D8.3
Awareness and training for EPES operators report

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DISCLAIMER

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List of Acronyms and Abbreviations

CD	Content Developer
GD	Graphic Designer
GUI	Graphical User Interface
ID	Instructional Designer
LMS	Learning Management System
PM	Project Manager
RE	Requirements Engineer
SE	Standardisation expert
SCO	Shareable Content Object
SCORM	Sharable Content Object Reference Model
SME	Subject Matter Expert
TE	Test Engineer
TEF	Proofreader
TL	Technical Leader
UA	Usability Analyst

Executive Summary

This deliverable depicts the security awareness and training materials developed during Task 8.2. During this task we have created the CyberSEAS eLearning platform that contains a multitude of courses developed based on the specific pilots and tools developed in this project.

The CyberSEAS learning platform can be detailed into two main components: the eLearning courses and the platform itself.

Regarding the eLearning courses, this document details the vision used to develop advanced interactive eLearning courses for the CyberSEAS project. The deliverable presents the eLearning methodology used to develop the courses, the content of the development team, the storyboard development, and the technical team involved. The pedagogical approach and the concepts used in the instructional design are detailed next. The deliverable describes the technical and functional features of the courses. All the courses developed on the platform are delivered in SCORM format (eLearning specific) and exe file type. This allows the courses to be played even without a specialised eLearning platform.

Regarding the eLearning platform, this deliverable depicts the technical features of the Learning Management System (LMS) platform proposed for CyberSEAS project. We have installed a fully functional LMS system to host the courses developed. The LMS allows us fully manage the users enrolled on the platform. All the user accounts are approved by the system administrator. Once the account is approved the user has access to all the courses available on the CyberSEAS platform and he/she can choose his learning track. After a course is finished the user will receive an attestation that can be downloaded from the platform.

We have developed **30 hours of learning content**. There are two main learning paths available to the CyberSEAS eLearning platform users. The learning paths present different courses. The user can start both eLearning paths in parallel. Each item from the learning patch represents a course.

Learning Path - Awareness and training for EPES operators:

- Introduction to the Learning Path
- Introducing CyberSEAS project
- Italian Pilot – Testing scenarios and Tools
- Slovenia & Croatia Pilot – Testing scenarios and Tools
- Romanian Pilot – Testing scenarios and Tools
- Finland Pilot – Testing scenarios and Tools
- Estonia Pilot – Testing scenarios and Tools

- Conclusions and Learning Objectives Analysis

Learning Path - Tools Descriptions Learning Path:

- Introduction

- 20 tools: SecurGrid, CyberRange, HwTEE – JNI, SIEM, ATRS, BP-IDS, PKI, Virtual testbed, RATING, TO4SEE, ALIDA, MDPI, Testing Lab, SAPPAN, MIDA Tool, HEINDALL, Attack-Defence Simulator, CVIAT, ARTEMIS, APEN

- Conclusions and Learning Objectives Analysis.

1 Introduction

WP8's goal is to promote a cyber-resilient culture in the energy supply chain. It also outlines the procedures for collaboration between operators in the energy supply chain and other EPES infrastructures, building on existing practices and governance. The model will undergo comprehensive validation not just in the context of the infrastructure trials but also in a cross-infrastructure setting including municipalities and government agencies. Along with proposing a composite indicator of EPES cyber security and resilience, WP8 will also seek approval from EPES owners and authorities. This indicator, which is based on current indicators, will enable benchmarking of best practice solutions, certification and standardisation approaches, early warning system identification, and enhanced resilience of interrelated EPES CI against new threats and cascading effects. This will be supplied by means of the reciprocal interaction of many stakeholders during the whole project, the outreach to professionals in training, and pertinent programmes and activities. The particular contributions made by CyberSEAS to the European policy and regulation discussion are consolidated in the deliverables D8.4 to D8.8.

Part of WP8 is Task 8.2: Training and awareness for EPES operators, leaded by SIMAVI. The partners participating in this task are: ENG, CINI, ACS, FRAUNHOFER, INF, ICS, BER, BEN, ELES, PETROL, ARN, HOPS, EMP, ELV, TEL, CRE. The goal of this task is to spread the innovative methodologies and best practices developed in the project, specific awareness and training materials will be created and launched.

Today's world demands a workforce who understands how to employ technology as a crucial tool for productivity and creativity. Furthermore, employers require workers to have the skills for collaboration, teamwork, information sharing across global networks, to analysing issues from a multidisciplinary perspective.

eLearning has become a key adjunct to the actual world. The traditional educational institutions (schools, universities) use eLearning to prepare learners to adapt to the society's needs; organisations use it as a strategy to leverage their intellectual capital, to create new skills and increase performance of their employees.

To be successful in the emerging digital world, we have shifted our thinking from designing relatively static distance-learning solutions (such as classroom extended, course-based experiences, and reconfiguring existing courses and content resources) to digital, interactive, reusable objects that can be used in different virtual spaces, in multiple scenarios and instructional sequences. The challenge calls for highly personalized learning solutions that help learners respond to their defined needs and allows them to manage their own learning experiences. Our training solutions are suitable also for blended learning allowing EPES operators to organise learning paths using different types of content and classroom training.

We have decided to create eLearning courses for the consortium members that will showcase our pilots and teach them how to use the tools for the following reasons:

- **Flexibility and Accessibility:**
  - Anytime, Anywhere: Learners can access courses at their convenience, making it easier to fit training into their busy schedules.

    - Remote Learning: eLearning allows for training to be delivered to employees in geographically diverse locations, reducing travel costs and time.
- **Cost-Effective**:
    - Reduced Overhead: eLearning eliminates the need for physical classrooms, instructors, and travel expenses.
    - Scalability: Courses can be easily scaled to accommodate a large number of learners without significant additional costs.
- **Availability:**
    - Longer availability: This training is available after the project ends.
    - Training of new employees: New employees can just enroll on the platform with no additional need to find instructors.
- **Personalized Learning:**
    - Self-Paced: Learners can progress through the material at their own pace, allowing them to focus on areas where they need more assistance.
    - Interactive Content: eLearning often incorporates interactive elements such as quizzes, simulations, and case studies to enhance engagement and understanding.
- **Continuous Learning:**
    - Updates: eLearning platforms can be easily updated to reflect the latest cybersecurity threats and best practices.
    - Microlearning: Short, focused modules can be delivered to employees on a regular basis to reinforce key concepts and keep them informed about emerging trends.
- **Measurable Outcomes:**
    - Tracking Progress: eLearning platforms can track learner progress, identify knowledge gaps, and provide detailed analytics.
    - Certification: Upon completion, learners can receive certifications to validate their cybersecurity skills and knowledge.

The eLearning courses have the following target audience:

- The members of the CyberSEAS consortium, in an effort to understand the pilot and tools.
- Energy Professionals: Those working in the energy sector, such as engineers, technicians, and managers, who seek to deepen their understanding of the infrastructure and cybersecurity aspects in the specific pilots.
- Cybersecurity Specialists: Individuals specializing in cybersecurity, especially within the context of energy systems, who are keen on understanding the specific threats and protocols associated with the specific pilots.
- Project Managers: Professionals overseeing energy projects, especially those related to cybersecurity, who need a detailed understanding of the specific pilot's infrastructure and potential security risks.
- Policy Makers and Regulators: Individuals involved in energy policy and regulation, aiming to comprehend the intricacies of energy infrastructure and cybersecurity to better shape policies and regulations.

The reminder of this document is structures as follows:

- **Chapter 2 eLearning pedagogical and technical content development**, details the following:
    - Depicts the eLearning development workflow by describing the roles and team structure, the methodology for content development, pedagogical approach when designing eLearning courses, and technical and functional specifications of an eLearning course.
- **Chapter 3 CyberSEAS Learning management system (LMS)**, details the following:
    - Details the features and technical specifications of the Learning Management System for CyberSEAS project
    - Depicts all the courses developed for the CyberSEAS projects
- **Chapter 4 Conclusion** – concludes this document
- **Annexes** – Courses storyboards. These are in a separate confidential document.

2 eLearning pedagogical and technical content development

2.1 General approach

The instructional design of the eLearning courses follows recognised eLearning standards, as described in 2.3 in this document, being applicable to all types of content. Emphasis is laid on the variety of learning activities, providing learners with a great variety of learning resources, from highly interactive do-type activities, such as simulations and problem-solving activities, to less interactive absorb-type activities that are very efficient in delivering large amounts of knowledge.

The Graphical User Interface (GUI) and interactions follow the current best practices in user-centred design and learner-centred design respectively, providing a familiar and intuitive interface and a pleasant experience for learners building on the experience we acquired during the latest UI standards.

The eLearning courses development will be based on storyboards developed between eLearning experts and Subject Matter Experts. Each course will have a set of learning objectives (based on Bloom's Taxonomy (Bloom, 1956) or any other appropriate agreed source, based on international best practice) that will define the course structure and learning activities. While learning objectives and the scientific content will be provided by the Subject Matter Expert, the learning activities will be shaped by the eLearning Expert (Instructional Designers).

The eLearning courses propose an exhaustive approach of the subject relying on learning methods that enhance the instructional performance. They contribute to the development of skills, aptitudes and abilities required by both the curriculum and the needs of the social and professional insertion of the learners by achieving the learning objectives.

Digital content developed within this project will use cognitive strategies that are open, heuristic and problem oriented. They are complementary to acknowledged instructional algorithms. The used active-participative methods contribute to the development of learners' abilities, skills, attitudes and behaviours. Mere memorising of information or behavioural routines is discouraged.

The eLearning courses will be provided at least in the following formats:

- standalone – exe, iso and html;
- SCORM packages compatible with the Learning Management Systems used world-wide.

2.2 Development workflow

The development workflow follows the global dynamic of the ADDIE (Branch, 2009) model (Analysis, Design, Development, Implementation, Evaluation. All development activities have specific quality assurance and control activities associated.

2.2.1 Team structure

The eLearning Content Development Centre (CDC) is structured on various roles and profiles, all presented in the following.

The roles, competencies and main responsibilities of team members are presented in the diagram below (Figure 1) and detailed in Table 1.

