate proper action upon suspicious email d. Remember good habits for keeping security
Prerequisites	The participant must have the following knowledge: • Basic knowledge of using e-mail • Basic knowledge of how a browser works
Module list	No modules. The training material for awareness of phishing consists of: • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 22. Course: Awareness of Phishing (P-02)

Table 23 describes the course “Awareness of Password Weaknesses”. Upon completion of this course, the trainee will be able to understand the need to have a password and be aware of good practices associated when defining it.

ID	P-03; Accompanying slide set number: 3
Name	Awareness of Password Weaknesses
Cybersecurity role	R1, R2, R3, R4, R5
Skill and expected skill level to be trained	For all roles, the skill obtained is general awareness and mitigation of well-known Password Weakness vulnerabilities they may be exposed to. This also implicitly trains them in the skills B1, B2, B3 by thinking about how such weaknesses may occur, what are the indicators, and how to mitigate such weaknesses.
Offering Level	Primer
Difficulty	Easy
Course Duration	15 minutes
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand the use of passwords for authentication 2. Understand the risks associated with weak passwords 3. Remember password best practices
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. For Learning Goal 1: a. Understand why a strong password is important b. Explain the need of different passwords for the various systems 2. For Learning Goal 2: a. List factors that make a password weak b. List different attacks exploring password weakness c. Explain the need to change a default password d. Describe different actions of an attacker with a password 3. For Learning Goal 3: a. List different guidelines for creating a strong password b. Identify password bad practices c. List mechanisms for password management
Prerequisites	General knowledge/experience in creating accounts (username and password) in software applications is an advantage, but not a requirement.
Module list	No modules. The training material for awareness of password weaknesses consists of: • PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 23. Course: Awareness of Password Weaknesses (P-03)

Table 24 describes the course "awareness of ransomware". Upon completion of the course, the trainee will learn about ransomware, a type of malware that imprisons user data making the data unavailable by encryption in order to request a ransom to release them (decrypt the data). The course participants will become aware of ransomware kill chain and of other types of malware, understanding impacts and correlation with other threats. Finally, the participant will be able to estimate suspicious payloads and evaluate proper action against attacks' attempts and good habits to mitigate malware probabilities of success.

ID	P-04; Accompanying slide set number: 4
Name	Awareness of Ransomware
Cybersecurity role	R1, R2, R3, R4, R5
Skill and expected skill level to be trained	For all roles, the skill obtained is general awareness and mitigation of well-known Ransomware attack they may be exposed to. This also implicitly trains them in the skills B1, B2, B3 by thinking about how such an attack may occur, what are the indicators, and how to mitigate such attacks.
Offering Level	Primer
Difficulty	Easy
Course Duration	15 minutes
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand what ransomware is among malware definition 2. Learn about the malware attack kill chain 3. Describe how Malware is increasingly targeting our society 4. Understand how to protect against Ransomware and other Malware
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. For Learning Goal 1: a. Remember what malicious software (malware) is and how ransomware is used b. Understand different types of malware 2. For Learning Goal 2: a. Recall the main stages of ransomware infection b. Understand the correlation with other cyber threats 3. For Learning Goal 3: a. Remember examples about malware attacks b. Understand why malware can't be completely defeated 4. For Learning Goal 4: a. Remember good cybersecurity hygiene practices b. Identify malware and ransomware indicators of infection c. Estimate proper action and mitigation after malware infection
Prerequisites	None.
Module list	No modules. The training material for awareness of ransomware consists of: • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 24. Course: Awareness of Ransomware (P-04)

Table 25 describes the course "awareness of data leakage". Upon completion of this course, the participant will understand the drivers of data leakage attacks, by learning attack vectors, scope and impacts of this threat. The participant will be aware of crucial factors that enable data leakage and the correlation with other threats or consequences (data breach, data disclosure).

ID	P-05; Accompanying slide set number: 5
Name	Awareness of Data Leakage
Cybersecurity role	R1, R2, R3, R4, R5
Skill and expected skill level to be trained	For all roles, the skill obtained is general awareness and mitigation of well-known Data Leakage weaknesses they may be exposed to. This also implicitly trains them in the skills B1, B2, B3 by thinking about how such a weakness may occur, what are the indicators, and how to mitigate such weaknesses.
Offering Level	Primer
Difficulty	Easy
Course Duration	15 minutes
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand the scope and impact of data leakage 2. Understand the attack vectors used for data leakage 3. Describe how data leakage is increasingly targeting our society 4. Understand how to protect against data leakage
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. For Learning Goal 1: a. Remember what data leakage is and what information is targeted b. Understand different scopes and impacts of data leakage c. Understand the difference between data leakage and personal data breach 2. For Learning Goal 2: a. Remember common data leakage attack vectors b. Understand the correlation with other cyber threats 3. For Learning Goal 3: a. Recall examples about data leakage and personal data breaches b. Recall new paths for attacks c. Name security threat agents and top sectors under attack 4. For Learning Goal 4: a. List data leakage mitigation actions and countermeasures b. Name security threat agents and top sectors under attack
Prerequisites	None.
Module list	No modules. The training material for awareness of data leakage consists of: • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 25. Course: Awareness of Data Leakage (P-05)

Table 26 describes the course "Awareness of Insider Threat". After doing this course, the trainee will be aware of the different insider threat profiles and how an insider threat can compromise the confidentiality, integrity and availability of the organization's network systems, data or premises.

ID	P-06; Accompanying slide set number: 6
Name	Awareness of Insider Threat
Cybersecurity role	R1, R2, R3, R4, R5
Skill and expected skill level to be trained	For all roles, the skill obtained is general awareness and mitigation of Insider Threats they may be exposed to. This also implicitly trains them in the skills B1, B2, B3 by thinking about how insider threats may occur, what are the indicators, and how to mitigate such threats.
Offering Level	Primer
Difficulty	Easy
Course Duration	15 minutes
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand the concept of insider threat 2. Remember the indicators of insider threats 3. Remember measures to detect insider threats 4. Understand legal concerns related with insider threats
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. For Learning Goal 1: a. Describe what an insider threat is b. Understand the need to know all your assets c. Understand the need to keep the record of all approved accesses/communications 2. For Learning Goal 2: a. List different characteristics of an insider threat b. Identify different insider threat profiles 3. For Learning Goal 3: a. Understand how an insider threat can be detected b. List different mechanisms to detect an insider threat 4. For Learning Goal 4: a. Understand the need to protect employee privacy b. Identify the boundaries between protecting and surveillance
Prerequisites	None.
Module list	No modules. The training material for awareness of insider threat consists of: • PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 26. Course: Awareness of Insider Threat (P-06)

5.2.3 Introduction to cyber-risk assessment

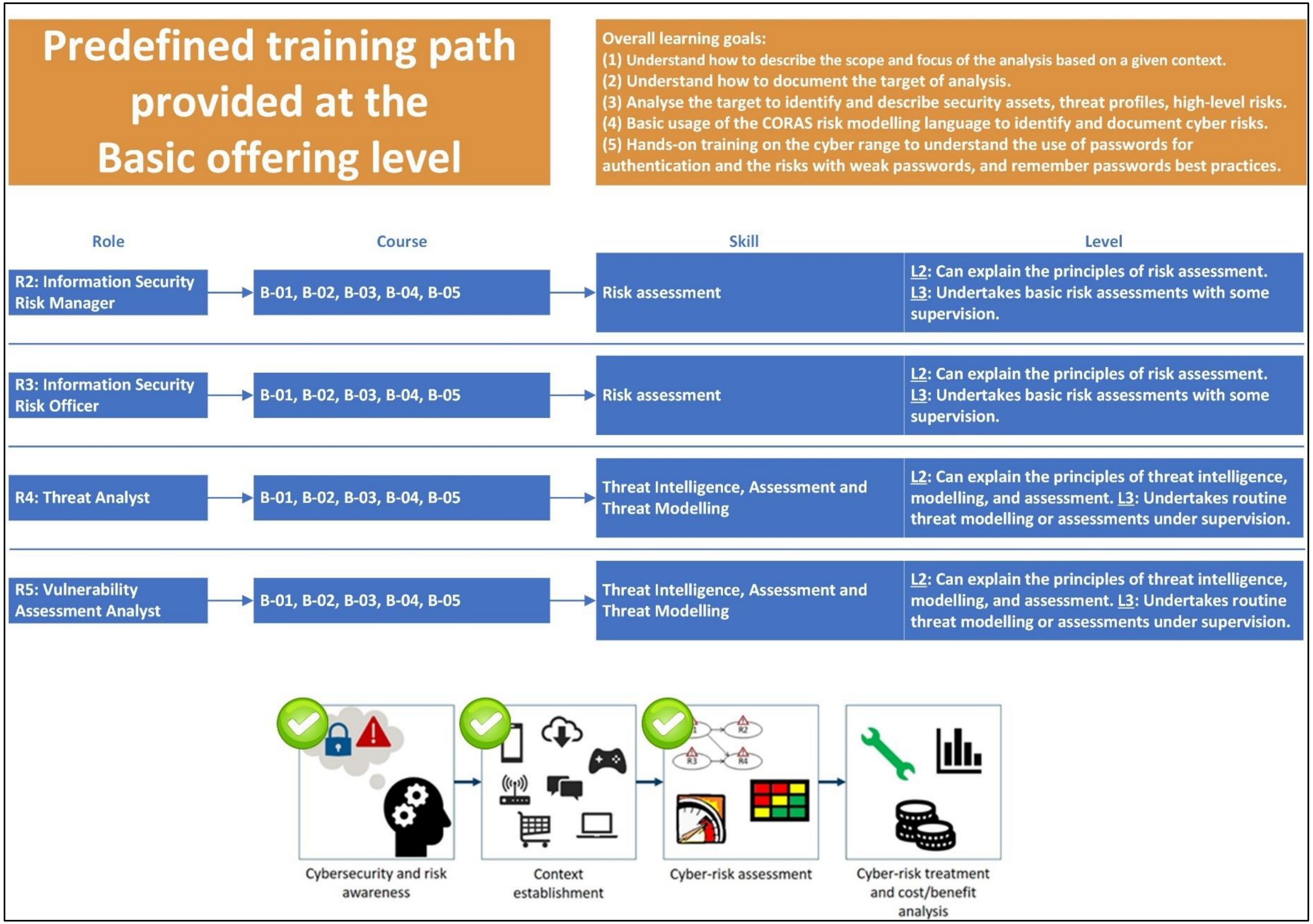
The purpose of this course is to teach in more detail (compared to Course P-01) the purpose of cyber-risk assessment including the activities risk identification, risk estimation, and risk evaluation. The course will go into more detail of various strategies for each of the aforementioned activities, but still stay at a general level.

ID	P-07; Accompanying slide set number: 7
Name	Introduction to cyber-risk assessment
Cybersecurity role	R2, R3, R4, R5
Skill and expected skill level to be trained	• R2 – Skill B2, Level 1, Level 2. • R3 – Skill B2, Level 1, Level 2. • R4 – Skill B1, Level 1. • R5 – Skill B1, Level 1.
Offering Level	Primer
Difficulty	Medium
Course Duration	45 minutes
Learning Goals	It is expected that by the end of this course, participants in this course will: Understand at a deeper level (compared to course P-01) the purpose of cyber-risk assessment and the activities typically covered within cyber-risk assessment.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: Describe at high-level the activities typically carried out in cyber-risk assessment including: a. Risk identification b. Risk estimation c. Risk evaluation
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. General knowledge within information technology is an advantage, but not a requirement.
Module list	No modules. The training material for awareness of phishing consists of: • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 27. Course: Introduction to cyber-risk assessment (P-07)

5.3 Courses for the basic offering level

This section describes the Courses B-01 – B-05 outlined in Table 18. Before describing all courses in detail, we illustrate in Figure 13 the predefined training path provided at the Basic offering level. This figure can be viewed as a high-level overview of the roles that may be trained by the courses provided at the Basic offering level, the courses to take, and skills (and skill levels) that are trained as a result of taking the indicated courses. Moreover, the figure also provides the overall learning goals as well as the part of the risk-centric learning path addressed by the Basic offering level (green check marks on cybersecurity and risk awareness, context establishment, and cyber-risk assessment). All courses referred to in Figure 13 are described in detail in the following sections.



Predefined training path provided at the Basic offering level

Overall learning goals:
(1) Understand how to describe the scope and focus of the analysis based on a given context.
(2) Understand how to document the target of analysis.
(3) Analyse the target to identify and describe security assets, threat profiles, high-level risks.
(4) Basic usage of the CORAS risk modelling language to identify and document cyber risks.
(5) Hands-on training on the cyber range to understand the use of passwords for authentication and the risks with weak passwords, and remember passwords best practices.

Role	Course	Skill	Level
R2: Information Security Risk Manager	B-01, B-02, B-03, B-04, B-05	Risk assessment	L2: Can explain the principles of risk assessment. L3: Undertakes basic risk assessments with some supervision.
R3: Information Security Risk Officer	B-01, B-02, B-03, B-04, B-05	Risk assessment	L2: Can explain the principles of risk assessment. L3: Undertakes basic risk assessments with some supervision.
R4: Threat Analyst	B-01, B-02, B-03, B-04, B-05	Threat Intelligence, Assessment and Threat Modelling	L2: Can explain the principles of threat intelligence, modelling, and assessment. L3: Undertakes routine threat modelling or assessments under supervision.
R5: Vulnerability Assessment Analyst	B-01, B-02, B-03, B-04, B-05	Threat Intelligence, Assessment and Threat Modelling	L2: Can explain the principles of threat intelligence, modelling, and assessment. L3: Undertakes routine threat modelling or assessments under supervision.

Cybersecurity and risk awareness → Context establishment → Cyber-risk assessment → Cyber-risk treatment and cost/benefit analysis

Figure 13. Predefined training path provided at the Basic offering level

5.3.1 Describe target of analysis, level 1

The purpose of this course is to teach about describing the scope and focus of the target system under analysis. The course will also explain the importance of doing this and teach about general strategies to document the target of analysis at a sufficient level of abstraction. The course has two modules. The first module (see Table 29) focuses on describing the scope and focus of the target system, while the second module (see Table 30) focuses on documenting the target of analysis.

ID	B-01
Name	Describe target of analysis, level 1
Cybersecurity role	R2, R3, R4, R5
Skill and expected skill level to be trained	• R2 – Skill B2, Level 2. • R3 – Skill B2, Level 2. • R4 – Skill B1, Level 2. • R5 – Skill B1, Level 2.
Offering Level	Basic
Difficulty	Medium
Course Duration	90 minutes (two modules, 45 minutes each module)
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand how to describe the scope and focus of the analysis based on a given context. 2. Understand how to document the target of analysis.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Describe the scope and focus of analysis with respect to a predefined context. 2. Create a model describing the target of analysis in an informal/semi-formal manner. By target of analysis, we mean the system to be simulated on the cyber range.
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment. Basic knowledge within but not limited to a bachelor's degree in computer science.
Module list	• B-01-M-01: Describe scope and focus of analysis, what is included and what is excluded? • B-01-M-02: Model the target of analysis

Table 28. Course: Describe target of analysis, level 1 (B-01)

ID	B-01-M-01; Accompanying slide set number: 8
Name	Describe scope and focus of analysis, what is included and what is excluded?
Learning Objective	It is expected that by the end of this module, participants will be able to: 1. Understand the concepts scope and focus and how they are related. 2. Describe the scope and focus of analysis with respect to a predefined context. 3. Understand the importance of, and how to explicitly describe, what is excluded from the target of analysis.
Module Duration	45 minutes
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment. Basic knowledge within but not limited to a bachelor's degree in computer science.
Content list	The following training material explaining how to describe scope, focus, and what is included/excluded of the analysis. • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 29. Module: Describe scope and focus of analysis, what is included and what is excluded? (B-01-M-01)

ID	B-01-M-02; Accompanying slide set number: 8
Name	Model the target of analysis
Learning Objective	It is expected that by the end of this module, participants will be able to: Model the target of analysis in an informal and semi-formal manner. This builds the basis for the participant to understand the scope of the cyber-risk assessment, and for creating simulated infrastructure on the CYBERWISER.eu cyber range (which is covered in Course I-02 – Describe target of analysis, level 2).
Module Duration	45 minutes
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment. Basic knowledge within but not limited to a bachelor's degree in computer science.
Content list	The following training material explaining how to model the target of analysis in an informal/semi-formal manner. • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 30. Module: Model the target of analysis (B-01-M-02)

5.3.2 Identify and describe security assets, level 1

The purpose of this course is to teach a structured approach to identify and document security assets that are to be considered in the cyber-risk assessment. This includes teaching strategies for how to analyse the target description to extract the asset-relevant information.

ID	B-02; Accompanying slide set number: 9
Name	Identify and describe security assets, level 1
Cybersecurity role	R2, R3, R4, R5
Skill and expected skill level to be trained	• R2 – Skill B2, Level 2. • R3 – Skill B2, Level 2. • R4 – Skill B1, Level 2. • R5 – Skill B1, Level 2.
Offering Level	Basic
Difficulty	Medium
Course Duration	45 minutes
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand how to analyse the target to identify and describe security assets. 2. Describe security assets using CORAS asset diagrams.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Identify and select appropriate security assets for the predefined target of analysis. 2. Understand the constructs necessary to create CORAS asset diagrams. 3. Create CORAS asset diagrams capturing security assets.
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment. Basic knowledge within but not limited to a bachelor's degree in computer science.
Module list	No modules. The following training material explaining how to analyse the target to identify and describe security assets, as well as describing assets using CORAS diagrams. • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 31. Course: Identify and describe security assets, level 1 (B-02)

5.3.3 Identify and describe threat profiles and high-level risks, level 1

The purpose of this course is to teach a structured approach to organize risk-related information based on the target description, and how to use this information later to identify risks. The course also introduces the basic constructs of the risk modelling language CORAS.

