E-learning environment to support certification processes

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An e-learning platform to support a newly proposed certification process, for any change within the total aviation system, is developed. The work comprises the following:

- Selection of a suitable e-learning solution
- Development of a course curriculum
- Development of learning objectives
- Description of course content

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Acronyms

Acronym	Definition
ASCOS	Aviation Safety and Certification of new Operations and Systems
CAST	Commercial Aviation Safety Team
CATS	Causal model for Air Transport Safety
CMA	Continuous Monitoring Approach
e-learning	Electronic learning
EASA	European Aviation Safety Agency
ECCAIRS	European Central Coordination Centre for Accident Reporting Systems
ECR	European Central Repository
ELS	E-Learning Support
EVAIR	EUROCONTROL Voluntary ATM Incident Reporting system
ICAO	International Civil Aviation Organization
IORS	EASA Internal Occurrence Reporting System
IRP	EUROCONTROL Integrated Risk Picture
MOOC	Massive Open Online Courses
SRC	EUROCONTROL Safety Regulation Commission
URL	Uniform Resource Locator (web address)

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Executive Summary

An e-learning platform to support a newly proposed certification process, for any change within the total aviation system, is developed. The work comprises the following:

- Selection of a suitable e-learning solution
- Development of a course curriculum
- Development of learning objectives
- Description of course content

Initially, Blackboard learn was chosen as e-learning platform, as it seems to provide all functionalities expected to be required for the ASCOS e-learning environment. However, implementing the Blackboard environment within the ASCOS public web-site appeared to be more time consuming and technically demanding as initially expected. Therefore, it was decided to discontinue the development in Blackboard and make the course content directly accessible through a separate page on the ASCOS public website, which is now available at http://www.ascos-project.eu.

For the course curriculum, initially 12 courses are identified. The structure of the curriculum is represented in a knowledge tree that shows which knowledge from previous courses is necessary for each of the 12 courses:

1. Introduction to the e-learning environment
2. ASCOS Initiative
3. Introduction to the total aviation system
4. Existing regulations and certification processes
5. Proposed certification process
6. Safety performance indicators
7. Baseline risk picture
8. Continuous safety monitoring
9. Safety databases
10. Safety methods
11. Safety tools
12. Safety Standards

Additional course modules, e.g. on the global framework for aviation, are currently under consideration. The course content is generated in collaboration with the ASCOS partners and the User Group members, in such a way that all the expertise and knowledge available within, and external to, the ASCOS team is fully utilized.

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1 Introduction

1.1 Background and scope

Fundamental changes in the institutional arrangements for aviation regulation in Europe, the introduction of new technologies and operations, and demands for higher levels of safety performance call for the adaptation of existing certification processes. The European Commission (EC) Project 'Aviation Safety and Certification of new Operations and Systems' (ASCOS) contributes to the removal of certification obstacles and supports implementation of technologies to reach the EU ACARE Vision 2020 [1, 2, 3] and Flight Path 2050 [4] goals. ASCOS outlines a newly proposed approach to certification that [5, 6]:

- Is more flexible with regard to the introduction of new operations, systems and products;
- Is more efficient, in terms of cost, time and safety, than the current certification processes;
- Considers the impact on safety of all elements of the total aviation system and the entire system life-cycle in a complete and integrated way.

Moving towards performance based regulation, based upon agreed safety performance in combination with risk based approach to standardization, is expected to lead to improvements in the way that safety risks are controlled [5, 6]. Anticipating on future risks and hazards by using a "proactive approach" helps to make the certification process robust to new developments. Introducing 'continuous safety monitoring' will ensure that new and essential safety data is effectively used immediately after it will be available.

Promising options for adaptations of the existing certification processes include [6]: 'change between performance-based and compliance-based or vice versa', 'proof of concept approach', 'enforce existing rules and improve existing processes', and 'cross-domain fertilization'. Introducing certification process adaptations cannot be done without giving due account to safety considerations: each of these options requires evidence on safety assurance as key element in a certification process. The need for safety improvement is also recognized in the ACARE Beyond Vision 2020 (Towards 2050) [3], which states that 'society is increasingly reluctant to accept failures in the Air Transport System, which exerts more pressure on safety considerations'. The Flightpath 2050 Vision for Aviation [4] specifically aims for a *holistic, total system approach to aviation safety, integrated across all components and stakeholders. This will be supported by new safety management, safety assurance and certification techniques that account for all system developments. Just culture will be adopted as essential element of the safety process* [4]. Clearly, there is a need for new safety based design systems and supporting tools that address the *total aviation system*, while being able to anticipate on *future and emerging risks* that may exist in a future aviation system that will differ from today's aviation system.