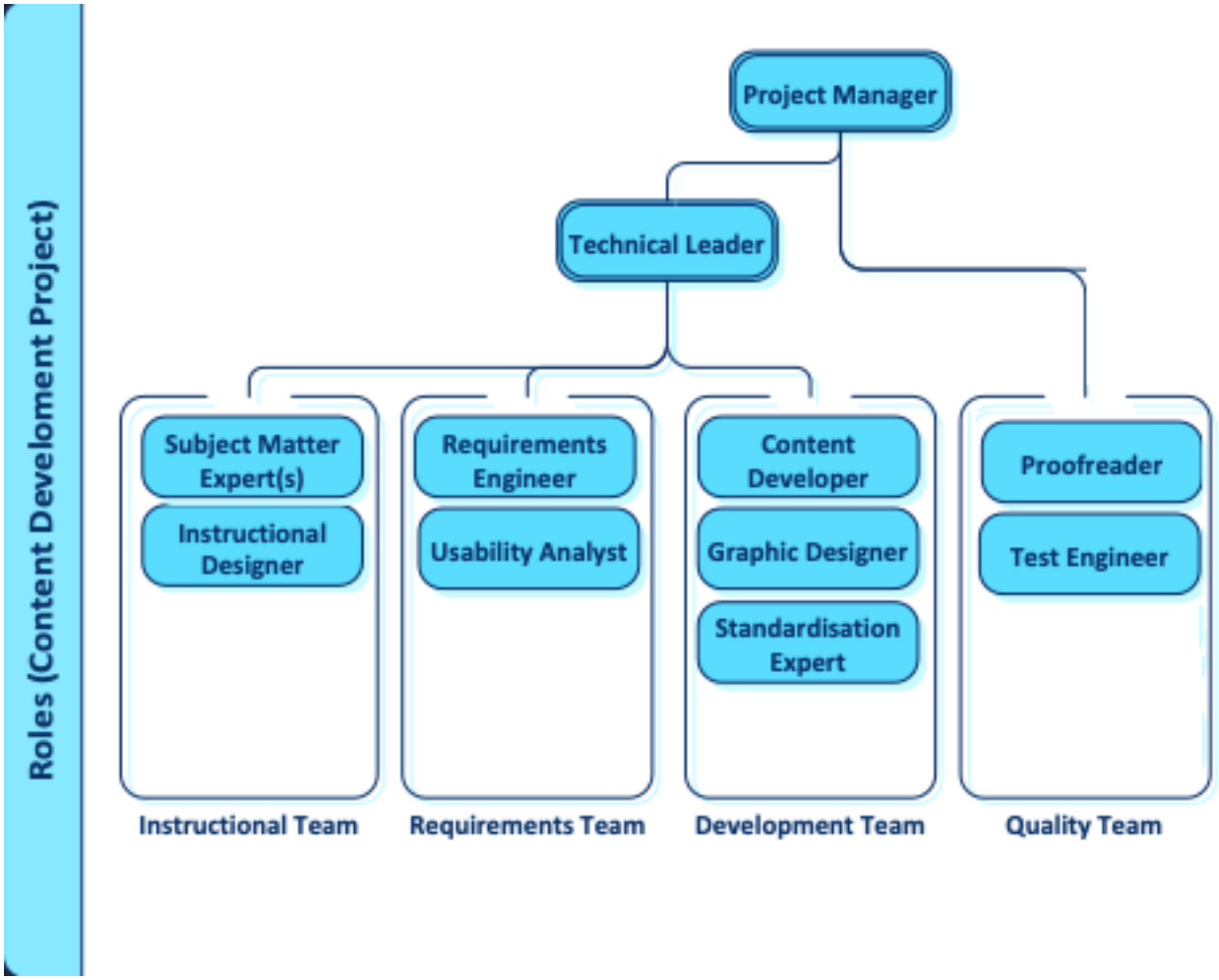

Figure 1: eLearning Content Project Team

#	Profile	Description	Responsibilities
1	Project Manager (PM)	The project manager is responsible for ensuring that the scope of the development, the needed input, contributions and timeline are clear to all the project stakeholders. Therefore, the involvement of the Project Manager starts already during the contractual definition of the scope of the project. We will assign a Project Manager for each RfA in order to monitor and manage the execution of the project.	• Time and Scope management; • Task, feedback and risk management; • Chairing meetings and conference calls; • Monitoring the performance indicators.
2	Technical Leader (TL)	The technical leader is involved from the beginning of the design phase and throughout the entire development process, as a technical solution provider, team leader and conflict manager.	• Participates in the design of the eLearning process providing technical solutions for software development; • Ensures the integration of all eLearning assets (content, associated media, etc.) to provide the learner with a best pedagogical/learning experience; • Tasks management and monitoring; • Creating and onboarding staff and integrating them into the project team; • Facilitates communication and information exchange between external groups and the project team • Monitors project progress, provides timely feedback; • Guides the team in implementing methodology rules to deliver the content is a rapid and reliable manner; • Technical writing;

			• Mitigation of conflicts within the development team.
3	Subject Matter Expert (SME)	The SME is the expert in the area of EPEs tool or pilot. His/her work is mostly collaborative, along with the Instructional Designers expert provided by the Consortium team. Together they will complement the content input from deliverables and will allow us to steer the design- and development process of an eLearning development project efficiently from the beginning to the end. SMEs will be involved as part of the development team. The ability to work together will determine the success of any training development effort. The subject matter expert (SME) provides the knowledge and expertise in a specific subject, business area, or technical area for a project/programme.	• provide all SME-recommended source material; • confirm the course content is targeted at the proper audience and that the course content can be used throughout EPES value chain • validate that the course is focused on achieving the agreed learning objectives and is comprehensive in its coverage; • confirm that policy procedures and official guidelines and legislations are represented in the course; • share relevant personal work experiences that will help make the content relevant and meaningful to the participant; • contribute actively to the building of work-based scenarios and case studies; • review outputs proposed by SIMAVI throughout the project; • work with other SMEs to devise and agree on content; • use the online content creation and review tools; • assist in the consolidation of post-pilot feedback; • be a true partner in the team—share ownership of the course to make it a success; • support the definition of processes and policies, supply business rules and procedures, and communicate the contexts in which the rules, processes and polices are applied; • validate the requirements and deliverables that describe the product(s) or service(s) that the project/program will produce;

			• bring information about the project/program back to the customer community; • provide input for the design and construction of test cases and scenarios, and may also validate executed test results; • provide input into and/or create and execute user documentation and training material; • test the product(s) or service(s) towards the end of the project/program (user acceptance testing), using and evaluating it for accuracy and usability, providing feedback to the project/program team; • guide other professionals on the project/program to ensure the content is accurate; • resolve issues relevant to project/program deliverable(s) within their area of expertise; • obtain or provide approval for changes to rules, processes and policies.
4	Instructional Designer (ID)	The instructional designer is one of the key resources in digital content development as his/her role is to make the connection between the subject experts (SMEs) and the development team. At the design stage (and during the remaining stages in order to ensure consistency), the team includes the Pedagogue Knowledge Manager (PKM) – a senior Instructional Designer, who leads the course design process. With a comprehensive understanding of the learners' needs and types, institutional requirements, and experience in eContent design, the PKM together with the Subject Matter Expert (SME) are responsible for	• Capable of quickly getting familiar with complex topics; • Reviewing supplied source material, checking against agreed learning objectives, identifying gaps and agreeing on solutions with SMEs; • Applying instructional design standards to course development; • Pedagogical Lead: Proposing the pedagogical approach, providing pedagogical advice and guidance on the use of learning assets and defining the pedagogical design of training materials (content and activities);

		reviewing course content for pedagogical conformity and correctness.	• Defining the eLearning approach and Detailed Pedagogical Map; • Ensuring that the complexity level of the course, including the learner interactivity is in accordance with the agreed requirements; • Bringing knowledge of relevant existing course material to discussions and incorporate where appropriate; • Logically organising course content so participants comprehend new material more easily; • Aligning learning objectives to target the intended audience to develop the appropriate skills; • Incorporating assessment mechanisms relevant to the level of the course; • Integrating the Instructional Design Map; • Creating application storyboards.
5	Requirements Engineer (RE)	The RE is responsible for the analysis phase at the start of each project and for requirements management throughout the project implementation phase. This involves close cooperation with the Usability Analyst (UA) and the ID in documenting the functional specifications of the proposed solution during the analysis phase. His/her involvement in each project will be required in case of complex systems (such as application development where (s)he has to collect, document and classify functional requirements).	• Data gathering; • Data analysis; • Requirements documentation; • Requirements management.

6	Usability Analyst (UA)	The usability analyst plays a major role in developing user-centred applications that are easy to use and pleasant to work with. The UA is also responsible for implementing various standards in accessibility, such as WCAG 2.0.	• User-centred design document, based on the data gathered from the user; • Application design documents – respectively High-Level Course Design and Visual Approach, including functional prototypes using wire-framing tools; • User-testing; • Testing that all usability requirements are met; • Implementing various standards in usability and accessibility.
7	Content Developer (CD)	The content developer is responsible for digital content development, using a programming IDE, and based on the application storyboard and graphic resources provided by the graphic designer.	• software development, based on graphic resources and application storyboard; • pedagogical Lead of eLearning modules: integration of all eLearning assets (content, associated media, etc.) to provide the learner with a best pedagogical/learning experience.
8	Graphic Designer (GD)	The graphic designer is responsible for the visual part of the digital content, being responsible with the design of all graphic resources and animations, as presented in the application storyboard.	• Defining the visual approach for each course, along with the Usability Analyst; • Creating the graphic resources for digital content development; • Creating the design and animations for digital content development; • Creating and editing various multimedia resources for digital content development.
9	Standardisation expert (SE)	The standardization expert is responsible for implementing various specifications so that the developed digital content will be compliant with relevant content standards (e.g. SCORM, AICC, and Common Cartridge).	• Defining the appropriate standardisation standard; • Providing the standardisation solution, including detailed description of additional functions that the standard implements (LMS reporting,

			bookmarks, navigation and Sequencing rules, metadata); • Content Packaging.
10	Proofreader (TEF)	The proofreader checks the storyboard for accuracy.	• Proofreading (content quality checks for accuracy, consistency, appropriateness, context, use of language).
11	Test Engineer (TE)	The test engineer performs functional testing of the content.	• Functional testing using various testing methods (exploratory, white-box, black-box); • Testing the conformity with content requirements; • Testing the compliance with the application storyboard; • Proofreading.

Table 1: Team responsibilities, per profile

2.2.2 Content Development

2.2.2.1 Content categorisation

We define certain types of training software to facilitate the development of the Storyboard

- **Presentation Software**: addresses topics from various curricula, providing information and knowledge in an exhibit manner: screen-based presentations, pod-casts, video or audio materials;
- **Thematic Software**: addresses themes from various curricula, offering the opportunity to develop knowledge horizons in various fields or to master certain professional skills (procedural, theoretical, etc.);
- **Simulation Software**: allows controlled reproduction of real phenomena or systems by using an analogue behaviour template. The use of a model makes it possible to alter certain parameters and to observe how the behaviour of the system changes; simulation facilitates understanding;
- **Investigation Software**: Learner is not provided with structured information; he/she is offered an environment where he / she will extract information from (both declarative and procedural) necessary to solve the proposed tasks according to a set of rules. Thus, the path followed largely depends on the student (the level of knowledge and his / her learning);

- **Evaluation / testing software**: it is probably the most varied type, because the specificity depends on many factors: test time, target / goal, type of interaction (with or without immediate feedback); is defined for each individual situation;
- **Training Management Software**: Databases, catalogues, etc. contain various information, documents related to the planning / management of different situations in the real world;
- **IT Application Software**: procedural simulation or interactive presentation of various IT applications. The presentation strategy is set in accordance with the training objectives;
- **Project-based software**: Based on a complex scenario that includes the participation of a group of students in meeting a common goal with or without a tutor, involving communication, debate, brainstorming, etc.;
- **Interactive Learning Software**: It is provided with a built-in strategy that allows for continuous feedback and control and determines individualization of the learning path according to the student's level of training. This is the most complex type, from a pedagogical point of view, which aims, with the help of an adaptive interaction, to ensure that the user will achieve certain educational objectives;
- **Learning Educational Game**: The game is used to achieve a goal by applying a set of smart rules that involve the student in a problem / situation resolution process.

The last two types of software can have two different types of presentation:

- A sequential combination of different multimedia resources;
- Immersive (serious game with avatar).