ID	B-03; Accompanying slide set number: 10
Name	Identify and describe threat profiles and high-level risks, level 1
Cybersecurity role	R2, R3, R4, R5
Skill and expected skill level to be trained	• R2 – Skill B2, Level 2. • R3 – Skill B2, Level 2. • R4 – Skill B1, Level 2. • R5 – Skill B1, Level 2.
Offering Level	Basic
Difficulty	Medium/Hard
Course Duration	45 minutes
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand the constructs necessary to create CORAS risk models. 2. Understand how to organize risk-related information to describe high-level risks. 3. Understand how to organize this information and later use it as input to risk identification.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Associate risk-related concept to the corresponding CORAS risk model constructs. 2. Create a high-level risk table to document: a. Threat sources by answering: who/what causes the risk? b. Threats, unwanted incidents, and assets by answering: how? What is the incident? What does the risk harm? Respectively. c. Vulnerabilities by answering: what makes the risk possible?
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment. B-02 Identify and describe security assets, level 1. Basic knowledge within but not limited to a bachelor's degree in computer science.
Module list	No modules. The following form of training material to teach about documenting high-level risks, including threats, incidents, assets, and vulnerabilities using high-level risk table: • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 32. Course: Identify and describe threat profiles and high-level risks, level 1 (B-03)

5.3.4 Identify risks, level 1

The purpose of this course is to teach the basic usage of the CORAS modelling language to identify and document cyber-risks. The course provides hands-on training in identifying cybersecurity risks by simulating a target of analysis exposed to certain cyber-attacks. The participant will, amongst other activities, look for possible attacks by observing the simulation and document these attacks using the CORAS modelling language.

ID	B-04
Name	Identify risks, level 1
Cybersecurity role	R2, R3, R4, R5
Skill and expected skill level to be trained	• R2 – Skill B2, Level 2, Level 3. • R3 – Skill B2, Level 2, Level 3. • R4 – Skill B1, Level 2, Level 3. • R5 – Skill B1, Level 2, Level 3.
Offering Level	Basic
Difficulty	Medium/Hard
Course Duration	90 minutes (two modules, 45 minutes each module)
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand how to apply the CORAS modelling language to identify risks. 2. Demonstrate the application of the CORAS risk modelling language by identifying appropriate risks with respect to a target of analysis simulated on the cyber range.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Understand the basics of the CORAS risk modelling language. 2. Identify risks, including threat source, threats, vulnerabilities, incidents, and security assets to protect, with respect to a target of analysis simulated on the cyber range.
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment. B-02 Identify and describe security assets, level 1. B-03 Identify and describe threat profiles and high-level risks, level 1. Basic knowledge within but not limited to a bachelor's degree in computer science.
Module list	• B-04-M-01: Introduction to CORAS • B-04-M-02: Identify risks using the CORAS risk modelling language with respect to simulated scenarios

Table 33. Course: Identify risks, level 1 (B-04)

The course has two modules to achieve the learning objectives. The first module introduces the CORAS risk modelling language and its basic usage (see Table 34), while the second module focuses on hands-on training of risk identification (see Table 35).

ID	B-04-M-01; Accompanying slide set number: 11
Name	Introduction to CORAS
Learning Objectives	It is expected that by the end of this module, participants will be able to: 1. Understand the basic constructs of the CORAS modelling language. 2. Associate cyber-risk concepts to the constructs of CORAS.

ID	B-04-M-01; Accompanying slide set number: 11
Module Duration	45 minutes
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment. B-02 Identify and describe security assets, level 1. B-03 Identify and describe threat profiles and high-level risks, level 1. Basic knowledge within but not limited to a bachelor's degree in computer science.
Content list	The following training material explaining the basics of the CORAS modelling language. • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 34. Module: Introduction to CORAS (B-04-M-01)

ID	B-04-M-02; Accompanying slide set number: 11
Name	Identify risks using the CORAS risk modelling language with respect to simulated scenarios
Learning Objective	It is expected that by the end of this module, participants will be able to: Create basic risk models using the CORAS constructs: Threat source, Threat, Vulnerability, Unwanted incident, and Asset with respect to simulated scenarios.
Module Duration	45 min.
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment. B-02 Identify and describe security assets, level 1. B-03 Identify and describe threat profiles and high-level risks, level 1. Basic knowledge within but not limited to a bachelor's degree in computer science.
Content list	The following training material explaining how to step-by-step create a CORAS risk model. • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 35. Module: Identify risks using the CORAS risk modelling language (B-04-M-02)

5.3.5 Awareness of Password Weakness with hands-on training

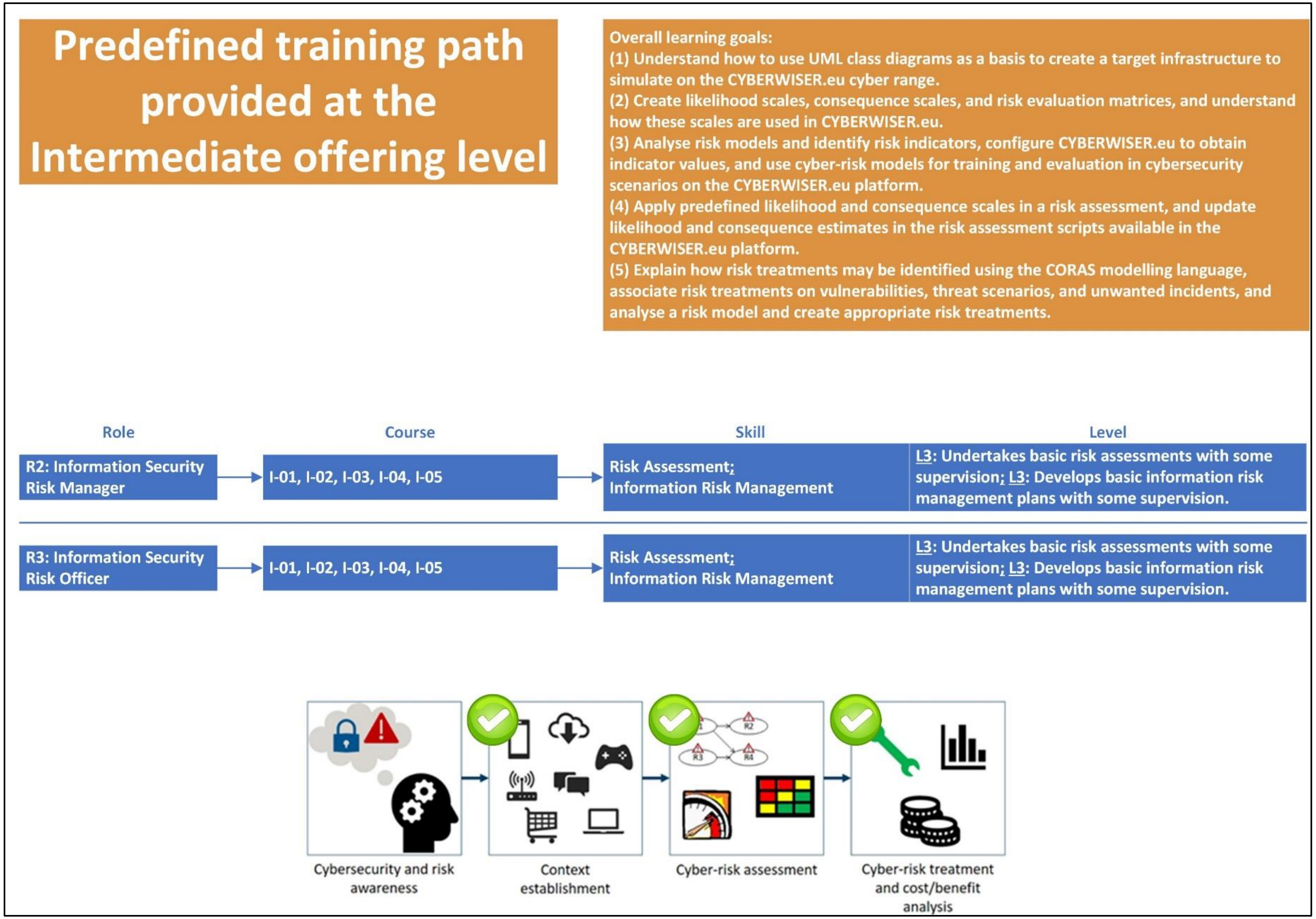
This course is an extended version of the Course P-03 (Awareness of Password Weaknesses). In addition to what is covered in P-03, this course provides hands-on training in demonstrating how weak passwords are exploited.

ID	B-05; Accompanying slide set number: 12
Name	Awareness of Password Weaknesses with hands-on training
Cybersecurity role	R2, R3, R4, R5
Skill and expected skill level to be trained	• R2 – Skill B2, Level 2. • R3 – Skill B2, Level 2. • R4 – Skill B1, Level 2. • R5 – Skill B1, Level 2.
Offering Level	Basic
Difficulty	Easy
Course Duration	45 minutes
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand the use of passwords for authentication 2. Understand the risks associated with weak passwords 3. Remember password best practices
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. For Learning Goal 1: a. Understand why a strong password is important b. Explain the need of different passwords for the various systems 2. For Learning Goal 2: a. List factors that make a password weak b. List different attacks exploring password weakness c. Explain the need to change a default password d. Describe different actions of an attacker with a password 3. For Learning Goal 3: a. List different guidelines for creating a strong password b. Identify password bad practices c. List mechanisms for password management
Prerequisites	Basic knowledge of Windows and Linux operation systems. General knowledge/experience in creating accounts (username and password) in software applications is an advantage, but not a requirement.
Module list	No modules. The following training material for awareness of password weaknesses, which also includes a hands-on training scenario: • PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file • Hands-on training on the cyber range

Table 36. Course: Awareness of Password Weaknesses with hands-on training (B-05)

5.4 Courses for the intermediate offering level

This section describes the Courses I-01 – I-05 outlined in Table 18. Before describing all courses in detail, we illustrate in Figure 14 the predefined training path provided at the Intermediate offering level. This figure can be viewed as a high-level overview of the roles that may be trained by the courses provided at the Intermediate offering level, the courses to take, and skills (and skill levels) that are trained as a result of taking the indicated courses. Moreover, the figure also provides the overall learning goals as well as the part of the risk-centric learning path addressed by the Intermediate offering level (green check marks on context establishment, cyber-risk assessment, and cyber-risk treatment and cost/benefit analysis). All courses referred to in Figure 14 are described in detail in the following sections.



Predefined training path provided at the Intermediate offering level

Overall learning goals:
(1) Understand how to use UML class diagrams as a basis to create a target infrastructure to simulate on the CYBERWISER.eu cyber range.
(2) Create likelihood scales, consequence scales, and risk evaluation matrices, and understand how these scales are used in CYBERWISER.eu.
(3) Analyse risk models and identify risk indicators, configure CYBERWISER.eu to obtain indicator values, and use cyber-risk models for training and evaluation in cybersecurity scenarios on the CYBERWISER.eu platform.
(4) Apply predefined likelihood and consequence scales in a risk assessment, and update likelihood and consequence estimates in the risk assessment scripts available in the CYBERWISER.eu platform.
(5) Explain how risk treatments may be identified using the CORAS modelling language, associate risk treatments on vulnerabilities, threat scenarios, and unwanted incidents, and analyse a risk model and create appropriate risk treatments.

Role	Course	Skill	Level
R2: Information Security Risk Manager	I-01, I-02, I-03, I-04, I-05	Risk Assessment; Information Risk Management	L3: Undertakes basic risk assessments with some supervision; L3: Develops basic information risk management plans with some supervision.
R3: Information Security Risk Officer	I-01, I-02, I-03, I-04, I-05	Risk Assessment; Information Risk Management	L3: Undertakes basic risk assessments with some supervision; L3: Develops basic information risk management plans with some supervision.

R2
R3
R4
Cybersecurity and risk awareness
Context establishment
Cyber-risk assessment
Cyber-risk treatment and cost/benefit analysis

Figure 14. Predefined training path provided at the Intermediate offering level

5.4.1 Describe target of analysis, level 2

The purpose of this course is to teach about creating UML models, in particular UML class diagrams, and how to use this notation to represent a corresponding simulated infrastructure on the CYBERWISER.eu cyber range. The course also provides a hands-on task to teach how to create corresponding simulated infrastructure.

ID	I-01; Accompanying slide set number: 13
Name	Describe target of analysis, level 2
Cybersecurity role	R2, R3
Skill and expected skill level to be trained	• R2 – Skill B3, Level 3. • R3 – Skill B2, Level 3.
Offering Level	Intermediate
Difficulty	Medium
Course Duration	60 minutes
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand how to use UML class diagrams to represent a target infrastructure to simulate. 2. Apply the relevant assets on the CYBERWISER.eu cyber range to create simulated infrastructure.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Explain what UML class diagrams are and how these diagrams can be used to represent target infrastructure for analysis. 2. Create UML class diagrams to represent a target infrastructure. 3. Use the relevant assets in the CYBERWISER.eu platform to create a simulated infrastructure with respect to a UML class diagram.
Prerequisites	Bachelor level knowledge about modelling in software development.
Module list	No modules. The following training material explaining how to create UML models (class diagrams) as well as simulated infrastructure to be simulated on the CYBERWISER.eu platform is included: • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file • Exercise on the cyber range (Described in D4.5 [34])

Table 37. Course: Describe target of analysis, level 2 (I-01)

5.4.2 Identify risk criteria

The purpose of this course is to teach about risk criteria. This includes defining likelihood and consequence scales. Such scales are used as part of cyber-risk assessment to estimate the consequence and likelihood of risks. Moreover, a risk is often calculated in terms of two factors, which is the product of a likelihood value and a consequence value. In CYBERWISER.eu, the likelihood is defined in terms of frequency intervals, while the consequence is defined in terms of monetary loss. To assess the severity of risks, that is, to identify risk levels, we create risk evaluation matrices, which are a combination of likelihood and consequence scales. This course also teaches about creating risk evaluation matrices with respect to predefined likelihood and consequence scales. Finally, the course provides an exercise on the cyber range to teach how to interpret and use the risk assessment produced in the CYBERWISER.eu platform as a basis to select appropriate countermeasures.

ID	I-02
Name	Identify risk criteria
Cybersecurity role	R2, R3
Skill and expected skill level to be trained	• R2 – Skill B3, Level 3. • R3 – Skill B3, Level 3.
Offering Level	Intermediate
Difficulty	Medium/Hard
Course Duration	120 minutes (four modules, 30 minutes each module)
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Learn how to create likelihood scales, consequence scales, and risk evaluation matrices based on these scales. 2. Understand how likelihood scales, consequence scales, and risk evaluation matrices are used in the CYBERWISER.eu platform.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Define likelihood and consequence scales, as well as risk evaluation matrices. 2. Interpret likelihood, consequence, and risk evaluation matrices on the CYBERWISER.eu platform.
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment.
Module list	• I-02-M-01: Define likelihood scales. • I-02-M-02: Define consequence scales for each information security asset. • I-02-M-03: Define risk evaluation criteria and corresponding risk evaluation matrix. • I-02-M-04: Cyber-risk reports on CYBERWISER.eu

Table 38. Course: Identify risk criteria (I-02)

Module ID	I-02-M-01; Accompanying slide set number: 14
Name	Define likelihood scales.
Learning Objectives	It is expected that by the end of this module, participants will be able to explain what likelihood scales are and create a scale for describing the likelihood of unwanted incidents. The scale is defined in terms of frequencies and is to be used when estimating cyber-risk values.
Module Duration	30 min.
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment.
Content list	• PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 39. Module: Define likelihood scales (I-02-M-01)

Module ID	I-02-M-02; Accompanying slide set number: 14
Name	Define consequence scales for each information security asset.
Learning Objectives	It is expected that by the end of this module, participants will be able to explain what consequence scales are and create consequence scales for describing the harm of identified unwanted incidents on information security assets that need protection. Consequence scales are to be used when estimating cyber-risk values.
Module Duration	30 min.
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment.
Content list	• PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 40. Module: Define consequence scales for each information security asset (I-02-M-02)

Module ID	I-02-M-03; Accompanying slide set number: 14
Name	Define risk evaluation criteria and corresponding risk evaluation matrix.
Learning Objectives	It is expected that by the end of this module, participants will be able to explain what risk evaluation criteria are and create a risk evaluation matrix as a function of likelihood and consequence.
Module Duration	30 min.
Prerequisites	I-02-M-01 Define likelihood scales. I-02-M-02 Define consequence scales for each information security asset. P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment.