Although a total aviation system approach is becoming more widely supported in aviation, there is still a lot to be done before this will actually be embedded in certification processes and safety management. Safety topics that require further research – in particular from a total aviation system point of view – are e.g. development of a framework of Safety Performance Indicators, establishment of a baseline risk picture and safety performance targets, definition of a process for continuous safety monitoring, development of risk models and accident scenarios representing the future aviation system, and subsequent incorporation of the – total aviation system – safety methods and tools in safety standards (and certification processes).

An important aspect of improving procedures and processes, such as involved in certification safety risk management, is teaching the people who are involved how they should apply the procedures and processes. In the past teaching usually involved a teacher standing in from of the classroom, after which students could ask questions and practice the material at home. One of the issues with this is that it requires both student and teacher at the same place at the same time, which may create difficulties with scheduling and travelling. Also the retention rate of a classical lecture is not always high, and it has been observed that only 10% of the information is remembered three days later.

E-learning methods try to increase effectiveness of teaching by using electronic methods to have the students actively participate in a lecture, even though direct communication with the teacher might not be plausible due to student numbers, physical locations and availability of a teacher at that time.

Offering courses online is one way of doing this. Massive Open Online Courses (MOOC) are one particular way in which tens of thousands of people can participate in a course for free to increase their knowledge and get familiar with an educational institute, such as universities. Professional masters, in which professionals pay and follow courses from home, work and/or abroad to increase the knowledge they require for work, already exist.

1.2 Objectives

The objective of this study is to develop an e-learning environment to support certification processes. This includes structuring the knowledge into course modules about all topics expected required, and developing learning objectives for potential users, in this context referred to as ‘students’. More specifically:

- To select a suitable e-learning solution
- To develop a course curriculum
- To develop learning objectives
- To define the proposed course content

1.3 Approach

Knowledge generated in the ASCOS project will be compiled and structured in different courses. This structure allows generating learning material with a specific scope on the knowledge intended to be taught in each course. This also reduces redundancy of materials, as contents of previous courses can be assumed as known.

The e-learning environment also makes the knowledge in ASCOS more accessible to students interested in learning about the results, methodologies and tools developed in the ASCOS project. It guides the student to the core aspects of the results of the ASCOS initiative, while also providing a point of entry to access supporting materials that contain more detailed information for the student.

ASCOS consortium partners and ASCOS User Group members can use the e-learning environment as a way to document their work, and educate other on results, tools and methodologies developed in ASCOS. Therefore, it provides another way of structured dissemination of the results of the ASCOS project. The content available in the e-learning environment will be structured in a way that highlights the most relevant contents for each.

The development of the e-learning environment is split up in two parts:

1. Providing a technical solution capable of generating courses and making them accessible to students. Existing e-learning environments are identified and compared, in order to be able to select the solution that best meets the requirements and expectations for ASCOS. The e-learning environment will be set-up and deployed, in order to make it accessible for the students and content providers.
2. Developing a structure of the courses for the e-learning environment in support of the generation of contents for the courses. The content for the courses in the ASCOS e-learning environment is generated using a suitable methodology. To develop the content for the e-learning environment, the knowledge available and generated in ASCOS has to be identified. The knowledge is structured into a curriculum of courses. The content of each course is defined. Based on knowledge provided by the ASCOS partners, the content may be generated and uploaded to the e-learning environment.

1.4 Structure of the document

Following this Introduction, Section 2 describes the set-up of the e-learning environment, including its expected functionalities. Section 3 describes how the knowledge that is generated and used in ASCOS will be compiled into a curriculum. The curriculum is structured in different courses, and the course material for each course is defined and described. Finally, Section 4 contains the conclusions and recommendations, including a description of follow-up ASCOS activities focusing on evaluation and validation of all generated course content.

2 E-Learning environment

The purpose of the e-learning environment is to allow content providers to add and students to access the course contents and supporting documents in an effective way.