2.2.2.2 Content development process – Overview

The content development process is depicted in Figure 2, below:

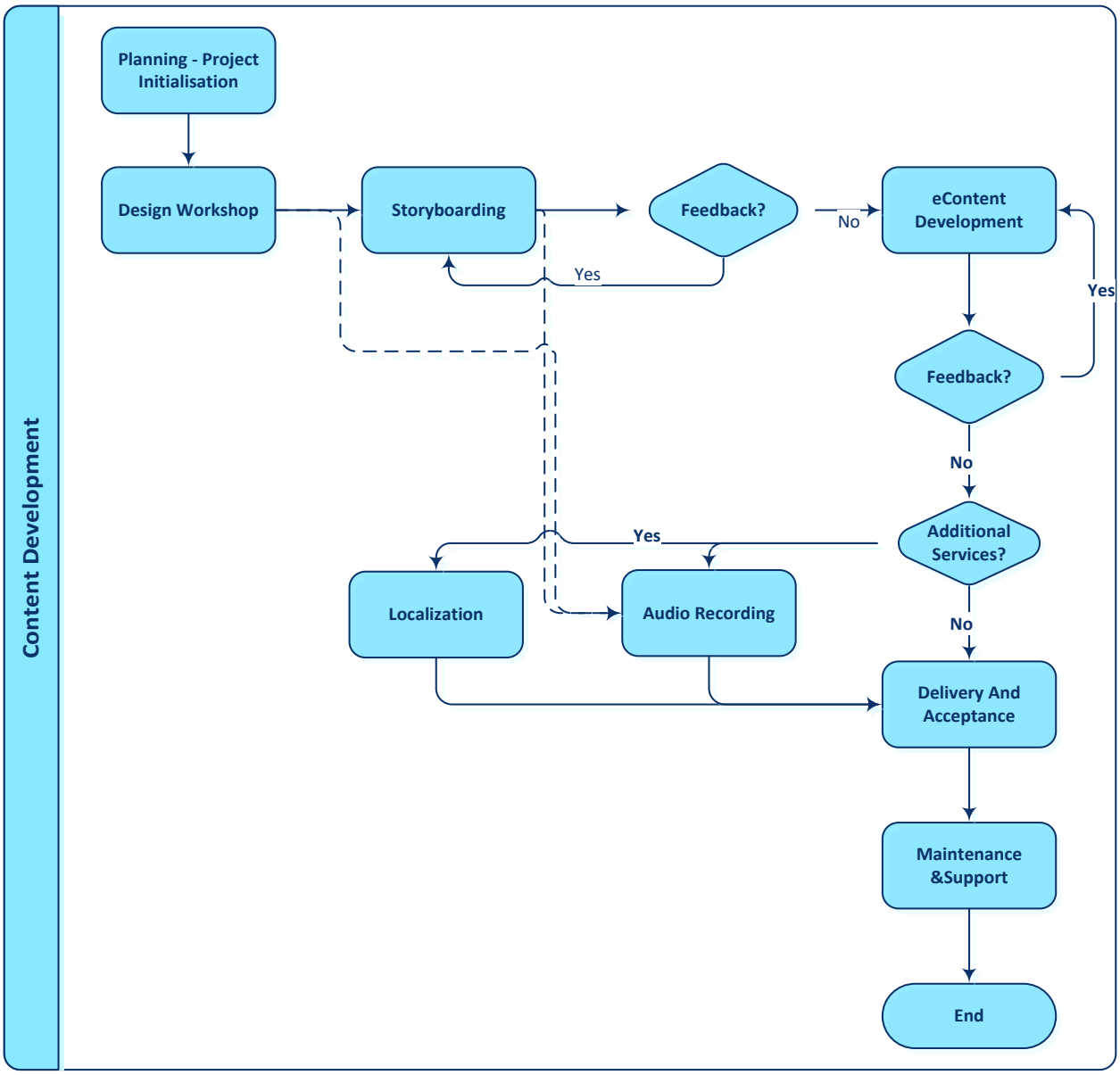

Figure 2: Content development workflow

2.2.2.3 Planning - Project Initialisation

As part of the planning step, the Request for Estimate (RfE) and a Preliminary Learning Brief (PLB) are issued.

The following information will be provided:

- Course type/ format, expected design complexity and interactivity level (as defined in the *Tendering Specifications*);
- Planned Scope;
- Named SMEs;

- Defined content domain;
- Planned target audience.

All information received will be assessed by the Project Manager, Pedagogue Knowledge Manager and the Instructional Designers. Additional information may be requested, new definitions or other changes to the materials.

2.2.2.4 Design Phase

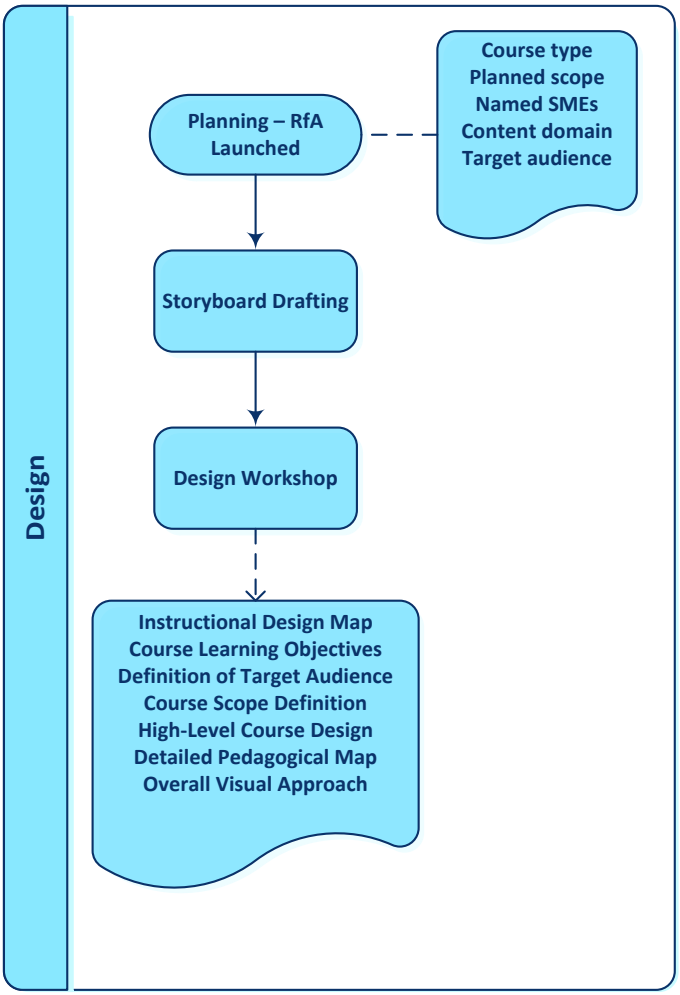

Figure 3: Design Phase

At the design stage, detailed in Figure 3, a Project Group is defined. The Project Group is composed of:

- SMEs from different CyberSEAS consortium;
- Content Development Centre experts
- Project Manager.

The ID Map and Visual Approach are authored by the Instructional Designer in collaboration with the Subject Matter Experts (SMEs) and Consortium members.

A high-level course map will be created and sent to SMEs ahead of a Design Workshop.

During the Design workshop the high-level Course Design, duration, objectives, topics, case studies and source material will be reviewed and the allocation of content, SME responsibilities, and the balance of the course (weighting of topics, flow of course, fidelity of courseware) will be agreed.

Meetings and virtual calls will be arranged, depending on need, before the phase is completed – this is most likely to take the form of one-to-one calls to discuss detailed design in certain content areas.

The detailed Pedagogical Map and Visual Approach will be compiled, informally verified with all the relevant SMEs for final verification and approval. Online discussions, e-mails or phone calls may be used for the purpose of verification with all relevant SMEs.

The Visual Approach will be adapted to the target audience and learning objectives, and provide the project with the visual framework within which the team will operate when developing and reviewing detailed screen elements during production.

A **design workshop** will take place aimed at agreeing upon the Instructional Design Map, including the following main elements:

- Course Learning Objectives;
- Definition of Target Audience;
- Course Scope Definition;
- High-Level Course Design (interim);
- Detailed Pedagogical Map;
- Overall Visual Approach;
- Pilot/ Release Event plan.

There are important elements that improve the quality of the final product (the educational software) that are analysed and decided in the instructional design phase. They make the routine more coherent and enhance the product efficiency, if used appropriately. These elements of teaching technology concern:

- the learner's performances and the analysis of the target population;
- the curriculum design;
- the definition of the instructional objectives that are being targeted;
- the correlation of the instructional objectives with the multimedia resources, the teaching strategy options.

The design workshop acts as a **kick-off meeting** for the eLearning course development. In this phase the different means of communication will also be defined.

2.2.2.5 Storyboarding Phase

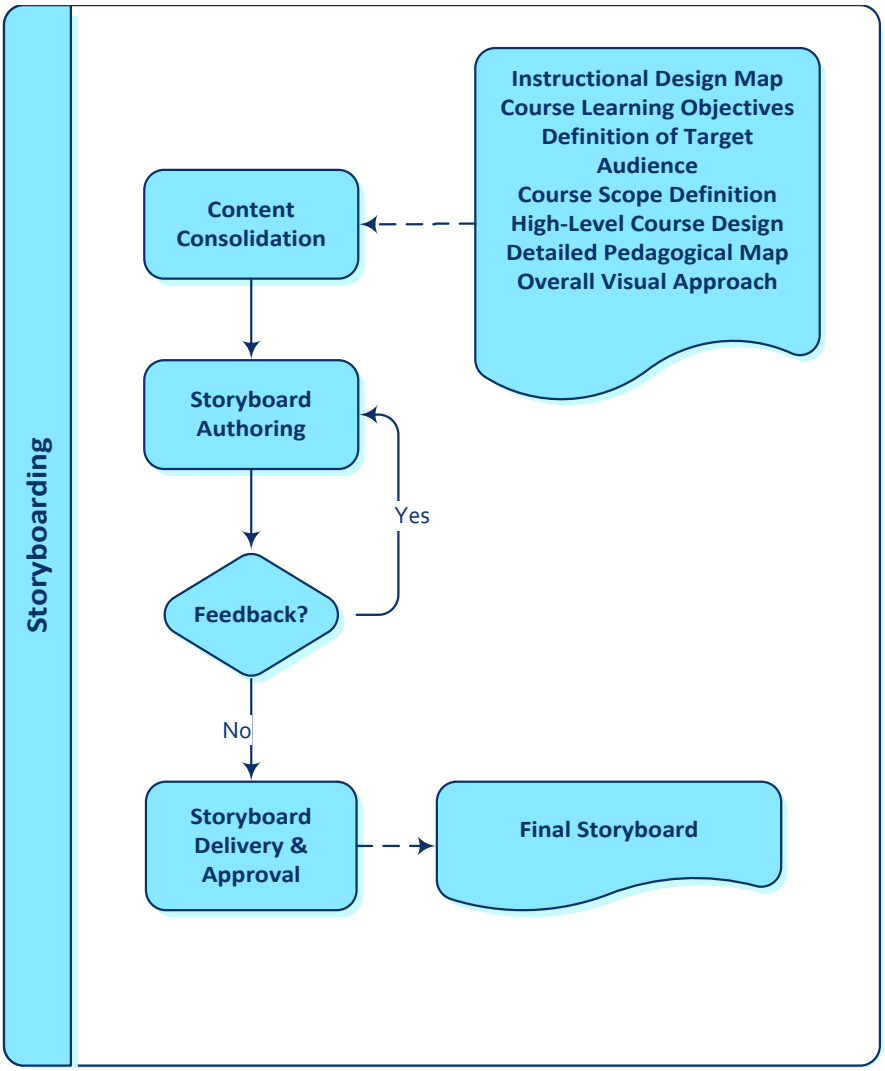

Figure 4: Storyboarding Phase

The storyboarding phase, Figure 4, relies on the agreed Instructional Design Map.

The storyboarding phase has two major steps:

- Content consolidation;
- Storyboard authoring;

The main outcome of this phase is the ***Storyboard*** that will give the technical team the information required for technical development.

2.2.2.6 Content consolidation

Collaboration between the ID and the SME is crucial in this stage of the project.

The ID and SME will have to rely on the Instructional Design Map components to define the content of the course, prior to storyboarding. E-mails, audio and video conversations and document sharing will be constantly required in this step.