Module ID	**I-02-M-03; Accompanying slide set number: 14**
Content list	• PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 41. Module: Define risk evaluation criteria and corresponding risk evaluation matrix (I-02-M-03)

Module ID	**I-02-M-04; Accompanying slide set number: 14**
Name	Cyber-risk reports on CYBERWISER.eu
Learning Objectives	This module is specifically related to the usage of the CYBERWISER.eu platform. It is expected that by the end of this module, participants will be able to interpret the cyber risk report produced by the Economic Risk Evaluator (ERE) asset of the CYBERWISER.eu platform, understanding its elements, structure and meaning.
Module Duration	45 minutes.
Prerequisites	I-02-M-01 Define likelihood scales. I-02-M-02 Define consequence scales for each information security asset. P-01 Introduction to cyber-risk analysis and cybersecurity. P-07 Introduction to cyber-risk assessment.
Content list	• PowerPoint presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file • Exercise on the cyber range (Described in D4.5 [34])

Table 42. Module: Cyber-risk reports on CYBERWISER.eu (I-02-M-04)

5.4.3 Identify risks, level 2

This course teaches about the identification of cyber-risk indicators and the inclusion of such indicators in a cyber-risk model using the CORAS risk modelling language. The course also teaches about the technical aspects of indicators and how the CYBERWISER.eu assets *Monitoring Sensors*, *Attack Simulator*, and *Vulnerability Assessment Tools* may be configured and used to obtain values for the risk indicators. Finally, the course provides an exercise on the cyber range which takes the participant through the steps of the scenario development method (documented in D4.5 [34]) to configure and make a scenario ready for execution on the cyber range. The exercise also helps the participant to understand how indicator values are used in the cyber range to support the real-time risk assessment and for the purpose of performance evaluation of the participants.

ID	I-03
Name	Identify risks, level 2
Cybersecurity role	R2, R3
Skill and expected skill level to be trained	• R2 – Skill B2, Level 3. • R3 – Skill B2, Level 3.
Offering Level	Intermediate
Difficulty	Hard/Challenging
Course Duration	135 minutes (four modules, 45 minutes each module)
Learning Goals	It is expected that by the end of this course, participants in this course will identify risk indicators and understand how to obtain indicator values and instantiate risk models available in CYBERWISER.eu.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Analyse a risk model and identify risk indicators. 2. Use and configure CYBERWISER.eu assets (Monitoring Sensors, Attack Simulator, Vulnerability Assessment Tools) to obtain indicator values and explain how the trainees' actions affect the risk and performance assessment. 3. Use cyber-risk models for training and evaluation in cybersecurity scenarios on the CYBERWISER.eu platform.
Prerequisites	B-04-M-01 Introduction to CORAS. B-04-M-02 Identify risks using the CORAS risk modelling language with respect to simulated scenarios.
Module list	• I-03-M-01: Identify risk indicators. • I-03-M-02: Obtaining indicator values in CYBERWISER.eu • I-03-M-03: Cyber-risk models in support of cybersecurity training and evaluation.

Table 43. Course: Identify risks, level 2 (I-03)

Module ID	I-03-M-01; Accompanying slide set number: 15
Name	Identify risk indicators.
Learning Objectives	It is expected that by the end of this module, participants will be able to analyse a risk model and identify risk indicators using the CORAS risk modelling language (extended with indicator constructs as explained in D2.8).
Module Duration	45 minutes.
Prerequisites	B-04-M-01 Introduction to CORAS. B-04-M-02 Identify risks using the CORAS risk modelling language with respect to simulated scenarios.
Content list	• PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 44. Module: Identify risk indicators (I-03-M-01)

Module ID	I-03-M-02; Accompanying slide set number: 15
Name	Obtaining indicator values in CYBERWISER.eu
Learning Objectives	This module is specifically related to the usage of the CYBERWISER.eu platform by scenario designers and trainers (Green/White team). It is expected that by the end of this module, participants will be able to configure and use the following CYBERWISER.eu assets to obtain indicator values in the training scenarios: 1. Monitoring Sensors 2. Attack Simulator 3. Vulnerability Assessment Tools Participants will be able to explain how the values of indicators are obtained, the difference between the types of indicators used in CYBERWISER.eu risk models (business, test, network, and application indicators) and how their values affect the risk assessment and performance evaluation of the trainees.
Module Duration	45 min.
Prerequisites	B-04-M-01 Introduction to CORAS. B-04-M-02 Identify risks using the CORAS risk modelling language with respect to simulated scenarios. I-03-M-01 Identify risk indicators.
Content list	• PowerPoint presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 45. Module: Obtaining indicator values in CYBERWISER.eu (I-03-M-02)

Module ID	I-03-M-03; Accompanying slide set number: 15
Name	Cyber-risk models in support of cybersecurity training and evaluation.
Learning Objectives	This module is specifically related to the usage of the CYBERWISER.eu platform. It is expected that by the end of this module, participants will be able to: 1. Remember the success criteria of the CYBERWISER.eu method for using cyber-risk models in support of cybersecurity training and evaluation. 2. Understand why the method is successful if the criteria are met. 3. Explain how the fulfilment of criteria is demonstrated. 4. Remember the overall method and roles involved. 5. List Input/output and goal of each step. 6. Explain the example provided.
Module Duration	45 minutes.
Prerequisites	B-04-M-01 Introduction to CORAS. B-04-M-02 Identify risks using the CORAS risk modelling language with respect to simulated scenarios. I-03-M-01 Identify risk indicators. I-03-M-02 Obtaining indicator values in CYBERWISER.eu
Content list	• PowerPoint presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file • Exercise on the cyber range (Described in D4.5 [34])

Table 46. Module: Cyber-risk models in support of cybersecurity training and evaluation (I-03-M-03)

5.4.4 Estimate risks

This course teaches about risk estimation in terms of applying predefined likelihood and consequences scales. Examples are provided using CORAS risk models. The course also provides a practical exercise using the components in the CYBERWISER.eu platform where the participant may update risk assessment algorithms with base line estimates and use different indicator values in the execution of the risk assessment algorithm. As part of the exercise, the participant then observes the resulting risk assessment with respect to the modifications.

ID	I-04
Name	Estimate risks
Cybersecurity role	R2, R3
Skill and expected skill level to be trained	• R2 – Skill B2, Level 3. • R3 – Skill B2, Level 3.
Offering Level	Intermediate
Difficulty	Medium/Hard
Course Duration	90 minutes (two modules, 45 minutes each module)
Learning Goals	It is expected that by the end of this course, participants in this course will be able to apply predefined likelihood and consequence scales to estimate risks. Participants will also understand how risk assessment scripts in CYBERWISER.eu works and how to configure the scripts in terms of likelihood and consequence estimation.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Apply predefined likelihood and consequence scales in a risk assessment. 2. Update likelihood and consequence estimates in the risk assessment scripts available in the CYBERWISER.eu platform.
Prerequisites	B-04-M-01 Introduction to CORAS. I-02-M-01 Define likelihood scales. I-02-M-02 Define consequence scales for each information security asset. I-02-M-03 Define risk evaluation criteria and corresponding risk evaluation matrix. I-02-M-04 Cyber-risk reports on CYBERWISER.eu For the second learning objective: Bachelor's degree level knowledge about programming languages.
Module list	• I-04-M-01: Likelihood and consequence estimation. • I-04-M-02: How to update risk assessment algorithms?

Table 47. Course: Estimate risks (I-04)

Module ID	**I-04-M-01; Accompanying slide set number: 16**
Name	Likelihood and consequence estimation.
Learning Objectives	It is expected that by the end of this module, participants will be able to apply predefined likelihood scales and consequence scales to estimate cyber-risks.
Module Duration	45 minutes.
Prerequisites	B-04-M-01 Introduction to CORAS. I-02-M-01 Define likelihood scales. I-02-M-02 Define consequence scales for each information security asset. I-02-M-03 Define risk evaluation criteria and corresponding risk evaluation matrix. I-02-M-04 Cyber-risk reports on CYBERWISER.eu
Content list	• PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 48. Module: Likelihood and consequence estimation (I-04-M-01)

Module ID	**I-04-M-02; Accompanying slide set number: 16**
Name	How to update risk assessment algorithms?
Learning Objectives	This module is specifically related to the usage of the CYBERWISER.eu platform. It is expected that by the end of this module, participants will be able to update the risk assessment scripts provided by CYBERWISER.eu with respect to base line likelihood/consequence estimates, as well as including parameters corresponding to indicators in the script.
Module Duration	45 minutes.
Prerequisites	B-04-M-01 Introduction to CORAS. B-04-M-02 Identify risks using the CORAS risk modelling language with respect to simulated scenarios. I-03-M-01 Identify risk indicators. I-03-M-02 Obtaining indicator values in CYBERWISER.eu Bachelor's degree level knowledge about programming languages.
Content list	• PowerPoint presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file • Exercise on the cyber range (Described in D4.5 [34])

Table 49. Module: How to update risk assessment algorithms? (I-04-M-02)

5.4.5 Treat risks, level 1

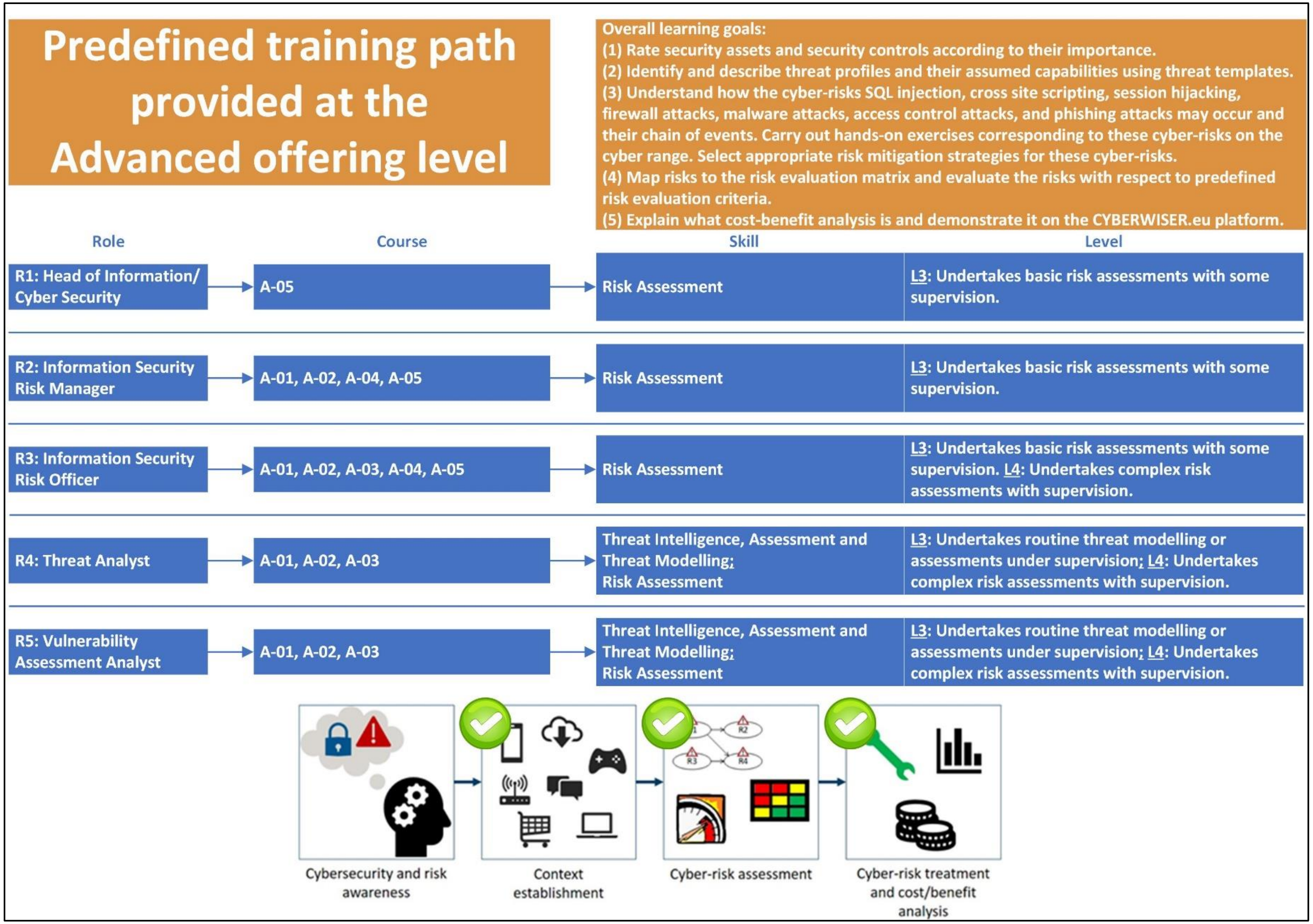
This course teaches about identifying appropriate countermeasures with respect to a predefined risk model, as well as associating countermeasures to threat scenarios, vulnerabilities, and unwanted incidents.

ID	I-05; Accompanying slide set number: 17
Name	Treat risks, level 1
Cybersecurity role	R2, R3
Skill and expected skill level to be trained	• R2 – Skill B2, Level 3. • R3 – Skill B2, Level 3.
Offering Level	Intermediate
Difficulty	Medium/Hard
Course Duration	45 minutes.
Learning Goals	It is expected that by the end of this course, participants in this course will be able to create risk models capturing risk treatments (countermeasures).
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Explain how risk treatments may be identified using the CORAS modelling language. 2. Associate risk treatments on vulnerabilities, threat scenarios, and unwanted incidents. 3. Analyse a risk model and create appropriate risk treatments.
Prerequisites	B-04-M-01 Introduction to CORAS. B-04-M-02 Identify risks using the CORAS risk modelling language with respect to simulated scenarios.
Module list	No modules. The training material consists of: • PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 50. Course: Treat risks, level 1 (I-05)

5.5 Courses for the advanced offering level

This section describes the Courses A-01 – A-05 outlined in Table 18. Before describing all courses in detail, we illustrate in Figure 15 the predefined training path provided at the Advanced offering level. This figure can be viewed as a high-level overview of the roles that may be trained by the courses provided at the Advanced offering level, the courses to take, and skills (and skill levels) that are trained as a result of taking the indicated courses. Moreover, the figure also provides the overall learning goals as well as the part of the risk-centric learning path addressed by the Advanced offering level (green check marks on context establishment, cyber-risk assessment, and cyber-risk treatment and cost/benefit analysis). All courses referred to in Figure 15 are described in detail in the following sections.



Predefined training path provided at the Advanced offering level

Overall learning goals:
(1) Rate security assets and security controls according to their importance.
(2) Identify and describe threat profiles and their assumed capabilities using threat templates.
(3) Understand how the cyber-risks SQL injection, cross site scripting, session hijacking, firewall attacks, malware attacks, access control attacks, and phishing attacks may occur and their chain of events. Carry out hands-on exercises corresponding to these cyber-risks on the cyber range. Select appropriate risk mitigation strategies for these cyber-risks.
(4) Map risks to the risk evaluation matrix and evaluate the risks with respect to predefined risk evaluation criteria.
(5) Explain what cost-benefit analysis is and demonstrate it on the CYBERWISER.eu platform.

Role	Course	Skill	Level
R1: Head of Information/ Cyber Security	A-05	Risk Assessment	L3: Undertakes basic risk assessments with some supervision.
R2: Information Security Risk Manager	A-01, A-02, A-04, A-05	Risk Assessment	L3: Undertakes basic risk assessments with some supervision.
R3: Information Security Risk Officer	A-01, A-02, A-03, A-04, A-05	Risk Assessment	L3: Undertakes basic risk assessments with some supervision. L4: Undertakes complex risk assessments with supervision.
R4: Threat Analyst	A-01, A-02, A-03	Threat Intelligence, Assessment and Threat Modelling; Risk Assessment	L3: Undertakes routine threat modelling or assessments under supervision; L4: Undertakes complex risk assessments with supervision.
R5: Vulnerability Assessment Analyst	A-01, A-02, A-03	Threat Intelligence, Assessment and Threat Modelling; Risk Assessment	L3: Undertakes routine threat modelling or assessments under supervision; L4: Undertakes complex risk assessments with supervision.

Cybersecurity and risk awareness → Context establishment → Cyber-risk assessment → Cyber-risk treatment and cost/benefit analysis

Figure 15. Predefined training path provided at the Advanced offering level

5.5.1 Identify and describe security assets, level 2

This course teaches about rating security assets according to their importance and identifying and describing existing security controls protecting the security assets. This prepares the participant for context establishment in terms of understanding how to prioritize the important parts of a simulated system under analysis in the cyber range.

ID	A-01; Accompanying slide set number: 18
Name	Identify and describe security assets, level 2
Cybersecurity role	R2, R3, R4, R5
Skill and expected skill level to be trained	• R2 – Skill B2, Level 3. • R3 – Skill B2, Level 3. • R4 – Skill B1, Level 3. • R5 – Skill B1, Level 3.
Offering Level	Advanced
Difficulty	Medium
Course Duration	30 minutes.
Learning Goals	It is expected that by the end of this course, participants in this course will understand how to evaluate and rate security assets and controls.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Rate security assets according to their importance. 2. Identify and describe existing security controls protecting the security assets.
Prerequisites	P-01-M-02 Overview of the overall cyber-risk analysis process. P-07 Introduction to cyber-risk assessment. B-03 Identify and describe threat profiles and high-level risks, level 1.
Module list	No modules. The training material consists of: • PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 51. Course: Identify and describe security assets, level 2 (A-01)

5.5.2 Identify and describe threat profiles and high-level risks, level 2

This course teaches about identifying and describing threat profiles and their assumed capabilities using threat templates. The course also teaches about identifying and describing the boundaries of a threat profile using threat overview diagrams. This course complements course A-01 in the sense that we describe threat profiles that may harm the assets we want to protect in the simulated infrastructure.