The e-learning environment has to satisfy the needs of 2 main user groups:

- Students have to be able to access the courses of the curriculum, view the course contents and supporting documents, and test that they gained the learning objectives of the course.
- Instructors use the e-learning environment to structure and create new courses, add and modify course content, upload supporting documents and create tests to validate that learning objectives for the course are met.

There are several commercial solutions for e-learning environments available. The initial ASCOS e-learning environment is based on Blackboard learn [7], a web-based solution used by, among many others, TU Delft.

2.1 Required functionalities of the e-learning environment

The following required functionalities for the e-learning environment are identified:

- It should be accessible through a web-browser and no installation of additional software is expected to be needed to access the contents of an e-learning environment.
- It should be possible to integrate the e-learning environment into the existing ASCOS website, as developed with WebtoDate 8 (website creation software provided by DATA BECKER GmbH & Co).
- It should be possible to adapt the design to meet the design template of ASCOS.
- All information and course content should be made publicly available. User management (through username/password should allow limiting access to restricted documents for only selected users.
- The structure of the course curriculum should be represented such that users can navigate between different courses and course materials.
- Instructors can provide and edit their content online, without the need for additional software.
- It should support various media types such as i.e. PowerPoint presentations, PDF documents, videos, audio files and links to other websites. All these media types should be integrated with the course contents, and stored within the e-learning environment.
- Instructors should be able to also create tests to allow students to validate that they met the learning objectives of a course.
- The content generation should be intuitive, using integrated web-based editing tools.
- Documentation on all functionalities of the e-learning should be made available online, and/or made available after consultation of the ASCOS webmaster through the ASCOS public website.

Blackboard learn seems to provides many functionalities that would allow to build the courses for the ASCOS e-learning environment in accordance with these required functionalities [9, 10, 11, 12]. Figure 1 shows a screenshot of the initial ASCOS e-learning environment, which is developed using Blackboard learn.

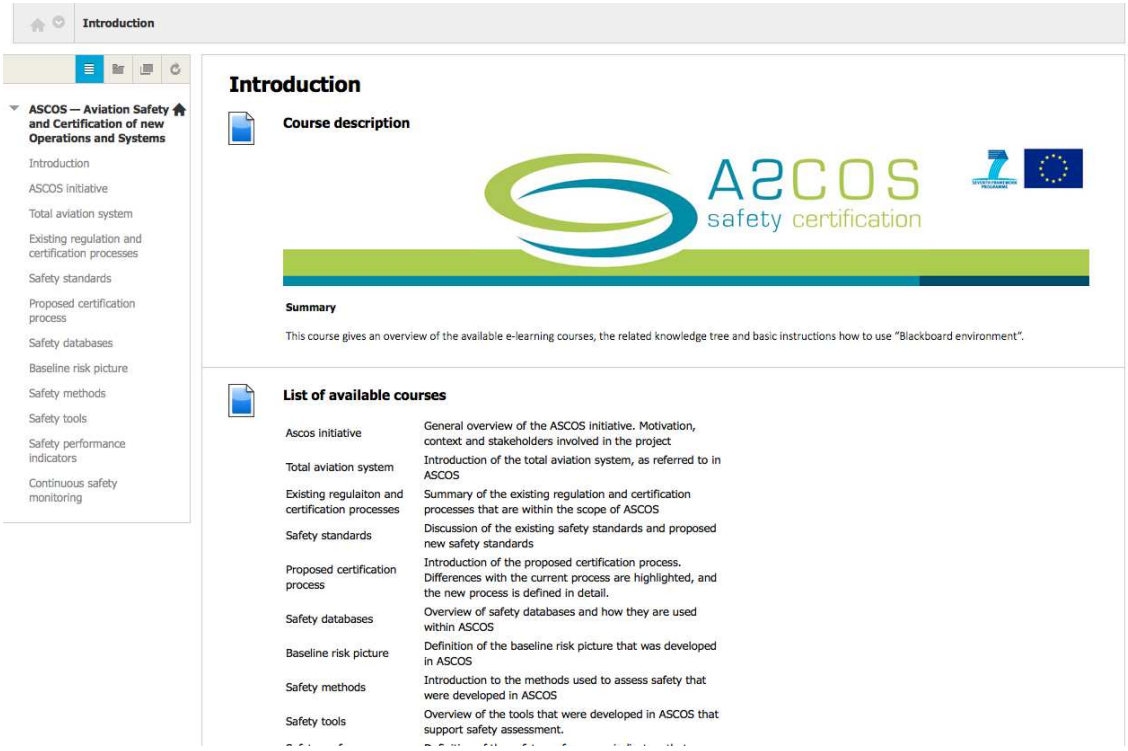

Figure 1: Screenshot of the initial ASCOS e-learning environment

A blackboard environment allows generating a cohesive layering of the contents of the curriculum and within the courses. These layers receive their content from various knowledge sources. A controller links between the layers and the knowledge sources. The diagram in Figure 2 shows the basic structure of the blackboard e-learning concept.