The Glossary of terms is collected via the collaborative environment and referenced throughout all three parts of the Production phase to ensure consistent use of terminology.

Once the content is 90% defined, the actual storyboarding is initialised. To ensure the mentioned Agile approach, the 90% criteria can be applied at module level (in order to be able to start the storyboard development for some modules while for the rest of the content is still defined).

2.2.2.7 Storyboard authoring

The main purpose of this stage of the production phase is to ensure that the content is complete and accurate, the flow of the course meets the priorities of the design, and the development is feasible within the technology of choice, prior to spending effort course development.

Storyboarding mostly involves the correlation between the cumulative action of a number of *learning assets* and the learning objectives proposed, to attain the expected educational/instructional effect. This correlation is made using the guidelines of modern instructional theories on the role of the learner, new educational paradigms generated by constructivist approaches.

Metadata for each content object is included in the storyboard.

The storyboard can either be visual, in the shape of mock-ups for each screen, or in text format, including the description of elements to be developed and including references to the multimedia elements that will be used in the Build stage. The format of the storyboard can be different according to the type of eLearning solution, and it will be agreed with the SMEs.

After the storyboard is created by the Instructional Designer (contacting the SME for additional support if necessary), it is sent to the SME for review and approval. The SME should make amendments and ask for changes in the Instructional Design approach at this step.

SMEs will be asked to review the storyboard and approve the draft screens and content prior to the initiation of the Build Phase.

2.2.3 eContent Development/Course Building

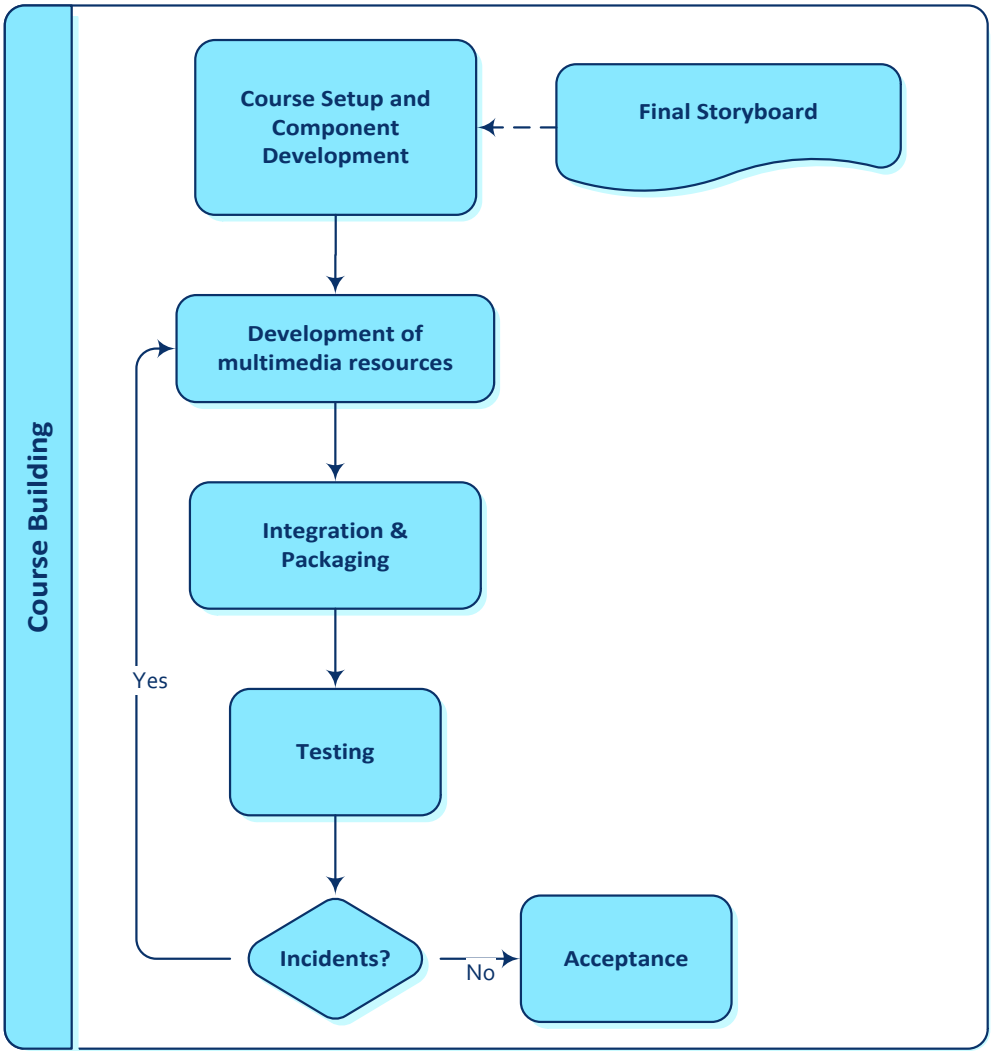

Figure 5: Course Building

The eContent course building depicted in Figure 5 is based on the final storyboard, the development team creates the eLearning course, using the selected technologies and further detailed during the design workshop.

The technical development relies on the storyboard, which includes directions for developers, using standard instructions, rules and norms specific to interface design and content development.

Course development has five main steps:

- Define course structure for learning objects;
- Course Setup and Component Development;
- Content Development;

- Integration & Packaging;
- Course validation.

2.2.3.1 Define course structure for learning objects

SIMAVI and SMEs will agree on the technical course structure at the start of the Build step, indicating whether each course is to be a single Shareable Content Object (SCO) or multiple SCO course.

From a **technical point of view** the most visible implication to this decision is that a single-SCO course will require an Internal course menu, whereas a multi-SCO course will need to use the menu generated by the host LMS. In addition, in terms of design and implementation a multi-SCO object cannot have deep-level links between SCO modules (learners must be directed to use the LMS menu to switch to a different SCO).

The Course Setup consists in developing and implementing common interface elements, menus, and navigation models. The main input is the Instructional Design Map, containing the overall visual approach, high-level course design, and course structure.

Once the storyboard is approved, specific components to be developed for subsequent content development are being identified and developed.

This step may not be required when the ordered course is an add-on to an existing course, or when no new elements are required (reusing interfaces and components)

2.2.3.2 Development of the multimedia resources

During this phase all the *learning assets* defined in the storyboard will be developed.

2.2.3.3 Implementation & Packaging

Developers write the source code, integrate the learning assets, compile, test and eliminate code and system flaws.

The software development process follows our standard software development methodology.

Depending on the specific requirements for each course, the chosen navigation and sequencing model the course is packaged in SCORM, exe, HMTL5, apk, app, ipsw, appx and iso formats.

2.2.3.4 Course validation

SMEs will be asked to review the built course and to validate that the courseware matches the intention as agreed in the storyboard prior to the Acceptance phase being started. Multiple partial validations may take place in a case of Agile content development feedback being collected and implemented by the SIMAVI.

Once the SMEs have validated the built course the project to move to the next phase.

2.2.4 Acceptance of the Built Course

This phase consists of two main phases:

- Pilot testing;
- Formal acceptance/Release.

2.2.4.1 Pilot Testing

The course piloting is aimed at identifying issues that may have been omitted by the consortium's QA.

For this step, the course is published online, details on accessing the Learning Management Platforms (LMS) in chapter 3. Pilot participants are expected to capture all issues and suggestions.

The received feedback is classified in the following categories:

- Editorial issues – text errors;
- Technical issues – functionality errors;
- Content issues – scientific or subject-related errors;
- Relevance issues.

The issues are prioritised and the effort for implementing is estimated. If more than 5% of the development budget is required for remedies, the pilot is deemed to have failed and an inquiry meeting is set up, to decide further actions.

In case of a "failed" pilot, SIMAVI will organise and hold an inquiry meeting. This meeting will be used to review the list of 'out of scope' changes and compare with various components that were signed off in previous phases to identify where the problems first arose. A decision will be taken on the scope of the solution envisaged, the extent to which a solution was foreseeable, and the funding and contractual implications.

During this meeting we will discuss and agree upon the following:

- the reasons for failure;
- Identify timeline requirements for delivery for each key audience segment;
- Identify the options for delivery (scope vs. timeline) for each key audience segment;
- Identify and agree the risks associated with each option;
- Negotiate the funding for each option, and determine the preferred option;
- Announce new scope, budget, and timeline.

2.2.4.2 Release

In this phase, the course is published in a Sharable Content Object Reference Mode (SCORM) Package(s) for uploading on Learning Management Systems;

2.2.5 Audio

During **Storyboarding**, we provide voice samples. A draft audio script is created at the same time as the storyboard.

During **Development**, the audio script is amended and a draft audio is recorded in-house after the course is developed.

For the **Pilot Testing**, the draft audio is used. After the course is deemed final, the audio script is approved and sent for professional recording (human voice or electronically generated speech).

2.3Pedagogical Approach

The scope of the eLearning courses is to provide the target group with a high-quality eLearning solution, fully customised to its needs and based on international best practice and recognised eLearning standards.

Knowing the target audience is of utmost importance from the planning and design phases onwards. Based on the results of each course's target group analysis and on recognised instructional design and pedagogical theories, a specific pedagogical approach is employed, which helps to choose the optimal combination of learning activities that maximise the accomplishment of the course's goals.

The eLearning courses will be designed to be used in different learning contexts, suitable for exclusively online or blended learning, synchronous or asynchronous, that allow for either independent usage or assisted by a trainer/ tutor.

The proposed instructional design recipe is tried and tested and has evolved over 12 years of experience in eLearning content development projects.

2.3.1 Instructional Design Concepts and Models

2.3.1.1 Target group analysis

The eLearning solution is aimed at providing learners with the required resources to achieve specific learning objectives and outcomes.

The specifics of the target audience will be considered while creating the courses – the eLearning courses' main audience is made up of consortium partners using the tools and pilots deployed in CyberSEAS.

However, eLearning courses are built to address the needs of broader audiences.

A key criterion with a major contribution to the quality of the instructional process is the extent to which it addresses and meets the identified learning objectives/targets/goals of the target groups. Information about the target group strongly impacts the development of eLearning software. We therefore consider the following factors when analysing the target population:

- **Demographical**: what are the general characteristics of the learners? Is there (or not) uniformity to *gender*, *age*, *educational* or *cultural background*?
- **Psychological**: what is the cognitive structure, the level of cognitive development, intellectual ability, the cognitive style? Do they want the information provided in a very

direct manner or do they prefer a games-based approach? What types of intelligences (Gardner) dominate the target group?

- **Attitudinal**: what is the learners' attitude towards the content presented or to training itself? What is their attitude to the use of technology-based training?
- **Experience with technology-based training**: are the learners already accustomed to using online materials? Are they comfortable with this approach or do they need *ITC abilities/skills training* beforehand?
- **Motivational**: what are the learners' work and career goals? How can the instructional programme help them to realise those goals?
- **Prior knowledge and experience**: what will the learners bring to the training in terms of specific skills and knowledge? To what extent are they currently working toward achieving the desired goals?
- **Organisational culture:** what are the organisational culture features for different groups' members?
- **Accessibility**: What are the general requirements of accessibility?

The learners' profile can be used to direct the instructional design. For example, an older audience might not respond well to a music video theme or review questions embedded within a game and a classic quiz format should be used. A young audience may not understand allusions to historical events that occurred before they were born, in which case the events need a more detailed explanation.

The eLearning courses will therefore be developed considering target group specificities:

- added support for domain specific terminology as English proficiency levels may vary;
- increased content usability as computer literacy levels may vary;
- the possibility of having a role-based menu structure, as domain knowledge and perspectives may vary;
- the possibility of having pre-test evaluation for each course section, allowing learners to choose the content to browser according to their own level of proficiency and domain knowledge.