ID	A-02; Accompanying slide set number: 19
Name	Identify and describe threat profiles and high-level risks, level 2
Cybersecurity role	R2, R3, R4, R5
Skill and expected skill level to be trained	• R2 – Skill B2, Level 3. • R3 – Skill B2, Level 3. • R4 – Skill B1, Level 3. • R5 – Skill B1, Level 3.
Offering Level	Advanced
Difficulty	Medium/Hard
Course Duration	60 minutes.
Learning Goals	It is expected that by the end of this course, participants in this course will identify and describe threat profiles using threat templates.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Identify and describe threat profiles and their assumed capabilities using threat templates. 2. Identify and describe the boundaries of a threat profile using threat overview diagrams.
Prerequisites	P-01-M-02 Overview of the overall cyber-risk analysis process. P-07 Introduction to cyber-risk assessment. B-03 Identify and describe threat profiles and high-level risks, level 1.
Module list	No modules. The training material consists of: • PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 52. Course: Identify and describe threat profiles and high-level risks, level 2 (A-02)

5.5.3 Identify risks, level 3

This course is an advanced course consisting of seven real-world cyber-risk scenarios. The course participants may take the role as either defender (Blue team) or attacker (Red team) to either defend against or attack with respect to the following cyber-risk training scenarios: SQL injection, cross-site scripting, session hijacking, firewall and network filtering, targeted malware, broken access control, or phishing. The exercises cover activities relevant in all stages of cyber-risk assessment: identify, estimate, evaluate, and treat the cyber-risks. Moreover, the exercises address cyber-risks in critical infrastructures with focus on the transport and the energy sector (the Pilots in CYBERWISER.eu).

ID	A-03
Name	Identify risks, level 3
Cybersecurity role	R3, R4, R5
Skill and expected skill level to be trained	• R3 – Skill B2, Level 4. • R4 – Skill B2, Level 4. • R5 – Skill B2, Level 4.
Offering Level	Advanced
Difficulty	Hard/Challenging
Course Duration	5 hours and 15 minutes (seven modules, 45 minutes each module)
Learning Goals	It is expected that by the end of this course, participants in this course will: 1. Understand how the cyber-risks SQL injection, cross site scripting, session hijacking, firewall attacks, malware attacks, access control attacks, and phishing attacks may occur and their chain of events. 2. Assess these cyber-risks with respect to their risk levels (likelihood and consequence) by carrying out hands-on exercises on the cyber range. 3. Select appropriate risk mitigation strategies, considering also cost-benefit assessment.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Explain each of the cyber-risk attacks mentioned above, how they work and what assets they affect. 2. Demonstrate each of the cyber-risk attacks mentioned above by carrying out hands-on exercises using the CYBERWISER.eu cyber range. 3. Outline the chain of events of the cyber-risk attacks mentioned above with the help of cyber-risk models. 4. As part of the hands-on exercise, evaluate the consequences of the cyber-risk attacks mentioned above and select appropriate countermeasures to mitigate the risks.
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity. P-02 Awareness of Phishing. P-03 Awareness of Password Weaknesses. P-04 Awareness of Ransomware. P-05 Awareness of Data Leakage. P-06 Awareness of Insider Threat. P-07 Introduction to cyber-risk assessment. B-02 Identify and describe security assets, level 1. B-03 Identify and describe threat profiles and high-level risks, level 1. B-04 Identify risks, level 1. I-02 Identify risk criteria. I-03-M-01 Identify risk indicators. I-04-M-01 Likelihood and consequence estimation.

ID	A-03
	I-05 Treat risks, level 1. A-01 Identify and describe security assets, level 2. A-02 Identify and describe threat profiles and high-level risks, level 2. Previous knowledge about the cyber-risk attacks covered in the course is an advantage, but not a required prerequisite.
Module list	• A-03-M-01: SQL injection • A-03-M-02: Cross-site scripting • A-03-M-03: Session hijacking • A-03-M-04: Firewall attack and network filtering • A-03-M-05: Targeted malware • A-03-M-06: Broken access control • A-03-M-07: Phishing

Table 53. Course: Identify risks, level 3 (A-03)

Module ID	A-03-M-01; Accompanying slide set number: 20
Name	SQL injection
Learning Objectives	It is expected that by the end of this module, participants will be able to: 1. Explain what an SQL injection is, how it works and what it affects. 2. Demonstrate an SQL injection attack by carrying out a predefined SQL injection exercise using the CYBERWISER.eu cyber range. The exercise is described in Deliverable D5.2. 3. Outline the chain of events in an SQL injection attack pattern with the help of cyber-risk models. The cyber-risk model representing an SQL injection attack pattern is documented in Deliverable D2.8. 4. Evaluate the consequences of an SQL injection and select appropriate countermeasures to mitigate the risk.
Module Duration	45 minutes
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity P-02 Awareness of Phishing P-03 Awareness of Password Weaknesses P-04 Awareness of Ransomware P-05 Awareness of Data Leakage P-06 Awareness of Insider Threat P-07 Introduction to cyber-risk assessment B-02 Identify and describe security assets, level 1 B-03 Identify and describe threat profiles and high-level risks, level 1 B-04 Identify risks, level 1 I-02 Identify risk criteria I-03-M-01 Identify risk indicators I-04-M-01 Likelihood and consequence estimation I-05 Treat risks, level 1 A-01 Identify and describe security assets, level 2 A-02 Identify and describe threat profiles and high-level risks, level 2 Previous knowledge about the cyber-risk attacks covered in the course is an advantage, but not a required prerequisite.

Module ID	A-03-M-01; Accompanying slide set number: 20
Content list	• PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file • SQL injection exercise on the cyber range (Described in D4.5 [34])

Table 54. Module: SQL injection (A-03-M-01)

Module ID	A-03-M-02; Accompanying slide set number: 20
Name	Cross-site scripting
Learning Objectives	It is expected that by the end of this module, participants will be able to: 1. Explain what a cross-site scripting (XSS) is, how it works and what it affects. 2. Demonstrate a cross-site scripting attack by carrying out a predefined cross-site scripting exercise using the CYBERWISER.eu cyber range. The exercise is described in Deliverable D5.2. 3. Outline the chain of events in a cross-site scripting attack pattern with the help of cyber-risk models. The cyber-risk model representing a cross-site scripting attack pattern is documented in Deliverable D2.8. 4. Evaluate the consequences of a cross-site scripting and select appropriate countermeasures to mitigate the risk.
Module Duration	45 minutes
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity P-02 Awareness of Phishing P-03 Awareness of Password Weaknesses P-04 Awareness of Ransomware P-05 Awareness of Data Leakage P-06 Awareness of Insider Threat P-07 Introduction to cyber-risk assessment B-02 Identify and describe security assets, level 1 B-03 Identify and describe threat profiles and high-level risks, level 1 B-04 Identify risks, level 1 I-02 Identify risk criteria I-03-M-01 Identify risk indicators I-04-M-01 Likelihood and consequence estimation I-05 Treat risks, level 1 A-01 Identify and describe security assets, level 2 A-02 Identify and describe threat profiles and high-level risks, level 2 Previous knowledge about the cyber-risk attacks covered in the course is an advantage, but not a required prerequisite.
Content list	• PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file • Cross-site scripting exercise on the cyber range (Described in D4.5 [34])

Table 55. Module: Cross-site scripting (A-03-M-02)

Module ID	A-03-M-03; Accompanying slide set number: 20
Name	Session hijacking
Learning Objectives	It is expected that by the end of this module, participants will be able to: 1. Explain what a session hijacking is, how it works and what it affects. 2. Demonstrate a session hijacking attack by carrying out a predefined session hijacking exercise using the CYBERWISER.eu cyber range. The exercise is described in Deliverable D5.2 and demonstrates a session hijacking via an XML External Entity (XXE) Processing. 3. Outline the chain of events in a session hijacking attack pattern with the help of cyber-risk models. The cyber-risk model representing a session hijacking attack pattern is documented in Deliverable D2.8. 4. Evaluate the consequences of a session hijacking and select appropriate countermeasures to mitigate the risk.
Module Duration	45 minutes
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity P-02 Awareness of Phishing P-03 Awareness of Password Weaknesses P-04 Awareness of Ransomware P-05 Awareness of Data Leakage P-06 Awareness of Insider Threat P-07 Introduction to cyber-risk assessment B-02 Identify and describe security assets, level 1 B-03 Identify and describe threat profiles and high-level risks, level 1 B-04 Identify risks, level 1 I-02 Identify risk criteria I-03-M-01 Identify risk indicators I-04-M-01 Likelihood and consequence estimation I-05 Treat risks, level 1 A-01 Identify and describe security assets, level 2 A-02 Identify and describe threat profiles and high-level risks, level 2 Previous knowledge about the cyber-risk attacks covered in the course is an advantage, but not a required prerequisite.
Content list	• PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file • Session hijacking exercise on the cyber range (Described in D4.5 [34])

Table 56. Module: Session hijacking (A-03-M-03)

Module ID	A-03-M-04; Accompanying slide set number: 20
Name	Firewall attack and network filtering
Learning Objectives	It is expected that by the end of this module, participants will be able to: 1. Explain what a firewall attack and network filtering are, how they work and what they affect. 2. Demonstrate a firewall attack and network filtering by carrying out a predefined exercise using the CYBERWISER.eu cyber range. The firewall attack exercise is described in Deliverable D5.2. 3. Outline the chain of events in a firewall attack pattern with the help of cyber-risk models. The cyber-risk model representing a firewall attack pattern is documented in Deliverable D2.8.

Module ID	A-03-M-04; Accompanying slide set number: 20
	4. Evaluate the consequences of a firewall attack and select appropriate countermeasures to mitigate the risk.
Module Duration	45 minutes
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity P-02 Awareness of Phishing P-03 Awareness of Password Weaknesses P-04 Awareness of Ransomware P-05 Awareness of Data Leakage P-06 Awareness of Insider Threat P-07 Introduction to cyber-risk assessment B-02 Identify and describe security assets, level 1 B-03 Identify and describe threat profiles and high-level risks, level 1 B-04 Identify risks, level 1 I-02 Identify risk criteria I-03-M-01 Identify risk indicators I-04-M-01 Likelihood and consequence estimation I-05 Treat risks, level 1 A-01 Identify and describe security assets, level 2 A-02 Identify and describe threat profiles and high-level risks, level 2 Previous knowledge about the cyber-risk attacks covered in the course is an advantage, but not a required prerequisite.
Content list	• PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file • Firewall and network filtering exercise on the cyber range (Described in D4.5 [34])

Table 57. Module: Firewall and network filtering (A-03-M-04)

Module ID	A-03-M-05; Accompanying slide set number: 20
Name	Targeted malware
Learning Objectives	It is expected that by the end of this module, participants will be able to: 1. Explain what a targeted malware attack is, how it works and what it affects. 2. Demonstrate a targeted malware attack by carrying out a predefined exercise using the CYBERWISER.eu cyber range. The exercise is described in Deliverable D5.2. 3. Outline the chain of events in a targeted malware attack pattern with the help of cyber-risk models. The cyber-risk model representing a targeted malware attack pattern is documented in Deliverable D2.8. 4. Evaluate the consequences of a targeted malware and select appropriate countermeasures to mitigate the risk.
Module Duration	45 minutes
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity P-02 Awareness of Phishing P-03 Awareness of Password Weaknesses P-04 Awareness of Ransomware P-05 Awareness of Data Leakage P-06 Awareness of Insider Threat P-07 Introduction to cyber-risk assessment B-02 Identify and describe security assets, level 1

Module ID	A-03-M-05; Accompanying slide set number: 20
	B-03 Identify and describe threat profiles and high-level risks, level 1 B-04 Identify risks, level 1 I-02 Identify risk criteria I-03-M-01 Identify risk indicators I-04-M-01 Likelihood and consequence estimation I-05 Treat risks, level 1 A-01 Identify and describe security assets, level 2 A-02 Identify and describe threat profiles and high-level risks, level 2 Previous knowledge about the cyber-risk attacks covered in the course is an advantage, but not a required prerequisite.
Content list	• PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file • Targeted malware exercise on the cyber range (Described in D4.5 [34])

Table 58. Module: Targeted malware (A-03-M-05)

Module ID	A-03-M-06; Accompanying slide set number: 20
Name	Broken access control
Learning Objectives	It is expected that by the end of this module, participants will be able to: 1. Explain what a dictionary attack is, how it works and what it affects. 2. Demonstrate broken access control via dictionary attack by carrying out a predefined exercise using the CYBERWISER.eu cyber range. The exercise is described in Deliverable D5.2. 3. Outline the chain of events in a dictionary attack pattern with the help of cyber-risk models. The cyber-risk model representing a dictionary attack pattern is documented in Deliverable D2.8. 4. Evaluate the consequences of a dictionary attack and select appropriate countermeasures to mitigate the risk.
Module Duration	45 minutes
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity P-02 Awareness of Phishing P-03 Awareness of Password Weaknesses P-04 Awareness of Ransomware P-05 Awareness of Data Leakage P-06 Awareness of Insider Threat P-07 Introduction to cyber-risk assessment B-02 Identify and describe security assets, level 1 B-03 Identify and describe threat profiles and high-level risks, level 1 B-04 Identify risks, level 1 I-02 Identify risk criteria I-03-M-01 Identify risk indicators I-04-M-01 Likelihood and consequence estimation I-05 Treat risks, level 1 A-01 Identify and describe security assets, level 2 A-02 Identify and describe threat profiles and high-level risks, level 2 Previous knowledge about the cyber-risk attacks covered in the course is an advantage, but not a required prerequisite.

Module ID	A-03-M-06; Accompanying slide set number: 20
Content list	• PowerPoint presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file • Broken access control exercise on the cyber range (Described in D4.5 [34])

Table 59. Module: Broken access control (A-03-M-06)

Module ID	A-03-M-07; Accompanying slide set number: 20
Name	Phishing
Learning Objectives	It is expected that by the end of this module, participants will be able to: 1. Explain what a phishing attack is, how it works and what it affects. 2. Demonstrate phishing attack by carrying out a predefined exercise using the CYBERWISER.eu cyber range. The exercise is described in Deliverable D5.2. 3. Outline the chain of events in a phishing attack pattern with the help of cyber-risk models. The cyber-risk model representing a phishing attack pattern is documented in Deliverable D2.8. 4. Evaluate the consequences of a phishing attack and select appropriate countermeasures to mitigate the risk.
Module Duration	45 minutes
Prerequisites	P-01 Introduction to cyber-risk analysis and cybersecurity P-02 Awareness of Phishing P-03 Awareness of Password Weaknesses P-04 Awareness of Ransomware P-05 Awareness of Data Leakage P-06 Awareness of Insider Threat P-07 Introduction to cyber-risk assessment B-02 Identify and describe security assets, level 1 B-03 Identify and describe threat profiles and high-level risks, level 1 B-04 Identify risks, level 1 I-02 Identify risk criteria I-03-M-01 Identify risk indicators I-04-M-01 Likelihood and consequence estimation I-05 Treat risks, level 1 A-01 Identify and describe security assets, level 2 A-02 Identify and describe threat profiles and high-level risks, level 2 Previous knowledge about the cyber-risk attacks covered in the course is an advantage, but not a required prerequisite.
Content list	• PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file • Phishing exercise on the cyber range (Described in D4.5 [34])

Table 60. Module: Phishing (A-03-M-07)

5.5.4 Evaluate risks

This course teaches about mapping risks to the risk evaluation matrix with respect to their likelihood and consequence values, as well as evaluating risks with respect to the predefined risk evaluation criteria. This course acts as a basis for Course A-05 in terms of decision support in selecting appropriate countermeasures using the Countermeasure Simulator.

ID	A-04; Accompanying slide set number: 21
Name	Evaluate risks
Cybersecurity role	R2, R3
Skill and expected skill level to be trained	• R2 – Skill B2, Level 3. • R3 – Skill B2, Level 3.
Offering Level	Advanced
Difficulty	Medium
Course Duration	30 minutes.
Learning Goals	It is expected that by the end of this course, participants in this course will be able to evaluate risks using predefined risk evaluation matrices.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Map risks to the risk evaluation matrix with respect to their likelihood and consequence values. 2. Evaluate risks with respect to the predefined risk evaluation criteria.
Prerequisites	P-01-M-02 Overview of the overall cyber-risk analysis process. P-07 Introduction to cyber-risk assessment. I-02-M-01 Define likelihood scales. I-02-M-02 Define consequence scales for each information security asset. I-04-M-01 Likelihood and consequence estimation.
Module list	No modules. The training material consists of: • PowerPoint presentation • Review questions as part of the presentation • Exam questions at the end of the presentation • Compendium • Audio support • All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 61. Course: Evaluate risks (A-04)

5.5.5 Treat risks, level 2

This course teaches about cost-benefit analysis in general, and cost-benefit analysis following the CYBERWISER.eu approach. The course also teaches how to select appropriate treatments based on predefined budget using the Countermeasure Simulator component in the CYBERWISER.eu platform. This will also prepare the participant for the exercises in Course A-03.