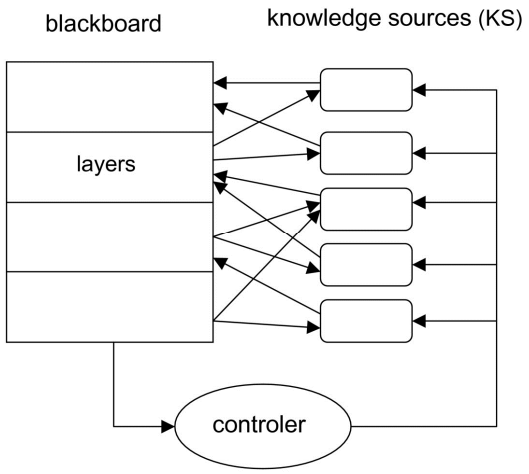

Figure 2: Structure of the blackboard e-learning concept

The initial ASCOS e-learning environment is structured in 4 main content areas. Figure 3 shows an example of this structure in an example:

- The part “Navigation” allows students to navigate between different courses.
- The part “Course description” contains the course summary
- The part “Core course documents” contains all the core learning modules for a course.
- The part “Supporting / additional documents” contains additional documents and links to external documents that support the course content.

Figure 3: Structure of the e-learning environment

2.2 Accessibility of the e-learning environment

The initial e-learning environment is established with Blackboard learn. However, implementing Blackboard learn environment within the ASCOS public web-site appeared to be more time consuming and technically demanding as initially expected. Therefore, it was decided to discontinue the development in Blackboard and make the course content directly accessible through a separate web-page on the ASCOS public website. Students can access the public part of the e-learning environment through the ASCOS website at the URL:

`http://www.ascos-project.eu/e-learning/`

Instructors that want to add or modify content need login information. These can be obtained through the ASCOS coordinator and/or the ASCOS webmaster (contact details available at the above listed web-address). This will allow instructors to join and access the ASCOS organization through a separate page with login details.

3 Content generation for the e-learning environment

3.1 Course curriculum

To generate content in a structured and efficient way, the knowledge that is generated and used in ASCOS has to be compiled into a curriculum. The curriculum is structured in different courses, and the course material for each course is developed. A curriculum of 12 courses is being set up. Table 1 gives an overview of the courses.

Table 1: ASCOS e-learning course curriculum

Title	Summary
Introduction to the e-learning environment	This course gives an overview of the available e-learning courses, the related knowledge tree and basic instructions how to use the e-learning environment.
ASCOS Initiative	This course teaches the student the back ground and motivation of the ASCOS initiative. The different stakeholders involved in the project, as well as their roles within the initiative are introduced. The work is motivated by introducing the current certification processes, and the benefits of new certification processes.
Introduction to the total aviation system	This Course introduces the understanding of the “total aviation system”. It introduces and describes the relationship between stakeholders, domains and elements in the total aviation system.
Existing Regulations and certification processes	This course will give an overview of the existing regulations, as well as the existing certification processes. Relationships between the regulatory materials are highlighted. The current regulatory view is explained. Also an overview of the different domain specific approval processes is given.
Proposed certification process	This course introduces the proposed certification process. Differences to the current certification process are highlighted and benefits of the proposed certification process are described. It is explained how the available information and inputs contribute to the proposed certification process. These inputs are e.g. certification language, quantification, safety barriers and decision-making support.
Safety performance indicators	The need for safety performance indicators for continuous safety monitoring is motivated. The framework of safety performance indicators developed in ASCOS is introduced and the process of deriving safety performance indicators is explained. A proposed set of safety performance indicators is defined and linked with the operational issues as outlined in the European Aviation Safety Plan. The required data and calculations for quantification of the indicators are explained.
Baseline risk picture	In this course the total aviation system baseline risk picture developed in ASCOS is presented. The meaning and relevance of the baseline risk picture within scope of ASCOS is defined. The methodology for how the baseline risk picture is established is explained. The various sources for data and information are introduced and it is shown how different domains contribute to risk. The course also introduces how