According to the data available for all these factors, we design software adapted to the target population concerned. Any significant information from the list above will be reflected in the Instructional Design Map and influence the development direction.

The modular structure and the SCORM packaging also provide the possibility to build different instructional paths, in accordance with target group characteristics, giving post development control over the eLearning content.

2.3.1.2 Constructivism

Modern education is based on discovery rather than on the mere transfer of information, so the learning situations created have the important role of building practical skills and transferring integrated competences. **Constructivism** is the learning theory that supports our methodology.

Most contemporary cognitive psychologists believe that learning is an individual construction of knowledge, generated by the interaction with the environment and cannot be dissociated from the social and cultural context in which it develops. In recent decades, several theories and models have evolved, each with specific characteristics, while keeping

the constructivist approach (rather than the behavioural one, for instance) as a common denominator/platform.

This common platform has the following characteristics that define constructivist instructional environments:

- provides multiple representations of reality, avoiding simplifications and representing the complexity of the real world;
- favours authentic tasks in a significant context rather than abstract ones out of the context of instruction;
- provides learning environments such as real situations or case studies instead of pre-established learning sequences;
- stimulates reflection on the experience;
- ensures the construction of knowledge in relation to the context and depending on it;
- encourages collaborative construction of knowledge through social negotiation, not through competition.

Cognitive constructivism (Piaget, 1919) is based on two assumptions:

- learning is an individual approach. Characteristics: learning through discovery, operating with objects, tasks that require operating with existing concepts and the techniques of Socratic dialogue;
- learning is an active process. Characteristics: assimilate and adapt direct experiences; errors, solution searching.

Social constructivism (Vygotsky, 1978) states that:

- learning and development are social activities, based on collaboration;
- proximate development area may be a guide for learning plans;
- learning should take place in a significant context;
- external experiences should be related to the learner's instructional experience.

The overlap between the constructivist platforms and the opportunities offered by an educational approach based on multimedia resources is obvious. This is why the constructivist paradigm was successfully used in the definition of the instructional strategy for our eLearning content.

From this perspective, the instructional strategy is structured on some basic conclusions of constructivism.

The instructional strategy for an eLearning course:

- encourages and supports learner autonomy and initiative;
- regards learners as having their own will and aim;
- considers learning a process;
- encourages the learner to explore;
- admits the role of experience in learning;
- stimulates the natural curiosity of the learner, takes into consideration the learner's mental model;
- takes into account both performance and understanding in assessing the learning;
- extensive use of cognitive terminology, such as prediction, creation and analysis;
- takes into account how the learner learns;

- encourages learners to engage in dialogue with other learners;
- encourages learning through cooperation;
- involves learners in critical situations;
- takes into account the context in which the learning occurs;
- takes into account the learner's beliefs and attitudes;
- provides learners with the opportunity to build new knowledge and understanding through an authentic experience.

2.3.1.3 Learning/Operational Objectives

A taxonomy of learning objectives is a system of classification and ordering of the general objectives based on their content and specific degree of complexity of mental operations (cognitive processes) involved in the learning process. (Bloom, 1956) developed the taxonomy for the cognitive domain in 1956. Our model is based on **Bloom's taxonomy revised by** (Anderson and Krathwohl , 2001)**.**

The operationalisation of educational objectives is a strategy applied by the instructional designer in collaboration with the course developer for the analysis of the goals of the learning process, relying on two complementary actions to maximise learning/assessment efficiency:

- to derive actual objectives from the general and particular aims of the course;
- to define these objectives as educational tasks to be carried out by the learner during an instructional unit (course, module, etc) stated as:
    - **content objectives** (mainly informational);
    - **psychological (cognitive) objectives** (mainly formative), adapted to the particularities of the learning environment.

The strategy of operationalising educational objectives is designed and achieved to specify the end behaviour of the learner, expressed by a verb – describing the concrete action carried out by the learner – and a concrete performance, expressed in terms of learning outcome (content).

Operationalising educational objectives also implies the specification of criteria necessary and sufficient to enclose the manifold modifications and transformations in terms of human personality, of a category of competences, viewed as the outcome of the learning process, triggered by the educational activity. To define an educational objective on the operational level means to specify the ways in which the learner's behaviour is expected to be changed.

Operational objectives are those which clearly state the knowledge, skills and competences of the learner at the end of an instructional activity. Operational objectives are about learning, comprehending or applying something new, unknown before the moment of learning. So operational objectives anticipate an observable and measurable change of behaviour, obtained during instructional activities.

Therefore, operationalised objectives provide the connection between the components of an educational activity and help facilitate the transition from general to particular, from concrete to abstract.

Although the objectives may be specified in an almost unlimited number of ways, the learner behaviours involved in these objectives can be represented by a relatively small number of

classes. The taxonomy is therefore designed to be a classification of the learner behaviours which represent the intended outcomes of the educational process (Anderson, 2000).

Objectives provide a purpose for learning. Identifying objectives is the most important step in Instructional Design. It is based on the **Revised Taxonomy Matrix** developed by (Anderson and Krathwohl , 2001) based on Bloom's taxonomy of cognitive processes. Out of a rather static classification made by Bloom, Anderson and Krathwohl imagined a dynamic matrix that can be drawn for every course, no matter what the character of the specific content involved is. The structure of the Revised Taxonomy Matrix "provides a clear, concise visual representation of the alignment between educational goals, objectives, products, and activities".

An objective is classically defined by two elements: verb and knowledge (VK) which provides information of the curriculum content that the subject (learner) has to learn, employing a specific cognitive process. The objective refers to the content using a verb. The verb provides clues as to the cognitive process category intended by the course designer to be attained/obtained by the learner.

Adopted from the original Bloom's taxonomy of educational objectives, the Revised Taxonomy Matrix has six cognitive process categories:

- **remembering**: produce the right information from memory;
- **understanding**: make meaning from educational materials or experiences;
- **applying**: use a procedure;
- **analysing**: break a concept down into its parts and describe how the parts relate to the whole;
- **evaluating**: make judgments based on criteria and standards;
- **creating**: put pieces together to form something new or recognize components of a new structure.

Each of the six cognitive process categories was divided into specific cognitive processes. Nineteen specific cognitive processes were identified; the most important aspect of these cognitive processes being that they are expressed through verbs. Each of the verbs below can be used in defining an operational objective:

- **remember**: recognising, recalling;
- **understand**: interpreting, exemplifying, classifying, summarizing, inferring, comparing, explaining;
- **apply**: executing, implementing;
- **analyse**: differentiating, organising, attributing;
- **evaluate**: checking, critiquing;
- **create**: generating, planning, and producing.

These verbs or their synonyms contribute to the definition of objectives. Even if the objective's definition verb is not among these verbs it can easily be approximated by one of them. Through this verb we identify the cognitive process for every instructional outcome (objective).

Curriculum content represents the core of learning; it exists outside the learner as defined by the instructional designer. Learning is, in the end, integrating the content in the learner's mental system. When content is integrated it becomes knowledge. This transformation of content to knowledge takes place through the cognitive processes used by the learner.

For several reasons, *content* was replaced by *knowledge* in the matrix. There are four Types of Knowledge:

- **Factual Knowledge**: the basic elements learners must know about a subject, even solving problems on that subject;
- **Conceptual Knowledge**: a learner's representation of the major concepts in a system;
- **Procedural Knowledge**: the knowledge exercised in the accomplishment of a task;
- **Metacognitive Knowledge**: metacognition is defined as "cognition about cognition", or "knowing about knowing" or "learning how to learn". It can take many forms; it includes knowledge about when and where to use particular strategies for learning or for problem solving.

Anderson and Krathwohl combined the two major concepts in a matrix depicted in Table 2: the columns are the six Cognitive Processes and the lines are the four Knowledge Dimensions:

Knowledge/ Dimension	**The Cognitive Process**					
	REMEMBER Recognising Recalling	**UNDERSTAND** Interpreting Exemplifying Classifying Summarizing Inferring Comparing Explaining	**APPLY** Executing Implementing	**ANALYSE** Differentiating Organising Attributing	**EVALUATE** Checking Critiquing	**CREATE** Generating Planning Producing
Factual Knowledge	**Path 1**	**Path 2**	**Path 3**	**Path 4**	**Path 5**	**Path 6**
Conceptual Knowledge	**Path 7**	**Path 8**	**Path 9**	**Path 10**	**Path 11**	**Path 12**
Procedural Knowledge	**Path 13**	**Path 14**	**Path 15**	**Path 16**	**Path 17**	**Path 18**
Metacognitive Knowledge	**Path 19**	**Path 22**	**Path 21**	**Path 22**	**Path 23**	**Path 24**

Table 2: Cognitive processes

The instructional designers work on every autonomous fragment of the curriculum content, each fragment having one or more objectives already attached by the course designers and implicitly one or more verbs (see above).

For each fragment they will determine the knowledge dimension (from the content characteristics) and the cognitive process (from the objective's verb attached). From the Revised Taxonomy Matrix, they choose the path that corresponds to the intersection of the two categories.

There are 24 paths. A path of a certain content fragment, in our approach, is composed of:

- the knowledge dimension;

- the cognitive process;
- **the optimal combination of multimedia resources.**

These optimal combinations of multimedia resources for the 24 cases of the Revised Taxonomy Matrix represent our original contribution to the development of interactive, multimedia content. It is the output of more than 12 years of work in eLearning capitalising on the research by our specialists.

To the identified path we will add all the attributes and information necessary to describe in detail the instructional process (e.g., level of interactivity, inputs about the targeted group, software tools, assessment level or pedagogic strategy, etc). All these attributes will be defined at their corresponding development stage.

2.3.1.4 The theory of multiple intelligences

The theory of multiple intelligences, developed by (Gartner, 1987) classifies intelligence by eight modalities, mostly sensory, as opposed to seeing intelligence as a singular ability. Each individual is characterised by a unique mixture of all intelligences.

The eight intelligence modalities defined by Gardner are:

- Intrapersonal;
- Interpersonal;
- logical-mathematical;
- naturalist;
- spatial;
- bodily-kinesthetic;
- linguistic;
- musical.

While each individual is unique and possesses a specific combination of the above, by analysing the target audience, a common inclination towards specific intelligences can be easily identified (i.e., all computer programmers have a highly developed logical-mathematical intelligence; people lacking interpersonal intelligence will never be inclined towards jobs involving public interactions).

Traditional educational systems only measure linguistic and logical-mathematical abilities. By identifying the target audience's inclination towards specific intelligences, the courses can be designed in a manner that addresses their specific inclinations, to help them in the learning process. Gardner states that the purpose of schooling and training "should be to help people reach vocational and avocational goals that are appropriate to their particular spectrum of intelligences. People who are helped to do so, feel more engaged and competent and therefore more inclined to serve society in a constructive way." (Gartner, 1987).

2.3.2 Interactivity

Learners will interact directly with the content, through the use of various learning activities and will be provided with feedback through the course of their study.

The main characteristics of the interactive content objects are:

- **feedback**: users will be provided with feedback for each of their actions. The feedback will be generated by comparing learners' performance to the criteria. Learners will be provided with auditory and graphical feedback for their performance and will be guided to improve their performance. The auditory feedback will also be duplicated in the form of text;
- **control**: learners will be in control of their own learning process. The persistent navigation will allow them to navigate freely within the eLearning course and within the content objects. Each learning activity will be provided with specific controls that will allow learners to restart, pause, stop and resume any activity at any point inside the learning process;
- **creativity**: the developed digital content will allow students to find multiple solutions to a given problem. This will be achieved through the use of highly interactive learning items;
- **adaptive**: various highly interactive learning items will provide customised feedback based on learners' actions. These activities will not provide linear activities and will force students to find the best approach or more than one solution to a given problem. This will be achieved by using learning games, simulations and problem-solving activities.