ID	A-05
Name	Treat risks, level 2
Cybersecurity role	R1, R2, R3
Skill and expected skill level to be trained	• R1 – Skill B2, Level 3. • R2 – Skill B2, Level 3. • R3 – Skill B2, Level 3.
Offering Level	Advanced
Difficulty	Hard/Challenging
Course Duration	90 minutes (two modules, 45 minutes each module)
Learning Goals	It is expected that by the end of this course, participants in this course will understand how cost-benefit analysis is carried out in general and how it is carried out in the CYBERWISER.eu platform. The participant will also apply the platform to demonstrate selection of countermeasures considering cost-benefit analysis.
Learning Objectives	To determine whether the participants have achieved the learning goals, it is expected that participants, by the end of the course, will be able to: 1. Explain what cost-benefit analysis is, in the context of cyber-risk assessment. 2. Explain how cost-benefit analysis is carried out in the CYBERWISER.eu platform. 3. Apply the Countermeasure Simulator in the CYBERWISER.eu platform to select countermeasures considering also cost-benefit analysis.
Prerequisites	P-01-M-02 Overview of the overall cyber-risk analysis process. P-07 Introduction to cyber-risk assessment. I-05 Treat risks, level 1. A-05-M-01 Cost-benefit analysis in the context of cyber-risk assessment
Module list	• A-05-M-01: Cost-benefit analysis in the context of cyber-risk assessment • A-05-M-02: How to use countermeasures in CYBERWISER.eu – the Countermeasures Simulator

Table 62. Course: Treat risks, level 2 (A-05)

Module ID	A-05-M-01; Accompanying slide set number: 22
Name	Cost-benefit analysis in the context of cyber-risk assessment
Learning Objectives	It is expected that by the end of this module, participants will be able to explain what cost-benefit analysis is, in the context of cyber-risk assessment.
Module Duration	45 minutes.
Prerequisites	P-01-M-02 Overview of the overall cyber-risk analysis process. P-07 Introduction to cyber-risk assessment. I-05 Treat risks, level 1.

Module ID	A-05-M-01; Accompanying slide set number: 22
Content list	- PowerPoint presentation - Review questions as part of the presentation - Exam questions at the end of the presentation - Compendium - Audio support - All the above is made available in the Cross-Learning Facilities via a SCORM file

Table 63. Module: Cost-benefit analysis in the context of cyber-risk assessment (A-05-M-01)

Module ID	A-05-M-02; Accompanying slide set number: 22
Name	How to use countermeasures in CYBERWISER.eu – the Countermeasures Simulator
Learning Objectives	This module is specifically related to the usage of the CYBERWISER.eu platform. It is expected that by the end of this module, participants will be able to apply the Countermeasure Simulator in the CYBERWISER.eu platform to select appropriate treatments, considering a simulated budget.
Module Duration	45 minutes.
Prerequisites	P-01-M-02 Overview of the overall cyber-risk analysis process. P-07 Introduction to cyber-risk assessment. I-05 Treat risks, level 1. A-05-M-01 Cost-benefit analysis in the context of cyber-risk assessment
Content list	- PowerPoint presentation - Compendium - Audio support - All the above is made available in the Cross-Learning Facilities via a SCORM file - Exercise on the cyber range (Described in D4.5 [34])

Table 64. Module: How to use countermeasures in CYBERWISER.eu – the Countermeasures Simulator (A-05-M-02)

5.6 The usage environment of the courses

The following sections provide a high-level explanation of two main usage areas of the CYBERWISER.eu courses, namely using the courses for self-study and using the courses for classroom lectures.

5.6.1 Applying the courses for self-study

The Cross-Learning Facilities will allow CYBERWISER.eu to create standalone independent study courses to be used by trainees.

Given the online nature of the Cross-Learning Facilities, they can provide a high degree of flexibility for trainees who can study at any time and in any location, without the direct interaction with a teacher.

For this reason, the Cross-Learning Facilities also offers tools to help students in their learning path such as progress tracker to help them know where they stand in a course, and different evaluation mechanisms such as tests and quizzes to keep the students engaged and motivated.

All courses in CYBERWISER.eu will be accompanied by:

- A set of PowerPoint slides.
- Supporting audio for each slide (implemented in Moodle).
- Accompanying literature including references to external sources/literature (compendium).

In addition, some of the courses will also have:

- Questions/quiz during the course.
- Questions/quiz exam at the end of the course.
- Associated training scenarios on the cyber range.

Thus, the courses in CYBERWISER.eu are very well supported and organized for self-study. The quizzes/exams are not relevant for the platform-specific courses where the participant learns how to use the CYBERWISER.eu platform itself, and the training scenarios are not relevant in the courses that mainly provides the *theoretical* foundation for cyber-risk assessment and cybersecurity.

5.6.2 Applying the courses for classroom lectures

Topics presented during classroom lectures should be atomic as much as possible. This means that each theoretical topic should be started and completed by the end of the lecture, if possible. When a topic is not fully explained during the same lecture, it would be hard to directly start by continuing from the stopping point of the previous lecture, a recap is always necessary. This will usually take time and should be avoided.

The trainer should be supported by a set of slides, previously distributed to trainees. Giving them before the lecture starts let them the time to be confident with this initial training material. Slides are also useful to keep trainees' attention at an acceptable level. Slides presented during the lecture should be furnished with additional materials (e.g. booklets or lecture notes) provided by the trainer by the end of the lecture. This additional material will contain all the details which cannot be added to the slides. This will also answer to most of trainees' doubts, which may raise after the lecture ends.

An import point, when conducting a classroom lecture, is the alternation between theoretical topics and practical implications. Participants usually lose attention when lectures are only focused to theoretical part. In order to gain back their attention, it is important the teacher shows how the theoretical concepts can be applied in practice. This can be done by the means of the CYBERWISER.eu platform if a corresponding scenario is available for the course.

Before starting each classroom lecture, it is important to have a Q/A session with course participants. This will let them ask questions regarding topics explained during the previous lecture. Having doubts/questions clarified will let the participants be more focused on new topics. The same applies for the last part of each classroom lecture, it should be used for a Q/A session about topics explained during the same day.

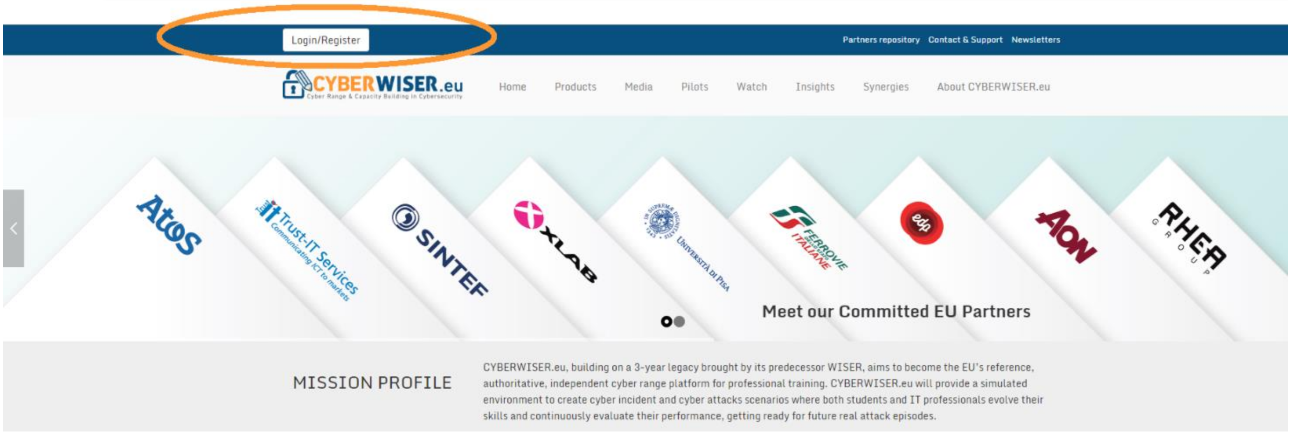
Courses, when provided in the form of classroom lecture, should be furnished with interactive questionnaire, to keep the attention of the participants. At some point during the lecture and at the end of it, participants should ask the teachers to answer a brief questionnaire about the topics explained. This questionnaire should be anonymous, as the focus is not to give trainees a grade, but to check the overall learning level. This can be helpful also to the participant in terms of clarifying related questions.

6. Accessing and editing training material in the platform

This section describes how the training material (including the courses) are accessed and edited in the CYBERWISER.eu platform. This includes logging into the CYBERWISER.eu platform, accessing the courses from a student/trainee perspective, overview of the training path section, editing the courses from a teacher/trainer perspective, overview of interactive and engagement features in the platform, and finally a section explaining the soft skill addressed by CYBERWISER.eu.

6.1 Logging into the CYBERWISER.eu Platform

The Workspace is the interface where trainers and trainees find the training courses. Each group of Pilot users has a dedicated Workspace that can be accessed via the CYBERWISER.eu website Login/Registration form with Single Sign On (Figure 16).



CYBERWISER.eu, building on a 3-year legacy brought by its predecessor WISER, aims to become the EU's reference, authoritative, independent cyber range platform for professional training. CYBERWISER.eu will provide a simulated environment to create cyber incident and cyber attacks scenarios where both students and IT professionals evolve their skills and continuously evaluate their performance, getting ready for future real attack episodes.

Figure 16. Login/Register in the Home Page to be able to access the Workspace

6.2 Accessing the courses – From a student perspective

After accessing the CYBERWISER.eu website, the student can enter the Workspace by clicking the “Cross Learning Facilities” button on the top left of the screen (Figure 17):

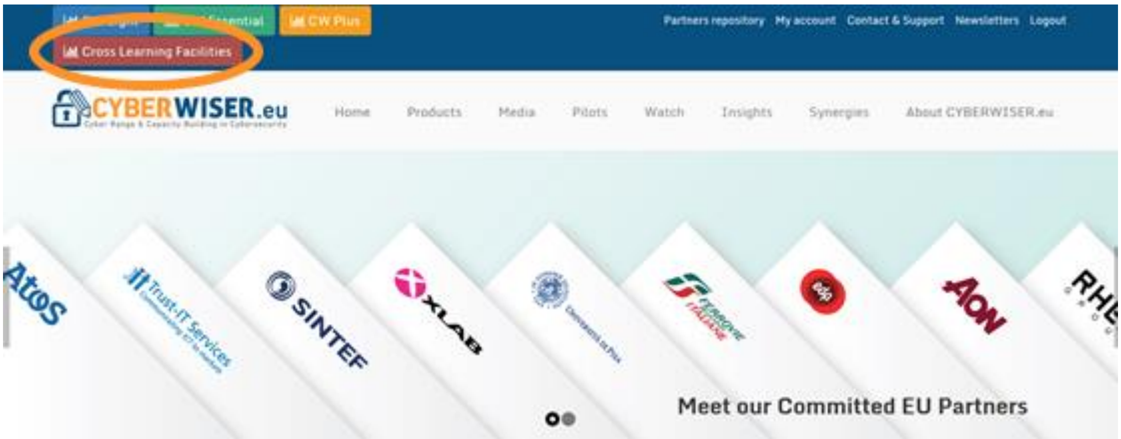
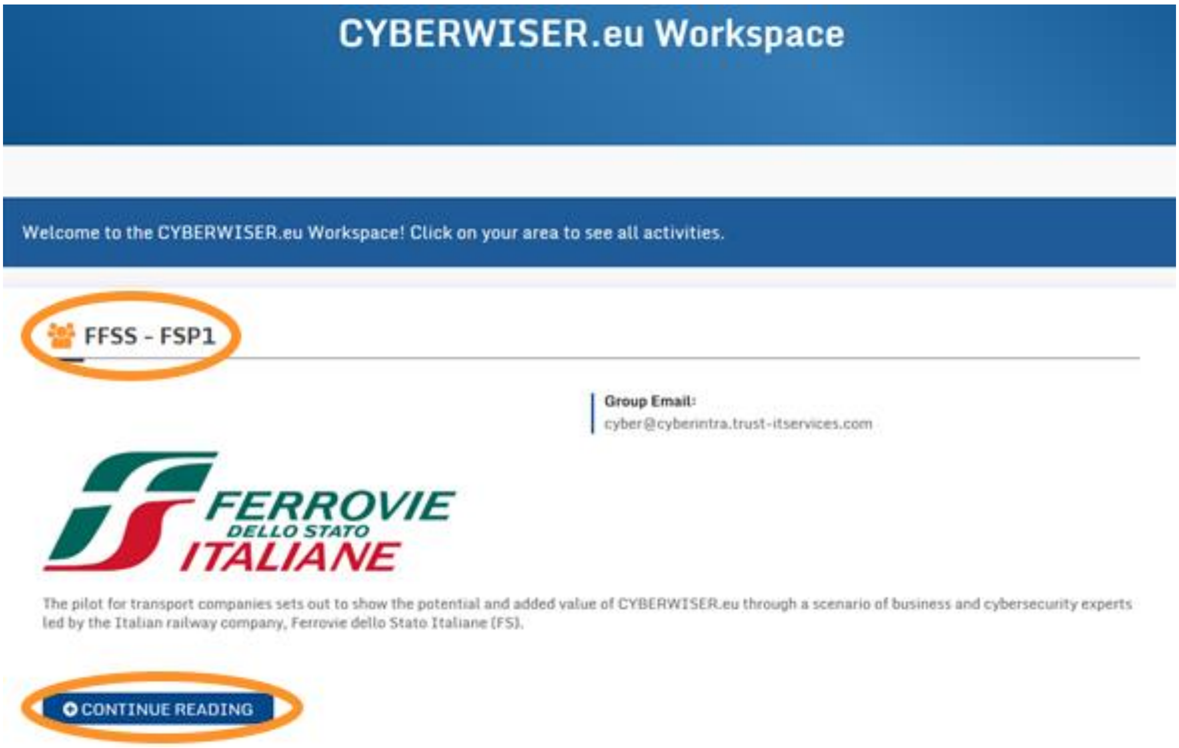


Figure 17. Click on “Cross Learning facilities” to enter the Workspace after the Login/Registration

In the example below, the user is part of the FFSS pilot in CYBERWISER.eu. Within the workspace, the student can enter his/her “Group Area”, by either clicking on the Pilot’s name or on the “Continue Reading” button (Figure 18). This procedure is the same whether the user is part of a Pilot (Full-Scale or Open) or is a customer.



CYBERWISER.eu Workspace

Welcome to the CYBERWISER.eu Workspace! Click on your area to see all activities.

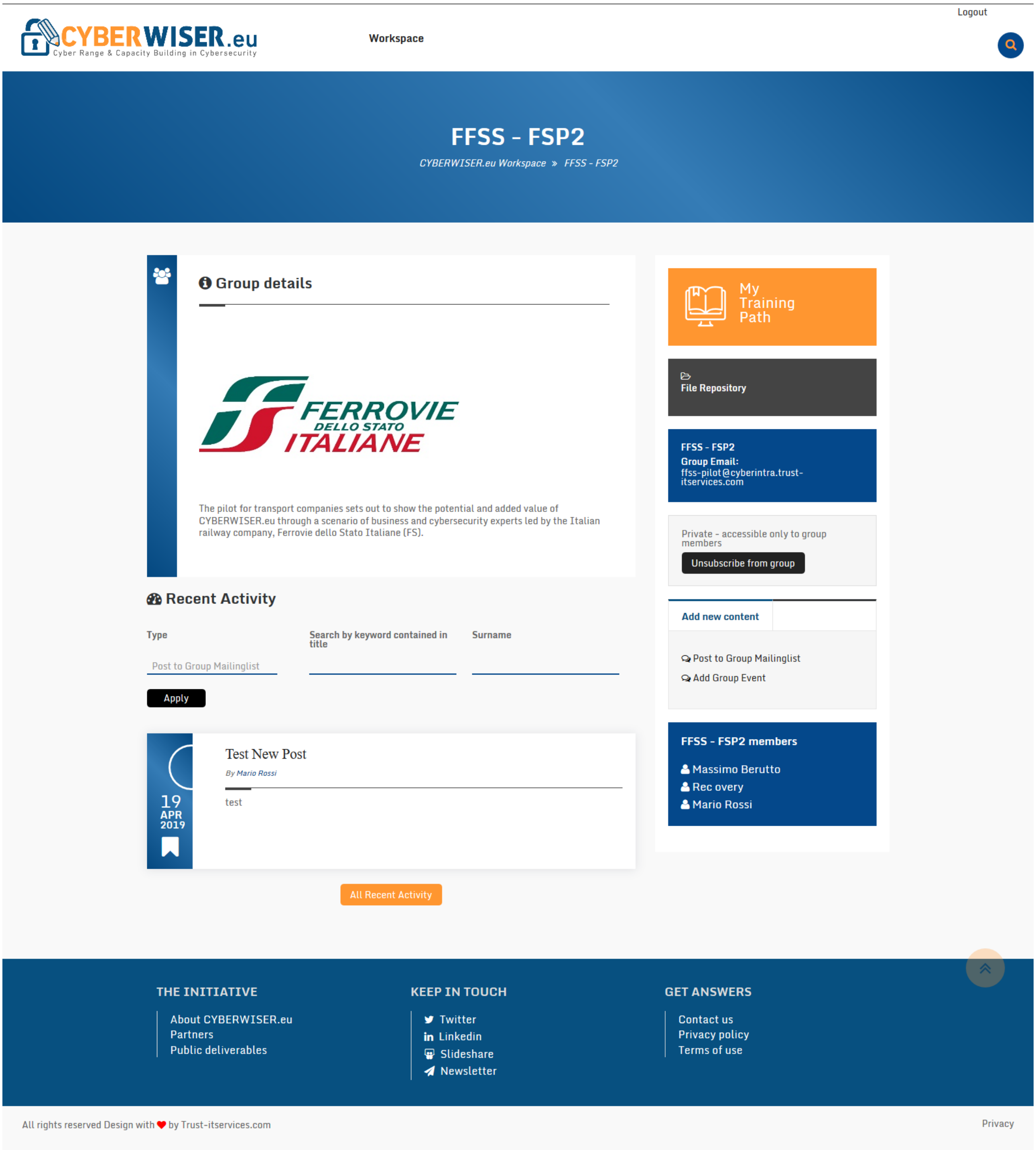
Group Email:
cyber@cyberintra.trust-itservices.com

The pilot for transport companies sets out to show the potential and added value of CYBERWISER.eu through a scenario of business and cybersecurity experts led by the Italian railway company, Ferrovie dello Stato Italiane (FS).