	the baseline risk picture links to other tools developed in ASCOS. Possibilities to use the baseline risk picture for continuous safety monitoring as well as safety risk management to support the introduction of new technologies are introduced. Differences with the baseline risk picture in the EUROCONTROL IRP are identified.
Continuous safety monitoring	In this course the process for continuous safety monitoring developed in ASCOS is introduced. The benefits of using Continuous Safety Monitoring are compared to the more traditional way of monitoring safety through (multi)-yearly cycles of collecting and analysing safety data. It is explained how CMA can be used as part of the life cycle processes for continued airworthiness of aircraft, maintenance of certificates for air navigation service providers, operators, and manufacturers.
Safety databases	This course introduces the various safety databases existing in aviation. General terminology and taxonomies used for aviation safety databases is identified. The general purpose of these safety databases is introduced. The usage of aviation safety databases in ASCOS is introduced and put in context of the project.
Safety methods	This course introduces the wide variety of methods for safety assessment in aviation through existing safety method databases. The methods for safety assessment as developed in ASCOS are explained. Requirements for the ASCOS methods are described. The concept of describing accidents as sequences of causal events is explained as the foundation for the ASCOS safety assessment methods. The steps of the ASCOS safety assessment methods are described. The representation of emerging and future risks in the ASCOS methods is explained.
Safety tools	This course introduces the software tools for safety risk assessment of new systems and technologies as developed within the ASCOS initiative. The use of safety tools in the context of certification is explained. The tools themselves are demonstrated and advantages and limitations are discussed. The tools are demonstrated through example cases. Required inputs - as well as the output - of the tools, are explained. The process for external organizations to obtain the software of the tools is shown.
Safety Standards	This course introduces existing safety standards and proposed adaptations of safety standards. An overview of the key acceptable means of compliance in relation to existing regulations and/or certification specifications is given. A unified process to establish acceptable means of compliance is motivated.

3.2 Structure of the courses - Knowledge tree

The structure of the courses within the ASCOS e-learning environment is represented in a knowledge tree that shows the relationship between the courses. The knowledge tree illustrates which previous knowledge from the curriculum a student requires in order to follow a course. Figure 4 shows the knowledge tree of the ASCOS e-learning environment.

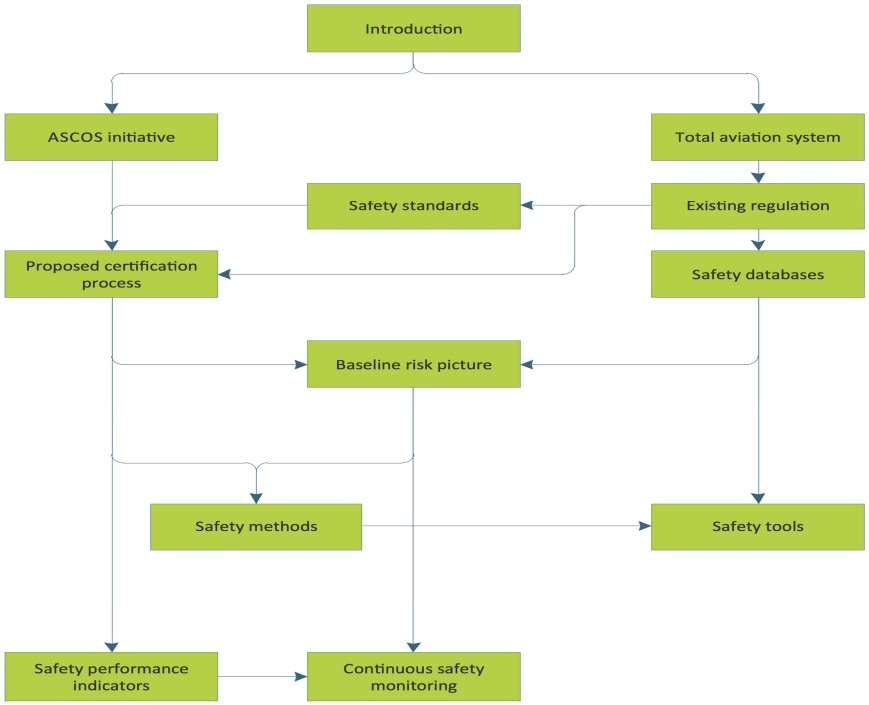

Figure 4: Knowledge tree of the e-learning environment

3.3 E-learning course forms

The information about each course is described in course forms. The course form contains the learning objectives, learning activities and possible assessment for each course. It holds the following information:

- Course Title
- Proposed contact for support: A contact person within the ASCOS team, who has expertise in the field of the course and can provide information and support the development of the course content.
- Summary: A short summary of the course content
- Learning objectives: A list of learning objectives for the course. The learning objectives define the knowledge that a student should gain by following the course. The learning objectives are formulated following “Bloom’s taxonomy” [8]
- Type of material: The materials that need to be available for the course to meet the learning objectives.
- Examination method: The type of examination for the course (if applicable)

The e-learning course forms for the ASCOS e-learning environment are described in the following.

3.3.1 Introduction to the e-learning environment

This course gives an overview of the available e-learning courses, the related knowledge tree and basic instructions how to use the e-learning environment.

3.3.1.1 Learning Objectives

1. Identify the modules within the e-learning environment
2. Select the modules that are relevant
3. Organize how to go through them
4. Describe how to access the information in the e-learning environment
5. Demonstrate basic instructions on the use of Blackboard

3.3.1.2 Type of material

- List of modules + short description (1)
- Knowledge tree (2,3)
- Explanation how the courses are arranged (3)
- User's guidance with instructions on the use of Blackboard (4, 5)

3.3.2 ASCOS initiative

This course teaches the student the back ground and motivation of the ASCOS initiative. The different stakeholders involved in the project, as well as their roles within the initiative are introduced. The work is motivated by introducing the current certification processes, and the benefits of new certification processes.

3.3.2.1 Learning Objectives

At the end of the course the student should be able to:

1. Distinguish the stakeholders involved in certification
2. Explain the need for change of the current certification processes
3. Recognize the potential benefits of new certification processes as developed in ASCOS
4. Describe the aims and objectives of the ASCOS project
5. Classify the intended users of ASCOS
6. Identify the ASCOS partners
7. Describe the work performed within the ASCOS initiative

3.3.2.2 Type of material

- Introductory presentation on the course (1-7)
- ASCOS flyer
- ASCOS brochure
- ASCOS public website
- ASCOS final report

3.3.3 Introduction to the total aviation system

This Course introduces the understanding of 'total aviation system' within the ASCOS initiative. It introduces and describes the relationship between stakeholders, domains and elements in the total aviation system.

3.3.3.1 Learning Objectives

At the end of the course the student should be able to:

1. Distinguish "elements", "stakeholders" and "domains" in the total aviation system
2. Name the different stakeholders in the total aviation system
3. Differentiate the stakeholders' roles and responsibilities
4. Characterize the relationship between different stakeholders in the total aviation system
5. Characterize the different domains in the total aviation system
6. Characterize the relationship between the elements in the total aviation system
7. Recognize the evolution of the total aviation system
8. Explain the relationship between safety and other aspects of the total aviation system
9. Explain the implications of a total aviation system safety approach

3.3.3.2 Type of material

- Introductory presentation on the course (1-9)
- Presentation of stakeholders' roles and responsibilities (2, 3, 4)
- Presentation of the total aviation system - domains, aspects, evolution, safety approach (5, 6, 7, 8, 9)

3.3.4 Existing regulations and certification processes

This course will give an overview of the existing regulations, as well as the existing certification processes. Relationships between the regulatory materials are highlighted. The current regulatory view is explained. Also an overview of the different domain specific approval processes is given.

3.3.4.1 Learning Objectives

At the end of the course the student should be able to:

1. Identify the existing regulations for the total aviation system
2. Locate updates and changes to regulations
3. Summarize the existing certification specifications
4. Locate existing certification specifications
5. Describe the safety relevant goals of certification
6. Differentiate between different approval processes
7. Describe the structure of the current certification process and safety cases
8. Explain the difference between performance based and compliance based certification
9. Identify the organizations involved in the current safety certification and approval process

3.3.4.2 Type of material

- Introductory presentation on the course (1-9)
- Presentation on the regulatory structure (1, 2, 3, 4)
- Presentation on the current approval process (5, 6, 7, 8)
- Link to website of European Commission with relevant regulations
- Link to EASA website with certification specifications
- Link to Eurocontrol SRC website

3.3.5 Proposed certification process

This course introduces the proposed certification process. Differences to the current certification process are highlighted and benefits of the proposed certification process are described. It is explained how the available information and inputs contribute to the proposed certification process. These inputs are e.g. certification language, quantification, safety barriers and decision-making support.