The developed digital content will be developed in cooperation with the Subject Matter Experts and will be validated at least twice with them through the design and development process and validated again in the pilot phase. All digital content will therefore be virtually free of errors and presented without bias or omissions that could mislead learners.

The developed digital content will be highly motivating for participants using a great variety of learning activities, highly interactive digital content and game mechanics integrated within learning activities. This will be achieved by using simulation and evaluation activities offering true-to-life learning activities.

The design and development methodology integrates years of experience and continuous evaluation of multimedia resources. The main characteristics of the digital content to be developed are presented below:

- designed to be attractive for learners, considering essential components, like learners' knowledge level, known metaphors, interactivity or graphic design;
- pedagogical approach will cater for the higher range of cognitive skills, such as application, analysis and comparison, synthesis, evaluation and creating;
- integrate a variety of learning resources;
- engage learners through the use of highly interactive digital content, game mechanics integration, and continuous feedback;
- develop critical thinking skills and encourage collaboration among students;
- designed to be accessible and reusable by tagging all resources with metadata and making them autonomous, ready to be reused in various learning situations;
- facilitate the understanding of particular terms, concepts and expressions through a variety of learning activities, highly interactive activities and collaboration.

The CyberSEAS courses are categorized as an IT application eLearning courses. They are training courses based on the 'Tell me, Show me, Try me, Test me' concept, which translates into the following cognitive processes: **remembering**, **understanding**, **applying**.

These courses will mostly include low, standard and higher interactivity elements, corresponding to Basic and Enhanced eLearning courses.

The IT Application eLearning courses can include a role-based menu structure, highlighting specific tasks and tracks to be followed by different learner roles.

Graphical elements will include application snapshots and *captivate* sequences, reproducing activities to be performed by users.

The assessment activities (knowledge checkpoints, random questions/pool and case studies) will also require learners to **apply** the recently acquired information.

The courses contain a multitude of multimedia resources from text, simple and complex graphics, voice over, animations, video etc.

2.4 Technical and Functional Specifications

The developed learning content will be technically flawless and will integrate the following characteristics:

- **Web optimised**, to allow fast access to the learning content, without long periods required for downloading the content;
- **Usable**, to deliver a pleasant experience to learners, without causing frustration for users with lower computer literacy skills;
- **Accessible,** with all content objects being designed considering the five principles of accessibility: perceivable, operable, understandable, and robust;
- **Tagged using metadata**, for increased accessibility to reusable learning objects;
- **Interoperable** across any platform integrating the SCORM 2004 4th edition specifications. For compatibility reasons (as requested in the Tender Specifications) we will check also SCORM 1.2 compatibility;
- **Reusable** – learning activities are designed to be autonomous and organised as reusable content objects that are easy to find and easy to reuse within a course or for further new courses;
- **Standardised** – each learning object implements the SCORM 2004 4th edition specification for digital content standardisation, making the developed digital content available across various platforms and supporting efficient maintenance and updating. For compatibility reasons (as requested in the Tender Specifications) we will check also SCORM 1.2 compliance.

2.4.1 Structure

eLearning courses will typically be structured in content objects. A **content object** is the smallest unit of learning, usually designed for five to fifteen minutes of learning, and consisting of several learning assets, such as text, graphics, video, simulations, animations and learning games.

The Content Objects are structured as follows:

- **Small learning units**, with a duration that normally goes from five to fifteen minutes of learning;

- **Complex software**, developed as standalone interactive objects, available within the eLearning platform included in SCORM Packages
- **Autonomous**, with each content object answering to one learning objective;
- **Reusable**, with each content object being independent from the others, making it reusable in a variety of contexts and learning setups, others than the initial one;
- **Searchable**, with all content objects being tagged with metadata using the IMS LOM standard. This means that each content object is tagged with a set of keywords that make learning assets more accessible, searchable and reusable;
- The specific structure of each eLearning course will be established during the planning or design phase. Typically, an eLearning course will integrate the following learning objects:
    - **Diagnostic assessment (optional)**, at the start of each eLearning course. Learners will be provided with two options:
        - To skip the test and run the entire eLearning course if they have no prior knowledge on the subject;
        - To take the test if they have prior domain knowledge and want to be guided to specific sections of the module based on their results. If learners are domain experts and can pass the pre-test from the first attempt, they will be allowed to go directly to the certification test.
    - **Reusable Content Objects**, organised in sections, and integrating various learning assets;
    - **Knowledge checkpoints**, formative assessment activities integrated within the content objects, allowing learners to self-assess their knowledge, to know whether they have reached the required proficiency level or they need to study more;
    - **Assessment (case studies)**, at the end of each eLearning course, evaluating learners' level of understanding, usually using scenarios based on real life examples;
    - **Certification exam (optional)**, available only for those learners that have successfully passed either the diagnostic assessment, or the case studies. The certification exam can differ according to the user's selected role;
      Feedback Provision / User Satisfaction Survey, each eLearning course will end with a 'congratulations and appreciation' note inviting trainees to participate to the user satisfaction survey via a hyperlink.

2.4.2 Graphical User Interface

The graphical user interface (thereafter alternatively referred to as GUI) will be consistent across all eLearning courses, integrating strong principles for increased accessibility and a simple and intuitive layout, designed to be usable for all major profiles within the target group.

The GUI will be customized according to the specifics of eLearning course groups (standard, IT application, performance simulation).

The GUI will be designed to fit into the existing infrastructure without issues in terms of resolution, graphical quality, interactivity and pedagogical purposes.

All graphic elements will be developed considering aesthetic principles. Graphics also have a functional role, not just aesthetic. All graphics included within the educational content packages will be aesthetically appropriate and attractive for the age of the learners, but will not distract them, so that they can focus on the activities.

The graphics and multimedia (sound, colour and motion) will be of good quality and high resolution, as mentioned in the multimedia requirements section. The graphics will have a functional role, connected to the rest of the content presented in the subsection. Except for layout purposes, graphics must not be used just for decorative reasons. Graphics, multimedia, interactions and text content used as a whole will be connected and will support the educational goal of the reusable learning object.

Visual design has a significant contribution to a clear understanding of the information provided and is consistent with instructional standards as well as with the particularities of the learners. The eLearning modules will comply with established guidelines, will promote the values of modern theories of teaching/learning with a view to innovate and optimise education and training.

Graphics will follow web design principles: unity, variety, balance, rhythm, harmony and emphasis. It has been proven that the use of a varied chromatic field can enhance the efficiency of intellectual activity, and research on the influence of colours on human psychic has been diversified. Their conclusion is that a proper mix of colours is an important element in the presentation of materials.

The user interface integrates the following common components:

- **Print functionality**: Learners have the option to print a screenshot of the course they follow;
- **Library**: Web addresses or other relevant additional sources/publications;
- **Glossary A-Z:** Inventory of terms used throughout the course;
- **Help Menu/user instructions:** integrated information on navigation rules and course guidelines;
- **Standard Navigation Buttons, Menu Bar:** providing for standard navigation functions within an eLearning course;
- **Advanced Navigation Buttons:** Pause, Replay and similar Menu bar (by default) providing for advanced navigation and similar functions within an eLearning course;
- **Book marking at each module completed:** Learners have the option of starting the module at the point where they last stopped and/or interrupted the course when running the course from a Learning Management System;
- **Audio On/Off**: Provision of specific menu functionality (for courses with audio);
- **Transcript On/Off**: Provision of transcript functionality (for courses with audio).

2.4.3 Navigation

The developed digital content will integrate two navigation types:

Persistent navigation, for navigation between reusable content objects, available in both SCORM and offline interfaces.

Within the SCORM Player, a float menu displays the organisation items on the left side of the screen, allowing learners to navigate freely between the various digital content objects.

Within the stand-alone version, an offline interface will emulate the SCORM player functionalities, providing a persistent navigation between the digital learning objects.

Sequential navigation, for navigation between different frames of the reusable content objects. This is made available through the use of numbered slides/pages.

The digital content allows learners to close, restart or pick another activity at any time. The developed digital content is designed for the learner to have control throughout its use; learners may intervene to review certain sections, to exit the programme or to get an overall view: they will be able to find their way rapidly and without hesitation to a complete and coherent instructional message. That is why the content will be designed to require minimum navigation skills, similar to those required by popular off-line applications or internet browsing software.

Navigation elements will be visible, easy to use and intuitive, with clear instructions available on the screen to guide the learner in solving the assigned tasks and free from excessive delay. Instructions are standardised, clear, simple; written in a clear, concise form they can be understood by learners with few computer abilities. Wording and definitions follow international standards.

Due to the modular structure of the content, meaning that they are structured into reusable learning objects, files are small, and require short loading time.

2.4.4 Usability

The development process will be based on a user-centred analysis performed at the beginning of each project which will provide a complete set of accessibility and usability requirements.

The main scope of the user-centred analysis phase is to address some of the issues of the target users have running the digital content; some of them may not be very advanced computer users.

User experience is a success factor in any software application and is one of the most important components within the design and development process for educational digital content, providing learners with a pleasurable experience, making the learning process more efficient and more engaging, without forcing students to focus their cognitive workload on understanding how the software application works.

Designing usable digital content requires a complex user-centred design phase prior to project execution phase. To provide usable digital learning objects, the following three phases will be performed during the project execution phase:

- **User-Centred Analysis**; this is performed during the analysis phase performed during the project definition phase. The user-centred analysis will provide tailored specifications based on learners' requirements;
- **User-Centred Design**; this is done during the solution design phase. All specifications generated within the User-Centred Analysis phase are included into the defined eLearning solution;
- **Usability Testing**; this is performed during the software testing process. Usability testing verifies whether the usability specifications, as defined within the user-centred analysis

phase, were implemented. Additionally, three types of usability tests will be made by Usability Analysts: holistic evaluation, heuristic evaluation and cognitive walkthrough.

Reports for each of the above-mentioned phases will be delivered through the project execution phase.

The default usability checklist, one that will be further updated during the user-centred analysis phase, is indicated below:

- scientific text, located on the left side of the screen, will be optimised for fast reading, having the line length of 45 characters;
- all acronyms and new terminology will be explained using hypertexts, with all hypertexts being integrated into a glossary of terms and expressions;
- presentations will minimise visual search; visual cues and focal points are made available to guide students within the digital learning object;
- graphics, charts and all multimedia resources will be labelled and free of clutter, to provide learners with the required tags for memorisation and also to favour a better understanding of the digital content;
- animated or video recorded events will be accompanied by descriptive audio narrations;
- colour, music and decorative features will be aesthetically pleasing and will not interfere with the learning objectives;
- the GUI will integrate known principles, providing an intuitive and familiar interface for learners, implicitly informing students how to interact with the digital learning object;
- all digital learning objects will integrate clear work instructions, guiding learners in reaching the learning objectives for the proposed digital learning object;
- all digital lessons will be structured as autonomous reusable learning objects, tagged with metadata and standardised using the SCORM 2004 4th edition specifications. This will make all digital learning objects available cross-platform, reusable in various learning contexts and easier to locate;
- the application will keep learners informed about what is going on via appropriate feedback in reasonable time;
- users will be provided with 'emergency exit' buttons, allowing them to skip or resume an activity at any time;
- digital content will implement current convention and interaction principles that users are accustomed with;
- digital content to be developed will integrate several mechanisms of error prevention, such as disabled buttons to prevent triggering various actions by accident;
- the design of the digital learning objects will consider the major cognitive differences between recognition and recall and will mostly use recognition at the interface level, decreasing the cognitive workload;
- the content to be developed will integrate a standardised help system, assisting learners to perform the required actions:
    - contextual help, in the form of work instructions, assisting learners to reach the learning objectives;
    - general help, at the interface level, offering instructions for navigation and user controls.