Figure 18. Click on the highlighted buttons to enter the “Group Area” within the Workspace

Inside the group’s area, the student can access the following sections, by simply clicking on them (Figure 19):

- Group’s details: a brief description of the Group the user is part of.
- My Training Path: Courses Overview where the student can choose between different course level; this section is described in detail in the paragraph 6.2.1.
- File Repository: repository containing any downloadable material.
- Group Contact Email (mails sent to this address will be delivered to all the members of a Group).
- Unsubscribe button.
- Add new content: users can post to the Group Mailing List and/or Add a Group Event. All members of a group will receive a mail notification each time a post is published.
- List of the Pilot’s members.
- Recent Activity: search bar allowing research by Type of activity, keywork or Surname.
- Posts Section where all existing posts are displayed.



Logout

Workspace

FFSS - FSP2

CYBERWISER.eu Workspace » FFSS - FSP2

Group details

The pilot for transport companies sets out to show the potential and added value of CYBERWISER.eu through a scenario of business and cybersecurity experts led by the Italian railway company, Ferrovie dello Stato Italiane (FS).

Recent Activity

Type: Post to Group Mailinglist

Search by keyword contained in title

Surname

Apply

Test New Post

By Mario Rossi

19 APR 2019

test

All Recent Activity

My Training Path

File Repository

FFSS - FSP2
Group Email:
ffss-pilot@cyberintra.trust-itservices.com

Private - accessible only to group members

Unsubscribe from group

Add new content

Post to Group Mailinglist
Add Group Event

FFSS - FSP2 members

Massimo Berutto
Rec overy
Mario Rossi

THE INITIATIVE
About CYBERWISER.eu
Partners
Public deliverables

KEEP IN TOUCH
Twitter
Linkedin
Slideshare
Newsletter

GET ANSWERS
Contact us
Privacy policy
Terms of use

All rights reserved Design with ♥ by Trust-itservices.com

Privacy

Figure 19. Sections of the “Group Area” within the Workspace

6.2.1 My Training Path section

The “My Training Path” section (Figure 20) contains the different Offering Level (Primer, Basic, Intermediate and Advanced) available for the specific Pilot or customer. The student can access the relative Offering Level, by clicking on it.

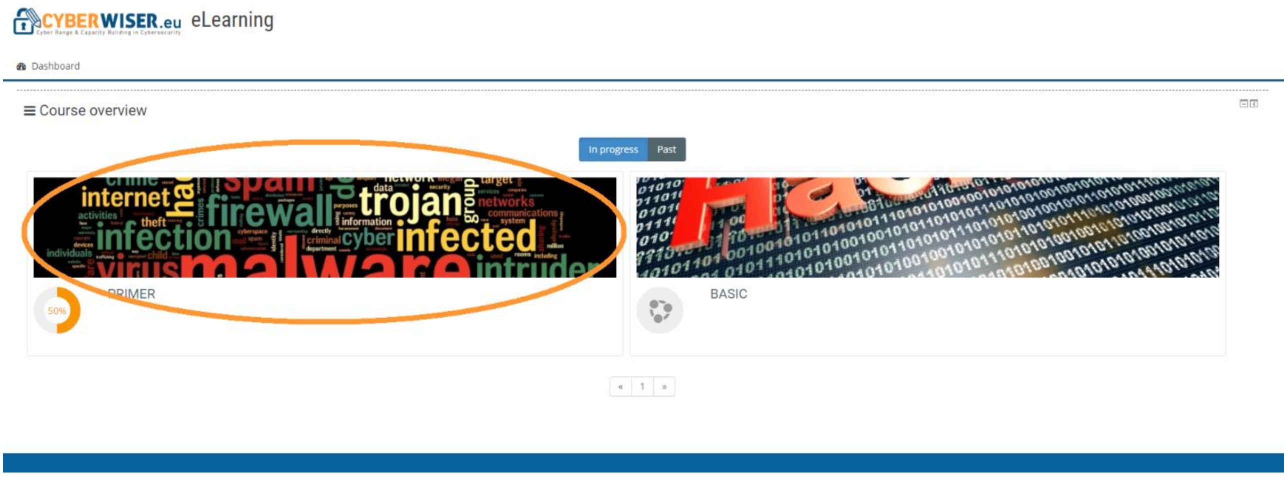


Figure 20. Inside the “My Training Path”, click on an Offering Level to access it.

Each Offering Level is made up of various courses, one or more quizzes or exercises on the cyber range and a certification page (Figure 21).

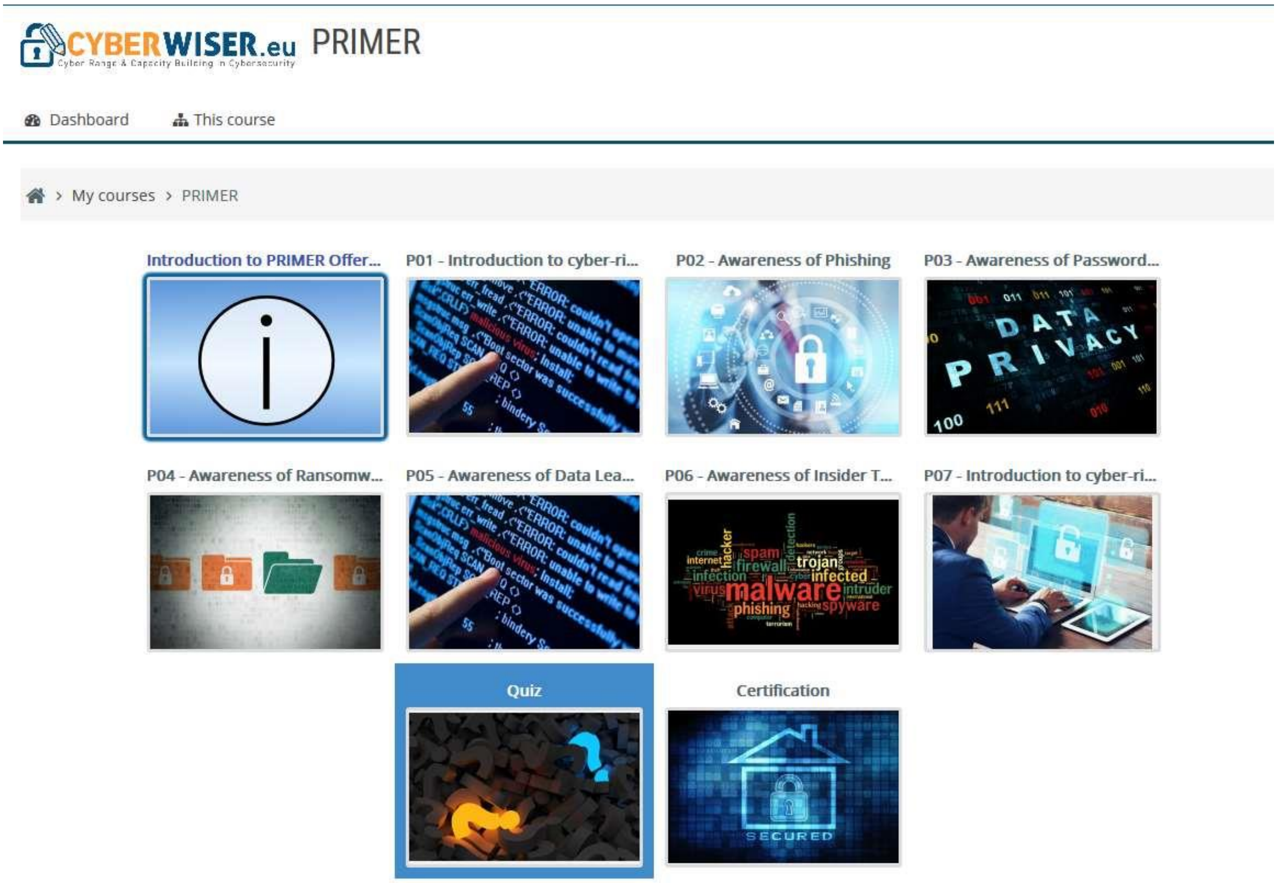
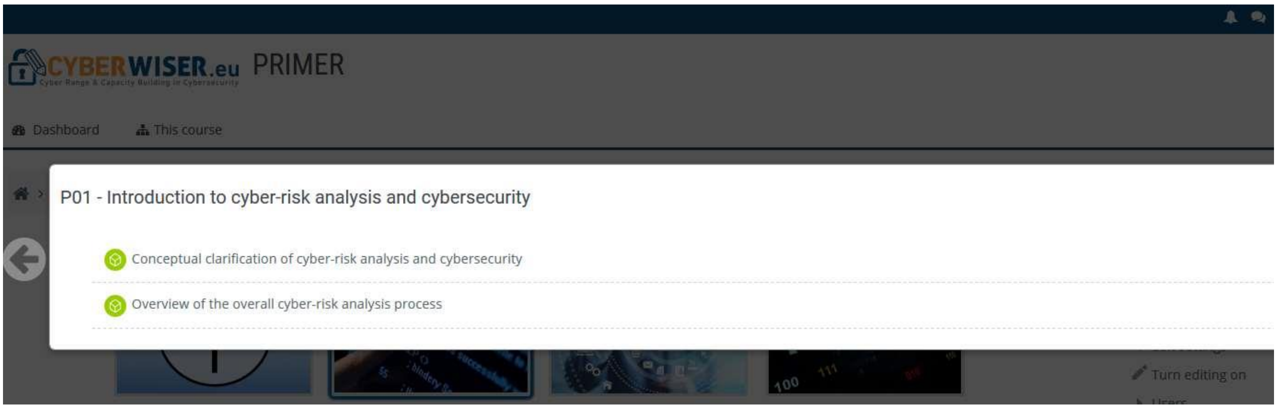

PRIMER
Dashboard
This course
My courses › PRIMER
Introduction to PRIMER Offer...
P01 - Introduction to cyber-ri...
P02 - Awareness of Phishing
P03 - Awareness of Password...
P04 - Awareness of Ransomw...
P05 - Awareness of Data Lea...
P06 - Awareness of Insider T...
P07 - Introduction to cyber-ri...
Quiz
Certification

Figure 21. Sections of the course level “PRIMER”

When all the courses and quizzes (or exercises) are completed, a certificate will be issued to the student. The student can enter a course, by clicking on it. Each course can be made up of one or more modules (Figure 22).

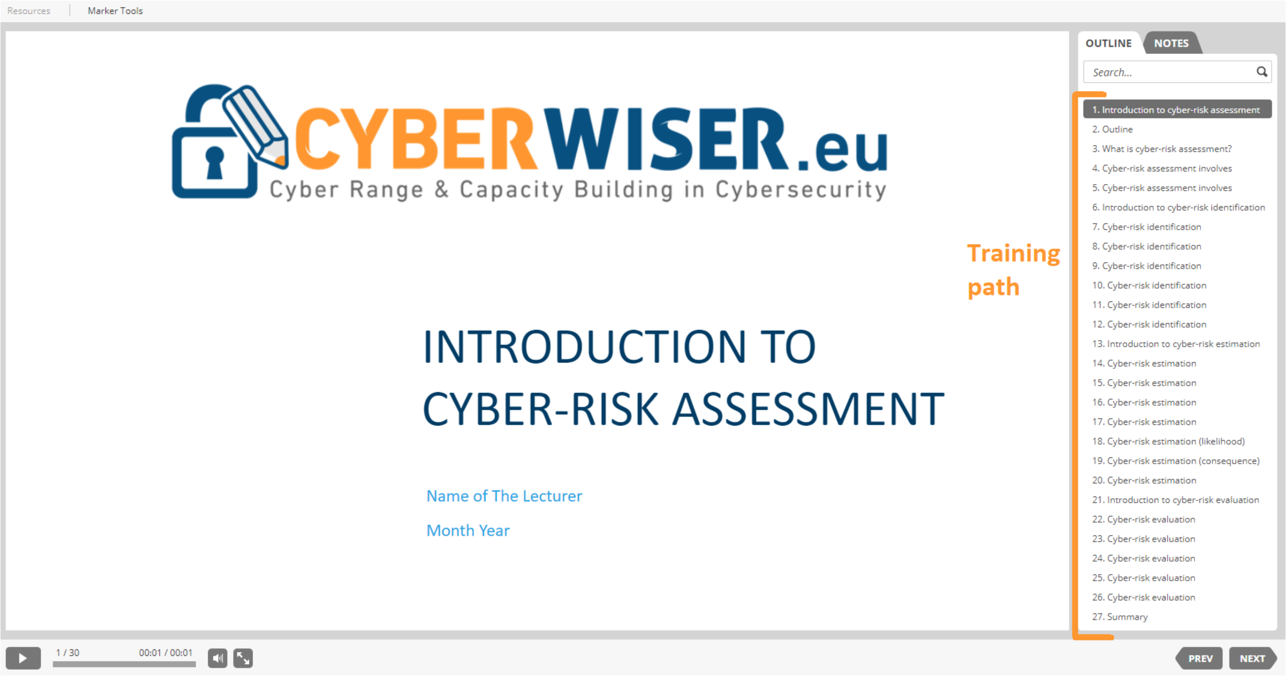


P01 - Introduction to cyber-risk analysis and cybersecurity

- Conceptual clarification of cyber-risk analysis and cybersecurity
- Overview of the overall cyber-risk analysis process

Figure 22. Modules of the first section of the PRIMER course

Each module can be made up of a "Training path" (Figure 23).



INTRODUCTION TO CYBER-RISK ASSESSMENT

Name of The Lecturer

Month Year

1. Introduction to cyber-risk assessment
2. Outline
3. What is cyber-risk assessment?
4. Cyber-risk assessment involves
5. Cyber-risk assessment involves
6. Introduction to cyber-risk identification
7. Cyber-risk identification
8. Cyber-risk identification
9. Cyber-risk identification
10. Cyber-risk identification
11. Cyber-risk identification
12. Cyber-risk identification
13. Introduction to cyber-risk estimation
14. Cyber-risk estimation
15. Cyber-risk estimation
16. Cyber-risk estimation
17. Cyber-risk estimation
18. Cyber-risk estimation (likelihood)
19. Cyber-risk estimation (consequence)
20. Cyber-risk estimation
21. Introduction to cyber-risk evaluation
22. Cyber-risk evaluation
23. Cyber-risk evaluation
24. Cyber-risk evaluation
25. Cyber-risk evaluation
26. Cyber-risk evaluation
27. Summary

Figure 23. Training Path of the first module

Each Training Path can be composed by several SCORM files that contains a combination of one or more of the following elements (Figure 23):

- Power Point Presentation.
- Cyber Range Tool Session, available starting from the Basic level, through a link to the Cyber Range Platform.
- Evaluation test.

In addition to the above, there is the possibility to include videos, training classes and webinars. Access to the cyber range in which hands-on training scenario exercises are provided for the relevant courses, as described in Section 5. Each element in the Training Path is available progressively only when the preceding one has been completed. A time indicator ensures that the student does not skip any element.

The Training Path is initiated from the Cross-Learning Facilities. Each mandatory step of the Training Path needs to be successfully completed by the course participant to acquire the “pass” mark from the platform, with automatic production & release of the personalised certificate for the participant.