The design and development methodology integrates a complete set of usability specifications, based on previous eLearning projects.

SIMAVI has a team of formally trained and certified usability analysts, having performed many projects or research and development in user experience design.

2.4.5 Accessibility

Digital content accessibility is considered a key factor in addressing the project's target group. The developed digital content will integrate those WCAG 2.0 guidelines applicable for the defined target group. A detailed description of the WCAG 2.0 specification can be found on the w3.org website.

The main WCAG 2.0 specifications to be implemented within the digital content to be developed are described below:

- **Colour and contrast**. Colour used in learning objects will help, along with other elements, to convey information, indicating an action, prompting a response or distinguishing a visual element. Moreover, the learning objects to be developed will be designed to have high contrast rates between the foreground and background colours, providing a pleasant and comfortable experience for users;
- **Control over audio files**. All audio files will be designed to play when initiated by the user, so as not to interfere with or disrupt users' actions;
- **Operability and navigability**. The learning objects to be developed will rely exclusively on non-timed user actions, thus providing the users with the chance to read and use the content at their own pace, without the pressure of time limits;
  For all animations and videos, play/pause controls are available to enable users to have full control of the multimedia item;
  To provide a **safe learning environment** for all learners, content objects to be developed will not integrate elements that flash more than three times a second, thus preventing seizures.
  From the point of view of **navigability**, the learning objects to be developed provide ways to help users navigate, find content, and determine where they are. On the interface of each content object will show users the title of the chapter to which the information in the object pertains, and the title of the object. Navigation between the screens of an object is done via Next/Previous buttons and the current position is reflected similarly to the breadcrumbs in web pages.
  For hypertexts, the name of the hypertext and the title of the pop-up window offer clear information on their contents.
- **Readability, predictability and assistance.** The language of each content object will be determined programmatically.
  All content objects will operate in predictable and consistent ways: all objects for a certain domain will have a consistent design, with similar mechanisms of navigation and position of GUI elements. Components (buttons, sliders etc) that have the same functionality within a set of learning objects will be consistently identified.
- **Context-sensitive help** will be available throughout the reusable learning objects, aiding the user in the correct use of the on-screen elements, while errors in operation will

be signalled by the software. The help design will take into account the target user group age and level of understanding.

2.4.6 Interoperability

Interoperability refers to the courses' capability to interact and exchange data with other systems.

2.4.6.1 SCORM Packaging

The developed learning courses will be delivered as SCORM 2004 4th Edition packages (while checking for SCORM 1.2 compatibility) to be integrated with compliant Learning Management Systems. Content packaging will be IMS CP conformant and will use the core functionalities of the SCORM standard:

- Metadata Tagging;
- Navigation and Sequencing Rules;
- LMS Reporting;
- Bookmarks.

The developed digital content will have all learning assets externalised (images, videos, audios, animations, simulation, text), with metadata tags, to provide full text search diagnostics and correction.

An eLearning course can either be packaged as one Sharable Content Object (SCO), corresponding to one SCORM package, or divided into multiple packages, either per Content Object or grouped in course subsections.

Multiple packages, corresponding to different role-based menu-structures, implementing sequencing variations, can be created upon request.

SCORM packaging may not always be the most suitable for high-interactive courses or for new eLearning formats. Newer interoperability protocols, such as Tin Can API[1]/ Experience[2] API are recommended for LMS communication for complex games and portable devices (tablets and phones).

2.4.6.2 Metadata tagging

Metadata tagging has an essential role in the searchability and reusability of the learning resources. Through the use of metadata tagging, resources are easier to find by having attached a series of data regarding the content.

Metadata tagging will comply with SCORM 2004 4th Edition specifications (while checking for SCORM 1.2 compatibility).

Metadata list will be finalized after the analysis phase. The default metadata list to be attached to each content object is presented below:

- titles for all learning assets;

[1] http://tincanapi.com/

[2] http://www.adlnet.gov/capabilities/tla/experience-api.html

- keywords;
- duration;
- learning objectives;
- learning outcomes;
- language;
- content object type (expositive, mixed, evaluation).

2.4.6.3 LMS Reporting

Depending on the learning management system (LMS) being used, the eLearning content can aggregate statistical data for the following types of reports:

- content objects completed;
- content objects accessed;
- time spent on each content object/ eLearning course;
- evaluation activities' results;
- number of attempts for each content object.

These reports are essential in the evaluation of learners, their motivation and the success of the learning course. Based on the generated outputs, the learning process can be adjusted to improve the final results.

2.4.6.4 Navigation and Sequencing

All eLearning courses will follow sequencing rules based on pedagogical requirements.

Navigation and sequencing rules are essential for a proper delivery of the message during the learning process.

Different types of navigation and sequencing rules can be made available within each eLearning course:

- **Free**: Learners are free to navigate within the eLearning course, without having any sequencing rules;
- **Assisted:** Learners are guided within the eLearning course based on their results from the pre-test evaluation (optional, upon request);
- **Role-based**: Learners are contextually guided according to their professional profile or role.

2.4.6.5 Learning Content Voice-over

The developed digital content can integrate voice-over functionality in various contexts:

- Instructions, to make learners more aware of their tasks and to improve the accessibility of the digital content;
- Scientific text, to allow users to focus on the multimedia area of the screen, rather than on the text. This option will also improve the accessibility of the digital content;
- Transcript, for various video resources, to allow users to focus on the video resource, rather than on the transcript.

2.4.6.6 Multimedia Specifications

All multimedia resources will be optimized for web use with no additional plug-in required to run these resources.

All multimedia resources will implement the following set of specifications:

- **Quality**. All multimedia resources are provided with the same minimum resolution or aspects ratio, providing the perfect trade-off between high quality and web optimization;
- **Size**. All multimedia resources are optimized for web use in terms of size and format used;
- **Controls**. All multimedia resources are provided with specific controls, enabling users to control each learning asset. The most common controls attached to each multimedia resource are:
    - **Start/Stop buttons**, allowing learners to pause or stop the multimedia resource at any point;
    - **Advanced navigation buttons**, such as Pause, Replay, when the content requires them;
    - **Volume bar**, allowing learners to adjust at suitable level the sound volume for the multimedia resources integrating audio files;
    - **Cue points**, allowing users to jump to various sections within a multimedia resource such as animation or video;
    - **Audio on/off**, when the learning asset contains audio;
    - **Transcript on/off**, when the learning asset contains audio.

Audio files will be kept to reasonably small sizes to reduce to the minimum acceptable the overall size of the learning resources. Only two compressed formats will be used: .mp3 and .wav. The bit rate will be between 16kbps and 48kbps. The mode will be stereo. Exceptions are made for voice recording where the mode can be mono if the bit rate exceeds 48kbps.

Image files will also be compressed to reduce the size of the eLearning module. The three accepted formats are: .jpeg, .gif, .png. The images will have minimum resolution of 72 dpi. Images of higher DPI are used as long as the file size is reasonable.

Video files will be compressed to reduce the size of the eLearning modules. The following formats will be used: Windows Media Video (wmv) or MPEG-4 (mp4). Minimum video size will be 320 x 240 pixels.

Animations will be developed using the authoring tool of choice and/or dedicated software (such as Adobe AfterEffects).

Audio and audio-visual assets will include a full set of playback controls. The playback controls that will usually be included for videos and animations are: play/pause, stop, and progress bar with navigation function and cue points.

All multimedia resources integrated within the digital content to be developed will reflect learning objectives and scope.

All learning assets will integrate the following specifications:

- Graphics will play an important functional role, apart from being attractive;

- The content will be accompanied by visual feedback and when necessary, auditory feedback;
- All content objects will offer the possibility of going back at a certain point or starting the activity, as it is described in greater detail within the navigation section.

3 CyberSEAS Learning management system (LMS)

3.1 Technical details

CyberSEAS Learning Platform is a digital ecosystem designed on the versatile **WordPress** framework. Learning Management System (LMS), the hub for all your educational needs regarding CyberSEAS and EPES. Our LMS is designed to provide you with a seamless and user-friendly experience, making learning more accessible and engaging than ever before.

CyberSEAS Learning Platform leverages key WordPress plugins to provide a comprehensive and user-friendly learning experience:

- At the core of CyberSEAS Learning is LearnPress, a robust Learning Management System (LMS) plugin.
- Wordfence security plugin fortifies the platform with a robust firewall, continuous threat intelligence updates, and regular malware scans.
- New User Approve plugin (Enhanced User Registration Control) & LoginPress plugin (Improved User Experience) – this plug in allows us to approve the new users/account on the platform.
- Insert or Embed e-Learning Content into WordPress plugin – simplifies the integration of e-learning materials into the CyberSEAS Learning Platform.

The CyberSEAS platform has the following main characteristics:

- **Innovative**:
  - on The platform is built on WordPress CMS with LearnPress LMS plugin, and Articulate Storyline as authoring tool.
  - Different WordPress plugins are used for seamless integration and UX: Insert or Embed Articulate Content, New User Approve, and LoginPress.
- **Engaging**:
  - Courses a**re** tailored for EPES operators, reviewed by SMEs working on the CyberSEAS project pilots.
  - We have used visual enhancements tools like: Synthesia Studio, Camtasia and Adobe Photoshop.
- **Secure**:
  - Security by design is implemented in the **LMS platform** using Wordfence Security plugin.
  - The security is enhanced by continuous improvement and community involvement that test and create timely patches.

- **Interactive with Articulate Storyline:**
  - Our courses come to life through Articulate Storyline, a powerful e-learning authoring tool, that creates interactive, scenario-based content that enhances learner comprehension. Through articulate offers:
    - Scenario-Based Learning
    - Rich Multimedia Integration
    - Responsive Design for Any Device
- **Interactive Courses with Articulate Storyline:**
  - Camtasia and Adobe Photoshop play a crucial role in enhancing the course materials. Camtasia enriches video elements, while Adobe Photoshop ensures visually stunning graphics, creating a visually stimulating and engaging learning environment. These tools offer:
    - Enhanced Video Elements with Camtasia
    - Visual Excellence with Adobe Photoshop
- **AI-driven video synthesis for education:**
  - Synthesia Studio revolutionizes content creation with AI-driven video synthesis. It seamlessly generates lifelike avatars delivering dynamic, multilingual presentations. Enhancing user engagement, it integrates seamlessly into the courses, creating a personalized and impactful learning experience for a global audience. AI offers:
    - **AI-Driven Video Creation**
    - **Multilingual Capabilities**
    - **Dynamic and Impactful Presentations**
- **User-Friendly Interface:**
  - The LMS boasts an intuitive and easy-to-navigate interface, ensuring that the courses and learning materials can be easily accessed.
- **Diverse Course Offerings:**
  - The LMS offers a diverse catalogue of courses to cater to diverse educational interests and needs from cybersecurity, energy systems, or a wide range of other subjects.
- **Interactive Learning:**
  - The LMS is equipped with various interactive elements, including quizzes, discussions, and simulations, to keep learners engaged and help them retain knowledge effectively.
- **Progress Tracking:**
  - The LMS progress tracking helps learners in their journey, allowing them to monitor their course completion, review scores, and assess theirdevelopment over time.
- **Mobile Accessibility:**
  - The LMS platform is not limited to a single device. The LMS platform is accessible on various devices, enabling learning from anywhere.
- **Self-Paced Learning:**
  - The LMS helps leaners with busy schedule. The LMS courses are self-paced courses that allow learners to tailor their learning experience to their own availability and preferences.
- **Certification:**

- The courses offer certifications upon successful completion. These certifications can be valuable in advancing the learner's career and showcasing their expertise.