6.3 Editing the courses – From a teacher perspective

The teacher can access the CYBERWISER.eu platform in the same exact way of a student as reported in section 6.1. The interface for the teacher is very similar to the one for the students but it allows the teacher to have more functionalities. After selecting an Offering Level, the teacher can access the editing functionalities by clicking on the “administrative” menu in the right corner of the page (Figure 24):

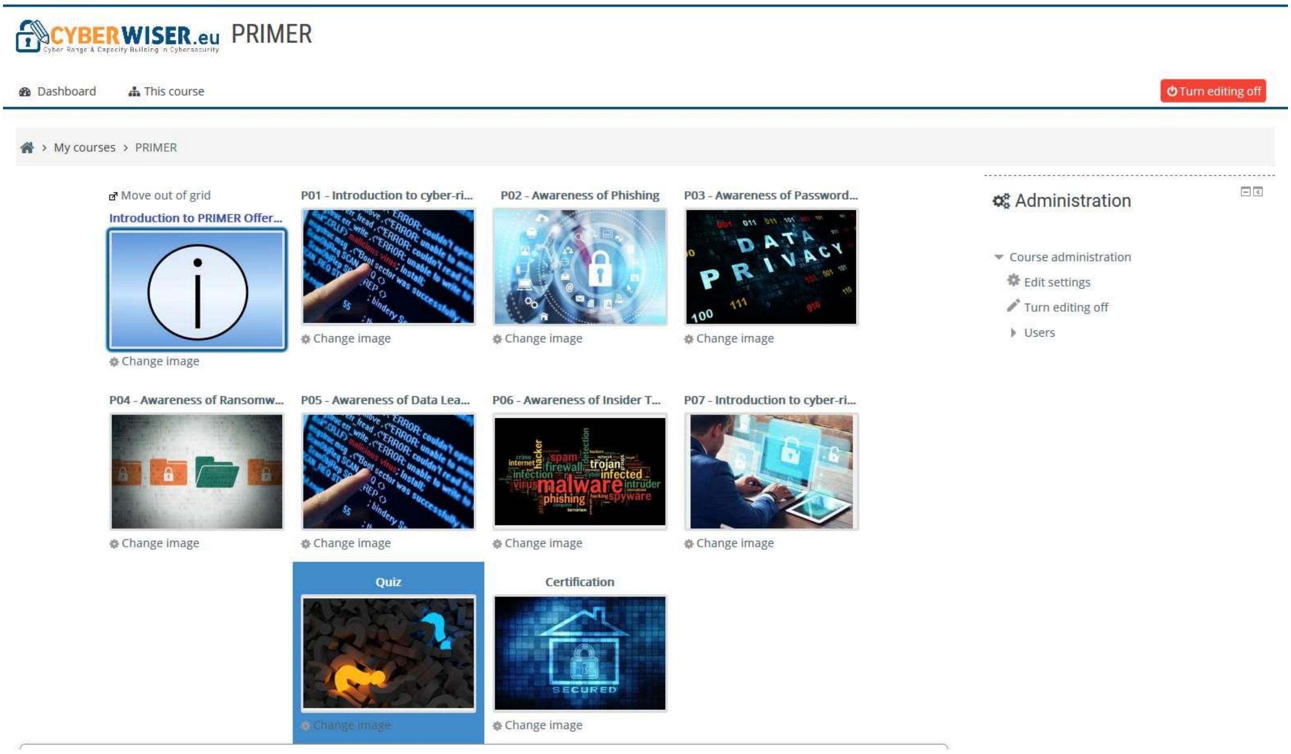
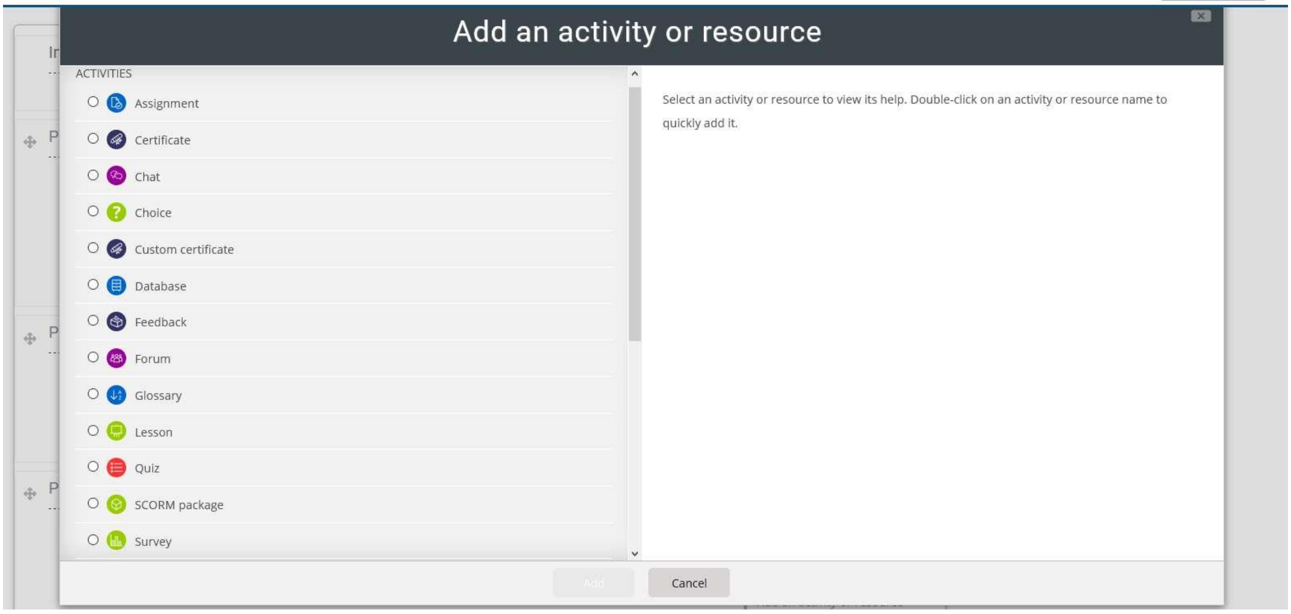

CYBERWISER.eu PRIMER
Dashboard
This course
Turn editing off
My courses > PRIMER
Move out of grid
Introduction to PRIMER Offer...
P01 - Introduction to cyber-ri...
P02 - Awareness of Phishing
P03 - Awareness of Password...
Change image
P04 - Awareness of Ransomw...
P05 - Awareness of Data Lea...
P06 - Awareness of Insider T...
P07 - Introduction to cyber-ri...
Quiz
Certification
Administration
Course administration
Edit settings
Turn editing off
Users

Figure 24. Administrative menu example

Every aspect of each course is customizable, spanning from titles of each course, images, course description etc. Inside each course, the teacher can add specific activities spanning from a different range of resources as shown in the figure below:

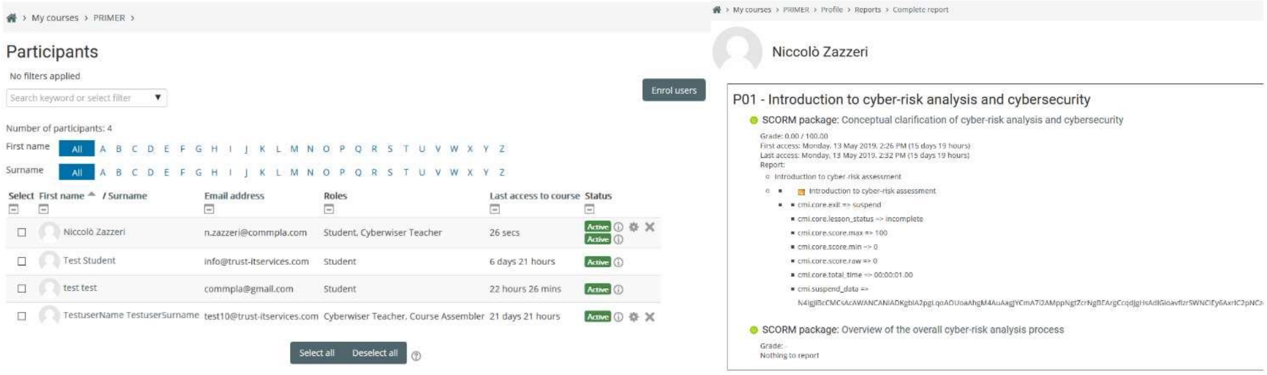


Select an activity or resource to view its help. Double-click on an activity or resource name to quickly add it.

Figure 25. Activities to be selected by a teacher

Typically, a teacher will add SCORM files that can contain a combination of different elements (as already explained in section 6.2) but will be also able to customise courses thanks to an archive of resources.

Thanks to the “administrative” menu, the teacher can clearly see the students that are taking each course and track their progress for each course as shown in the figure below:


My courses › PRIMER ›
Enrol users
Search keyword or select filter
First name All A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Surname All A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Select all
Deselect all
My courses › PRIMER › Profile › Reports › Complete report

Participants

No filters applied

Number of participants: 4

Select	First name / Surname	Email address	Roles	Last access to course	Status
☐	Niccolò Zazzeri	n.zazzeri@commpla.com	Student, Cyberwiser Teacher	26 secs	Active Active
☐	Test Student	info@trust-itservices.com	Student	6 days 21 hours	Active
☐	test test	commpla@gmail.com	Student	22 hours 26 mins	Active
☐	TestuserName TestuserSurname	test10@trust-itservices.com	Cyberwiser Teacher, Course Assembler	21 days 21 hours	Active

Niccolò Zazzeri

P01 - Introduction to cyber-risk analysis and cybersecurity

SCORM package: Conceptual clarification of cyber-risk analysis and cybersecurity

Grade: 0.00 / 100.00
First access: Monday, 13 May 2019, 2:26 PM (15 days 19 hours)
Last access: Monday, 13 May 2019, 2:32 PM (15 days 19 hours)
Report:

- Introduction to cyber-risk assessment
  - Introduction to cyber-risk assessment
    - cmi.core.exit => suspend
    - cmi.core.lesson_status => incomplete
    - cmi.core.score.max => 100
    - cmi.core.score.min => 0
    - cmi.core.score.raw => 0
    - cmi.core.total_time => 00:00:01.00
    - cmi.suspend_data =>

N4IgjIBcCMCsAcAWANCANIADKgbIA2pgLqoAOUoaAhgM4AuAagjYCmA7I2AMppNgtZcrNgBEArgCcqdJgHsAdIGloavflzrSWNCiEy6AxrlC2pNC

SCORM package: Overview of the overall cyber-risk analysis process

Grade: -
Nothing to report

Figure 26. Example of students monitoring

6.4 Interactive and engagement features

A series of features have been added to the training path in order to increase interactivity and engagement with the trainees.

These include mainly videos helping trainees to increase their learning motivation and quizzes that are presented to the trainees at the end of each module to test the gained knowledge. Some examples are reported below. Although the video/webinar feature is not yet included as part of the courses described in Section 5, we aim at using these features to support activities in WP6, such as the commercialization strategy.

Videos/Webinars - Video is one of the most effective ways to keep trainees engaged and interested. Within the platform this kind of multimedia can be used in different ways:

- as simple how-to videos on how to deploy scenarios, or how to run an exercise in the cyber range
- as live lectures in the form of webinars on a specific topic
- as catalogue of additional resources coming from external, reputable providers

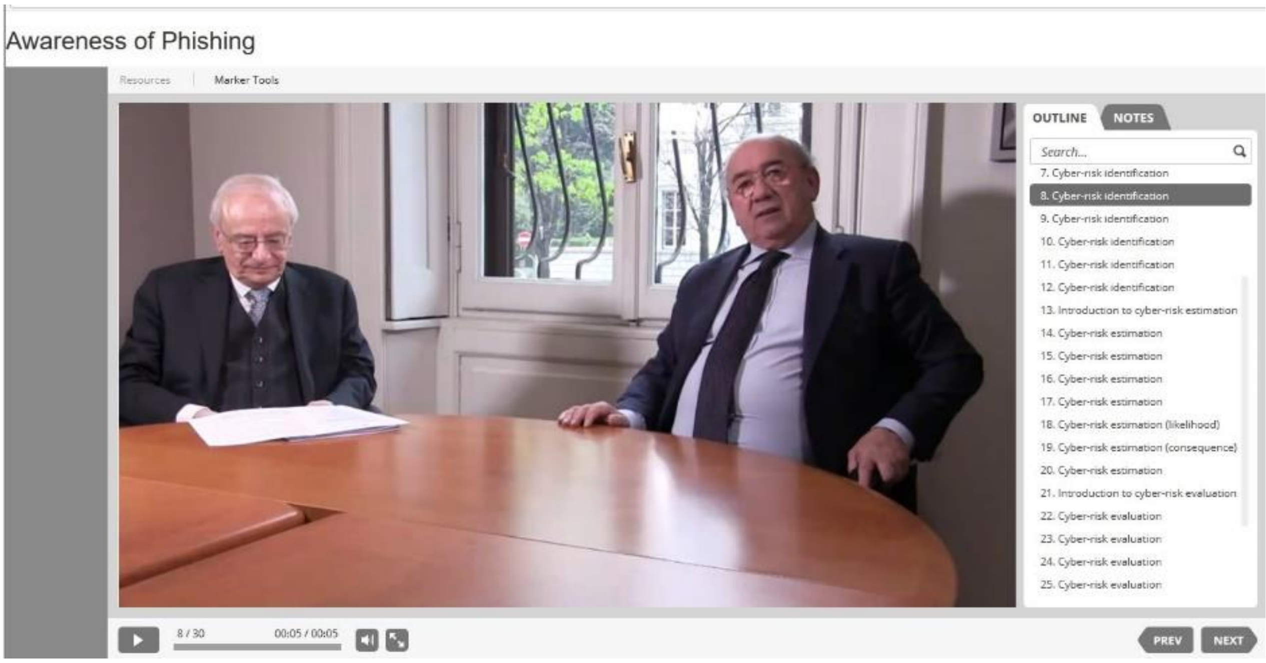
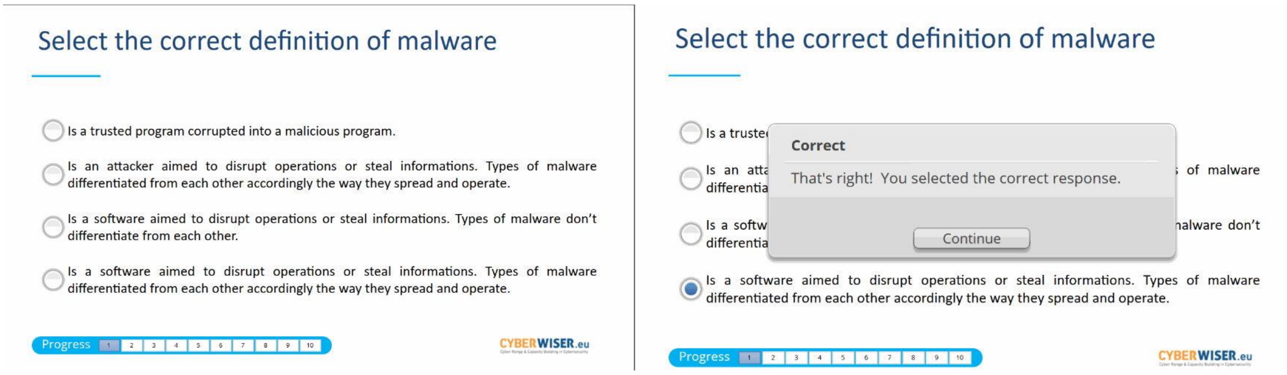

Awareness of Phishing
Resources
Marker Tools
OUTLINE
NOTES
Search...
7. Cyber-risk identification
8. Cyber-risk identification
9. Cyber-risk identification
10. Cyber-risk identification
11. Cyber-risk identification
12. Cyber-risk identification
13. Introduction to cyber-risk estimation
14. Cyber-risk estimation
15. Cyber-risk estimation
16. Cyber-risk estimation
17. Cyber-risk estimation
18. Cyber-risk estimation (likelihood)
19. Cyber-risk estimation (consequence)
20. Cyber-risk estimation
21. Introduction to cyber-risk evaluation
22. Cyber-risk evaluation
23. Cyber-risk evaluation
24. Cyber-risk evaluation
25. Cyber-risk evaluation
8 / 30
00:05 / 00:05
PREV
NEXT

Figure 27. Video example

Multiple choice - The trainee must choose from multiple answers based on a certain question. Two types of multiple choice are available - single answer (where there is only one correct answer) and multiple answer (where the trainee can pick all answers that apply). After submitting the answer, a message is shown to the trainee.



Select the correct definition of malware

○ Is a trusted program corrupted into a malicious program.

○ Is an attacker aimed to disrupt operations or steal informations. Types of malware differentiated from each other accordingly the way they spread and operate.

○ Is a software aimed to disrupt operations or steal informations. Types of malware don't differentiate from each other.

○ Is a software aimed to disrupt operations or steal informations. Types of malware differentiated from each other accordingly the way they spread and operate.

Select the correct definition of malware

○ Is a truste

○ Is an atta … of malware differentia

○ Is a softw … nalware don't differentia

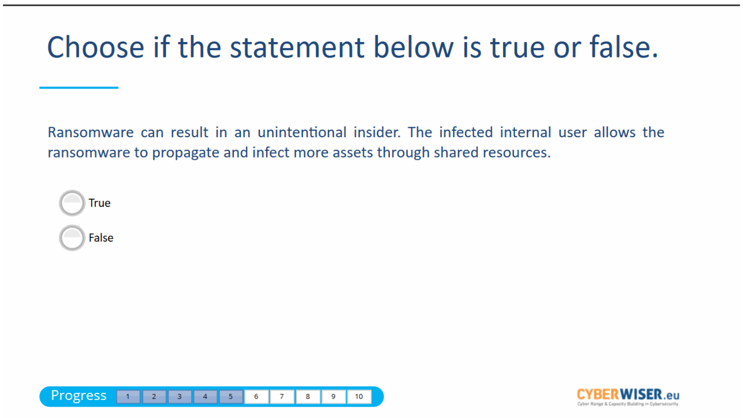
Correct

That's right! You selected the correct response.

● Is a software aimed to disrupt operations or steal informations. Types of malware differentiated from each other accordingly the way they spread and operate.