3.2 Accessing the platform

The CyberSEAS Learning Platform was successfully launched in December 2023, and it has been operating seamlessly ever since.

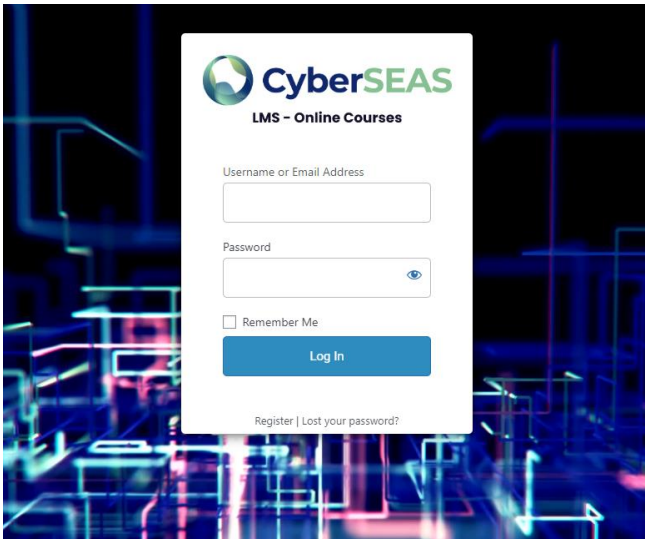

Figure 6: CyberSEAS log-in page

The CyberSEAS Learning Platform can pe accessed using the following link: https://lms.cyberseas.eu/, Figure 6.

- To access and enrol to learning modules, the users should provide name, username and e-mail address.
- **After the user is approved by an administrator,** he will receive an email to set a password.
- After setting the password you can login and start learning, Figure 7, Figure 8.§

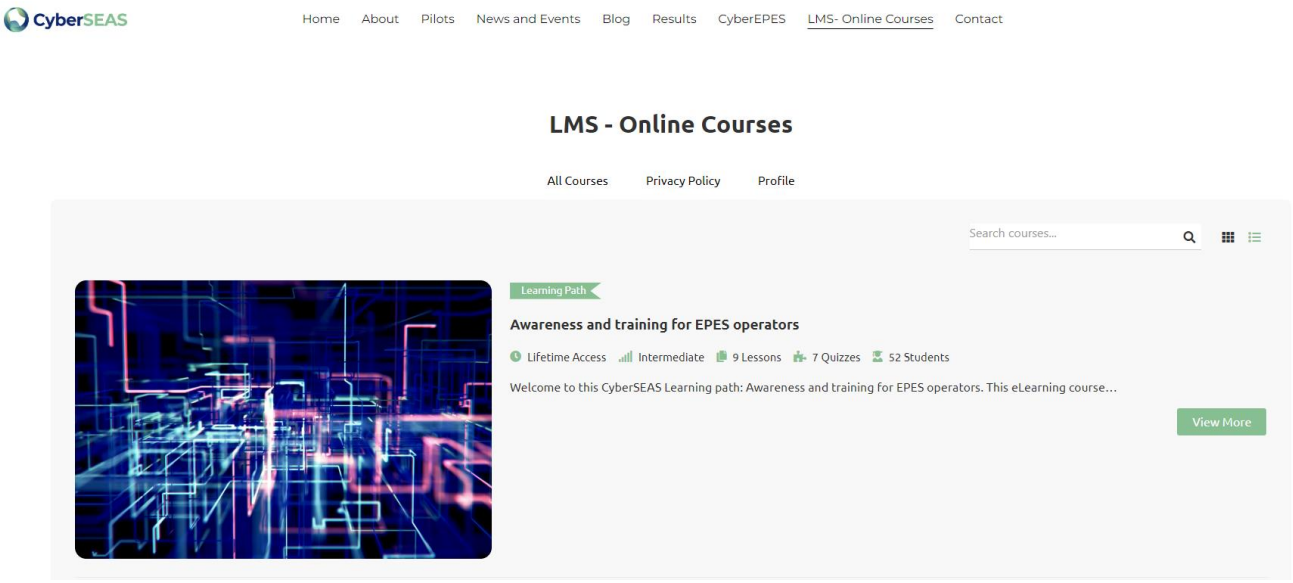

Figure 7 : CyberSEAS LMS 1

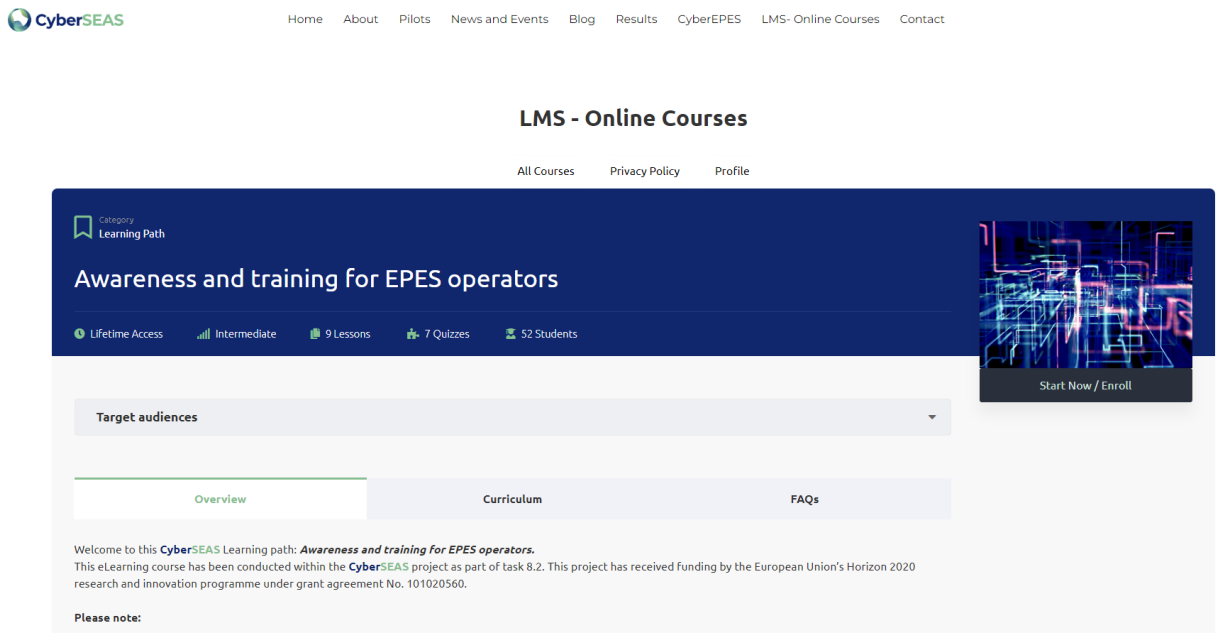

Figure 8: CyberSEAS LMS 2

3.3 Available courses

We have developed **30 hours of learning content**. We have developed an extensive library of eLearning courses for CyberSEAS project that showcase everything that was developed during the project. Table 3 is a comprehensive description of each course.

Learning Path – Awareness and training for EPES operators:

- Introduction to the Learning Path
- Introducing CyberSEAS project
- Italian Pilot – Testing scenarios and Tools
- Slovenia & Croatia Pilot – Testing scenarios and Tools
- Romanian Pilot – Testing scenarios and Tools
- Finland Pilot – Testing scenarios and Tools
- Estonia Pilot – Testing scenarios and Tools
- Conclusions and Learning Objectives Analysis

Learning Path – Tools Descriptions Learning Path:

- Introduction
- SecurGrid
- CyberRange
- HwTEE – JNI
- SIEM
- ATRS
- BP-IDS
- PKI
- Virtual testbed
- RATING
- TO4SEE
- ALIDA
- MDPI
- Testing Lab
- SAPPAN
- MIDA Tool
- HEINDALL

- Attack-Defence Simulator
- CVIAT
- ARTEMIS
- APEN
- Conclusions and Learning Objectives Analysis

The courses developed during the project are detailed in Table 3. The entire storyboards for the courses are in a separate document.

eLearning course name	**Description**
Italian Pilot infrastructure	The course details the CyberSEAS Italian infrastructure pilot. After this course you will be able to: • Understand the context of the Italian pilot: o Aim and objectives o Context o The companies involved in managing the energy grid o The electrical infrastructure used and power grid o Assets and location of pilot • Discover the operational model of the Italian Pilot: o Discover the actors and stakeholders involved o Workflow • Discover the cyber security threats that the Italian pilot is facing: o Situational factor and threats o IOT protocols used o Current processes and technologies o Potential security incidents and consequences
Finnish Pilot infrastructure	The course details the CyberSEAS Finnish pilot infrastructure. After this course you will be able to: • Understand the context of the Finnish pilot: o Aim and objectives o Context o The companies involved in managing the energy grid o How the cloud platform operates

	• Discover the operational model of the Finnish Pilot: o Discover the actors and stakeholders involved o Workflow • Discover the cyber security threats that the Finnish pilot is facing: o Known threats o IOT protocols used o Potential security incidents and consequences
Estonian Pilot infrastructure	The course details the CyberSEAS Estonian pilot. After this course you will be able to: • Understand the context of the Estonian pilot: o Aim and objectives o Assets of the Estonian pilot • Discover the operational model of the Estonian pilot: o Discover the actors and stakeholders involved o Workflow • Discover the cyber security threats that the Estonian pilot is facing: o IoT configuration o Potential security incidents and consequences
Romanian Pilot infrastructure	The course details the CyberSEAS Romanian pilot. After this course you will be able to: • Understand the context of the Romanian pilot: o Aim and objectives o Context and assets • Discover the operational model of the Romanian Pilot: o Discover the actors and stakeholders involved • Discover the cyber security threats that the Romanian pilot is facing: o Communication protocols used o Potential security incidents and consequences
Slovenian and Croatian Pilot infrastructure	The course details the CyberSEAS Slovenian and Croatian pilot. After this course you will be able to: • Understand the context of the Slovenian and Croatian pilot:

	o Aim and objectives o Context o The companies involved in managing the energy grid • Discover the operational model of the Slovenian and Croatian Pilot: o Discover the assets and operational model o IoT configuration per use case • Discover the cyber security threats that the Slovenian and Croatian pilot is facing: o Current processes and technologies o Potential security incidents and consequences
Italian Pilot scenarios	This course details the scenarios and tools that will be tested in the Italian pilot.
Finnish Pilot scenarios	This course details the scenarios and tools that will be tested in the Finnish pilot.
Estonian Pilot scenarios	This course details the scenarios and tools that will be tested in the Estonian pilot.
Romanian Pilot scenarios	This course details the scenarios and tools that will be tested in the Romanian pilot.
Slovenian and Croatian Pilot scenarios	This course details the scenarios and tools that will be tested in the Slovenian and Croatian pilot.
CyberSEAS tools	This course details the tools used in the CyberSEAS project. The mapping of each individual tool can be found in the description of each individual pilot. This course details over 20 tools used in the CyberSEAS project.

Table 3: CyberSEAS courses

4 Conclusion

This deliverable detailed the security awareness and training materials developed during Task 8.2. The document detailed the methodology for developing advanced interactive eLearning courses for the CyberSEAS project. The deliverable, described the technical details of the LMS proposed for CyberSEAS project. The storyboards for all the courses developed are also included.

The project developed 11 eLearning courses for CyberSEAS pilots and tools. We developed two courses for each of the five pilots: one for infrastructure and one for scenarios. A separate course was developed to showcase over 20 tools developed specifically for CyberSEAS.

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