Figure 28. Multiple choice answers

True/False – The trainee must choose either True or False based on a certain question, which could be either a text-based or an image-based question. After submitting the answer, a message is shown to the trainee.



Choose if the statement below is true or false.

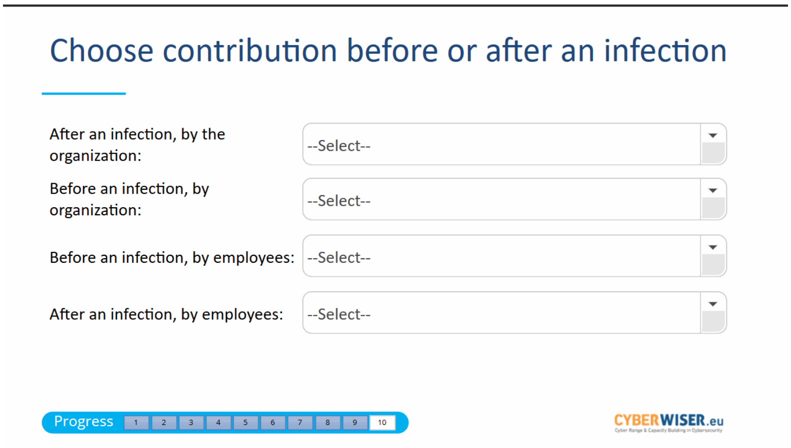
Ransomware can result in an unintentional insider. The infected internal user allows the ransomware to propagate and infect more assets through shared resources.

○ True

○ False

Figure 29. True/false answers

Embedded answers – This allows the use of multiple different question types within a single question. After submitting the answer, a message is shown to the trainee.

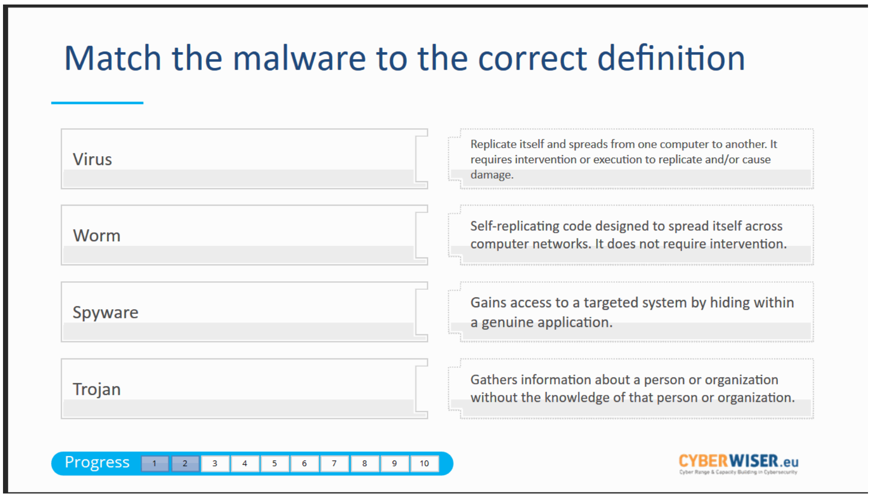


Choose contribution before or after an infection

After an infection, by the organization:	--Select--
Before an infection, by organization:	--Select--
Before an infection, by employees:	--Select--
After an infection, by employees:	--Select--

Figure 30. Embedded answers

Matching - The trainee must match a set of questions/statements against answers/other statements. This includes a drag and drop interface for the trainee. After submitting the answer, a message is shown to the trainee.



Match the malware to the correct definition

Virus

Worm

Spyware

Trojan

Replicate itself and spreads from one computer to another. It requires intervention or execution to replicate and/or cause damage.

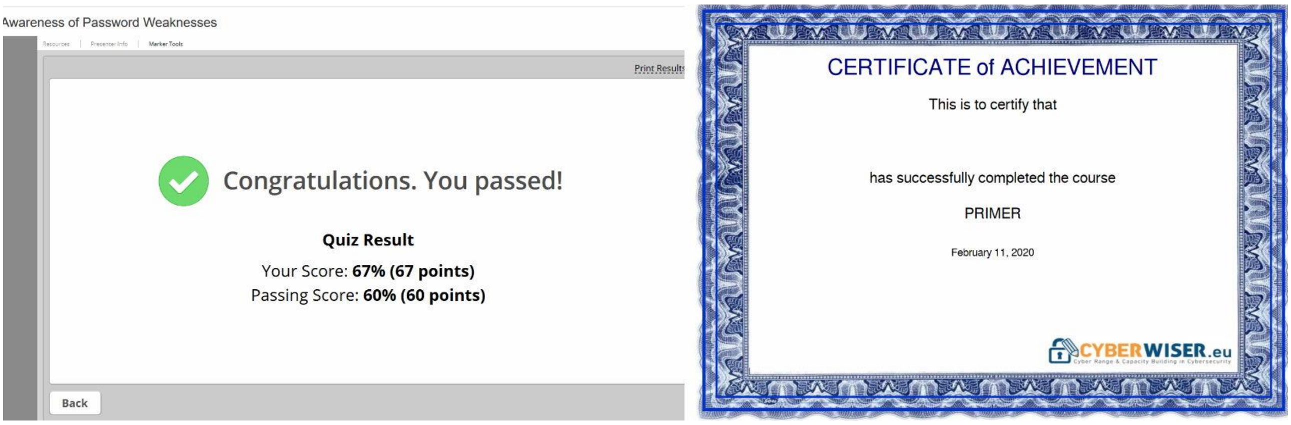
Self-replicating code designed to spread itself across computer networks. It does not require intervention.

Gains access to a targeted system by hiding within a genuine application.

Gathers information about a person or organization without the knowledge of that person or organization.

Figure 31. Matching

When a trainee successfully completes a test, the system automatically notifies this to him together with its scoring based on the answers given. A trainee that successfully complete an entire learning path is also automatically given a personalised certification.



Awareness of Password Weaknesses

Congratulations. You passed!

Quiz Result

Your Score: **67% (67 points)**
Passing Score: **60% (60 points)**

CERTIFICATE of ACHIEVEMENT

This is to certify that

has successfully completed the course

PRIMER

February 11, 2020

Figure 32. Automatic certification

6.5 Developing soft skills using the CYBERWISER.eu Platform

As mentioned in Section 3.3.1, the explicit training of soft skills (courses teaching about e.g. communication) is outside the scope of CYBERWISER.eu. However, by taking courses offered on the CYBERWISER.eu Platform, students can also benefit from and develop a range of general soft skills mainly in terms of "J3 – Communication and Knowledge Sharing" outlined in Table 7. Table 65 describes in detail the soft skill Communication and Knowledge Sharing. This soft skill has 6 advancement levels according to CIISec Skills Framework [24]. In the context of CYBERWISER.eu, however, we select the first four skill levels as relevant to trainees that use the CYBERWISER.eu platform (see Table 65) because Skill Levels 5 and 6 are required by already experts with high level of autonomy and very little oversight from others [24].

Skill	Principles	Example Skills
J3 – Communication and Knowledge Sharing	Communicates information clearly and in a manner relevant to the target audience. Influences senior management. Shares knowledge on Information Security. Negotiates effectively on Information Security issues.	**Level 1**: Understands and interprets instructions effectively. Communicates effectively with colleagues.
		Level 2: Has clear written and verbal communication skills. Shares information and knowledge with others.
		Level 3: Is sensitive and constructive when challenging other's ideas or decisions.
		Level 4: Proactively shares good practice and expertise with colleagues. Contributes effectively to debates and complex discussion demonstrating well-reasoned arguments and conclusions. Adapts communication style to suit audience, developing effective mechanisms to disseminate information to colleagues.
		Level 5: Is a persuasive communicator using logic to win support and change views. Sets a lead in sharing knowledge across the organisation and uses a variety of effective strategies to capture and share information. Addresses and discusses key concerns and ensures key stakeholders are kept informed.
		Level 6: Is persuasive and diplomatic in external negotiation, influencing major programmes, projects or policy outside of the organisation. Uses and develops knowledge sharing strategies to share experience across organisations. Presents effectively and influentially to a range of audiences.

Table 65. Description of soft skill Communication and Knowledge Sharing

For example, trainees in the Cross-Learning Facilities can benefit of a simple and intuitive channel to communicate with each other and with the teachers where they can exchange experience, problems, and solutions.

Furthermore, trainees can come from very different backgrounds, therefore reflecting an almost real-case scenario in which cybersecurity must be communicated to every level of the organisation, not only the technical or IT staff.

Collaboration and teamwork could also be improved by means of the actual cyber range environment in CYBERWISER.eu, in which trainees will be able to play the role of attackers (red team) and/or defenders (blue team) in different scalable and configurable scenarios.

A trainee's (course participant) advancement in these soft skills are clearly subjective, situational and most importantly highly dependent on how an organisation is structured and working. It is therefore difficult to measure the performance of the considered soft skill in a dynamic manner as for the technical skills described in Section 3.3 based on the evaluation criteria documented in Deliverable D4.2 [37]. Thus, in the context of CYBERWISER.eu, the soft skills need to be measured by a trainer/teacher as part of the Performance Evaluator in which the trainer/teacher comments on how well a trainee has performed based on observations done by the trainer/teacher.

Based on the courses currently available in CYBERWISER.eu documented in Section 5 (including supporting training material), the levels of advancement anticipated to be developed in skill J3 are:

- Level 1: Understands and interprets instructions effectively. Communicates effectively with colleagues.
- Level 2: Has clear written and verbal communication skills. Shares information and knowledge with others.

The courses at the Intermediate and Advanced offering levels require more interactivity, collaboration (e.g. red team/blue team), and communication, compared to the courses at Primer and Basic level, and therefore develop further skill J3 to levels 3 and 4.

7. Conclusions

This deliverable presents the final version of the training material provided in CYBERWISER.eu. This deliverable describes our systematic approach to develop the curriculum, courses including course templates, as well as the training material. The method consists of four main steps:

- Step 1: Identify target-user roles and skills to be trained via CYBERWISER.eu
- Step 2: Map the roles and their expected skills to the learning path of CYBERWISER.eu
- Step 3: Describe courses using predefined templates
- Step 4: Develop training material for the courses

The target-user roles considered are Head of Information/Cyber Security, Information Security Risk Manager, Information Security Risk Officer, Threat Analyst, and Vulnerability Assessment Analyst. The selected relevant skills associated with these roles are Threat Intelligence, Assessment and Threat Modelling, Risk Assessment, and Information Risk Management. The abovementioned roles are related to appropriate parts of the learning path in which one or more of the skills are required. The learning path consists of four main parts:

- Cybersecurity and risk awareness
- Context establishment
- Cyber-risk assessment
- Cyber-risk treatment and cost/benefit analysis

The learning path is carefully constructed to be in line with ISO 27001 [9] and ISO 27005 [10], which are security standards known globally and used both in industry and academia.

Using the above method this deliverable reports on in total 7 courses for the Primer offering level, 5 courses for the Basic offering level, 5 courses for the Intermediate offering level, and 5 courses for the Advanced offering level. Some of the courses are divided in two or more modules. In total there are 24 modules. Each module includes presentations, compendium, questionnaires, training scenarios in the cyber range, etc.

Finally, the deliverable outlines how the training material should be accessed and edited within the CYBERWISER.eu Platform (the Cross-Learning Facilities).

As next step, the final courses and training material documented in this report (presentations, compendium, etc.) will be tried out in the pilots of CYBERWISER.eu for evaluation of the courses/training material, as well as for checking the fulfilment of requirements defined for CYBERWISER.eu. This is addressed in context of Deliverable D5.2 Pilots – Experiences and results, initial version and D5.3 Pilots – Experiences and results, final version.

References

[1] Phishing.org. http://www.phishing.org/what-is-phishing – Accessed: 21.03.2019.

[2] European Union Agency for Cybersecurity (ENISA). Threat landscape tool by ENISA. https://etl.enisa.europa.eu/#/ - Accessed: 21.03.2019.

[3] Symantec. Internet Security Threat Report, Volume 24, February 2019. https://www.symantec.com/security-center/threat-report – Accessed: 21.03.2019.

[4] WatchGuard. Internet Security Report, Q4 2018. https://www.watchguard.com/wgrd-resource-center/security-report-q4-2018 – Accessed: 21.03.2019.

[5] The Open Web Application Security Project (OWASP). OWASP Top Ten Project. https://www.owasp.org/index.php/Category:OWASP_Top_Ten_Project – Accessed 21.03.2019.

[6] European Commission. General Data Protection Regulation. https://ec.europa.eu/info/law/law-topic/data-protection/data-protection-eu_en – Accessed: 21.03.2019

[7] European Union Agency for Cybersecurity (ENISA). The cost of incidents affecting CIIs. Published August 5, 2016. https://www.enisa.europa.eu/publications/the-cost-of-incidents-affecting-ciis – Accessed: 21.03.2019.

[8] CA Technologies. Insider Threat 2018 Report. https://www.ca.com/content/dam/ca/us/files/ebook/insider-threat-report.pdf – Accessed: 21.03.2019.

[9] ISO/IEC 27001 – Information technology – Security techniques – Information security management systems – Requirements (2013).

[10] ISO/IEC 27005 – Information technology – Security techniques – Information security risk management (2011).

[11] M.S. Lund, B. Solhaug, K. Stølen. Model-driven risk analysis – The CORAS approach. Springer (2011).

[12] A. Refsdal, B. Solhaug, K. Stølen. Cyber-risk management. Springer (2015).

[13] Object Management Group (OMG). Unified Modelling Language (UML) v2.5.1, Published December 2017.

[14] K. Beckers. Pattern and Security Requirements – Engineering-Based Establishment of Security Standards. Springer (2015).

[15] Anderson LW, Krathwohl DR, Airasian PW, Cruikshank KA, Mayer RE, Pintrich PR, Raths J, Wittrock MC. A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives, abridged edition. White Plains, NY: Longman. 2001.

[16] Wikipedia. Bloom's taxonomy. https://en.wikipedia.org/wiki/Bloom%27s_taxonomy – Accessed 29.03.2019.

[17] The SANS Institute. https://www.sans.org/about/ - Accessed 01.04.2019.

[18] European Cyber Security Organization. Energy Networks and Smart Grids – Cyber security for the energy sector. WG3 Sectoral Demand. November 2018. https://ecs-org.eu/documents/publications/5bfc08317f722.pdf – Accessed: 04.04.2019.

[19] Digital Guardian. A History of Ransomware Attacks: The Biggest and Worst Ransomware Attacks of All Time. January 3, 2019. https://digitalguardian.com/blog/history-ransomware-attacks-biggest-and-worst-ransomware-attacks-all-time – Accessed: 04.04.2019.

[20] Malwarebytes. Cybercrime tactics and techniques Q1 2017. https:\www.malwarebytes.com\pdf\labs\Cybercrime-Tactics-and-Techniques-Q1-2017.pdf – Accessed: 04.04.2019.

[21] CYBERWISER.eu Project. D2.5 Platform Design, Final Version. August 2019.

[22] CYBERWISER.eu Project. D6.4 Communication & Stakeholder plan 2nd iteration version. February 2020.

[23] Chartered Institute of Information Security. CIISec Roles Framework, Version 0.3, November 2019. https://www.ciisec.org/ - Accessed 28.01.2020.

[24] Chartered Institute of Information Security. CIISec Skills Framework, Version 2.4, November 2019. https://www.ciisec.org/ - Accessed 28.01.2020.

[25] The MITRE Corporation. https://www.mitre.org/ - Accessed 28.01.2020.

[26] The Open Web Application Security Project (OWASP). https://owasp.org/ - Accessed 28.01.2020.

[27] CREST - an international not-for-profit accreditation and certification body that represents and supports the technical information security market. https://www.crest-approved.org/index.html - Accessed 28.01.2020.

[28] The International Information System Security Certification Consortium. https://www.isc2.org/ - Accessed 28.01.2020.

[29] National Institute of Standards and Technology (NIST). Framework for Improving Critical Infrastructure Cybersecurity, Version 1.1, April 16, 2018. https://nvlpubs.nist.gov/nistpubs/CSWP/NIST.CSWP.04162018.pdf - Accessed 29.01.2020.

[30] European Cyber Security Organization (ECSO). https://ecs-org.eu/ - Accessed 10.02.2020.

[31] Wide-Impact cyber Security Risk framework (WISER). D3.2 - Cyber risk modelling language and guidelines, preliminary version. https://www.cyberwiser.eu/content/d32-cyber-risk-modelling-language-and-guidelines-preliminary-version – Accessed 10.02.2020.

[32] Wide-Impact cyber Security Risk framework (WISER). D3.4 - Cyber risk modelling language and guidelines, final version. https://www.cyberwiser.eu/content/d34-cyber-risk-modelling-language-and-guidelines-final-version – Accessed 10.02.2020.

[33] European Commission. Research Executive Agency. Grant Agreement Number 786668 – CYBERWISER.eu.

[34] CYBERWISER.eu Project. D4.5 Cyber-training scenarios and scenario development method, final version. August 2020.

[35] European Commission. Research Executive Agency. Grant Agreement Number 653321 – WISER.

[36] Sharable Content Object Reference Model (SCORM). https://scorm.com/ - Accessed 28.05.2020.

[37] CYBERWISER.eu Project. D4.2 Real-time performance and evaluation criteria. August 2019.