3.3.5.1 Learning Objectives

At the end of the course the student should be able to:

1. Explain the proposed certification process
2. Name the different phases of the certification life cycle
3. Indicate the differences between the current and the proposed certification process
4. Discuss the benefits of the proposed certification process
5. Explain how the proposed certification process is applicable in different domains
6. Explain how an argument based approach contributes to the proposed certification process
7. Explain how regulatory compliance contributes to the proposed certification process
8. Explain how the application of safety risk models contributes to the proposed certification process
9. Explain how establishing a rigour of evidence contributes to the proposed certification process
10. Explain how decision making and approval contributes to the proposed certification process
11. Explain how ASCOS methods and tools can be used within the proposed certification process
12. Indicate how the ASCOS methods and tools apply to different phases of the certification life cycle

3.3.5.2 Type of material

- Introductory presentation on the course (1-12)
- Presentation about the proposed certification process (1, 2, 3, 4)
- Presentation about the applicability of the proposed certification process in various domains (5)
- Presentation explaining how the identified inputs contribute to the proposed certification process (6, 7, 8, 9, 10)
- Presentation on the ASCOS methods and tools (11, 12)
- ASCOS D1.3 report
- ASCOS D1.5 report

- ASCOS D4.5 report
- ASCOS D1.6 report
- ASCOS D5.4 report

3.3.6 Safety performance indicators

The need for safety performance indicators for continuous safety monitoring is motivated. The framework of safety performance indicators developed in ASCOS is introduced and the process of deriving safety performance indicators is explained. A proposed set of safety performance indicators is defined and linked with the operational issues as outlined in the European Aviation Safety Plan. The required data and calculations for quantification of the indicators are explained.

3.3.6.1 Learning Objectives

At the end of the course the student should be able to:

1. Explain the application of safety performance indicators for continuous safety monitoring
2. Describe the framework of safety performance indicators as developed in ASCOS
3. Explain the relation between the safety performance indicators and the EASP operational issues.
4. Demonstrate how the safety performance indicators are calculated.

3.3.6.2 Type of material

- Introductory presentation on the course (1-4)
- Presentation about ASCOS safety performance indicators and link with EASp operational issues (3)
- Presentation about calculation of ASCOS safety performance indicators with aviation safety data (4)
- ASCOS Deliverable D2.1 (1, 2, 3)
- ASCOS Deliverable D2.5 (1, 2, 3, 4)
- Technical papers on safety performance indicators (1)

3.3.7 Baseline risk picture

In this course the total aviation system baseline risk picture developed in ASCOS is presented. The meaning and relevance of the baseline risk picture within scope of ASCOS is defined. The methodology for how the baseline risk picture is established is explained. The various sources for data and information are introduced and it is shown how different domains contribute to risk. The course also introduces how the baseline risk picture links to other tools developed in ASCOS. Possibilities to use the baseline risk picture for continuous safety monitoring as well as safety risk management to support the introduction of new technologies are introduced. Differences with the baseline risk picture in the EUROCONTROL IRP are identified.

3.3.7.1 Learning Objectives

At the end of the course the student should be able to:

1. Define the purpose of the baseline risk picture for ASCOS.

2. Explain the relevance of the baseline risk picture.
3. Identify the links of the baseline risk picture to other tools developed in ASCOS
4. Summarize the methodology used to develop the baseline risk picture.
5. Indicate the data sources used to develop the baseline risk picture.
6. Illustrate the risks contributed from the different domains.
7. Explain how the baseline risk picture may be used for continuous safety monitoring
8. Explain how the baseline risk picture may be used for safety risk management
9. Explain differences between the ASCOS baseline risk picture and the EUROCONTROL IRP

3.3.7.2 Type of material

- Introductory presentation on the course (1-9)
- Presentation about the ASCOS baseline risk picture (1-6)
- Technical paper based on ASCOS deliverable D2.2 (7, 8, 9)
- Information about the EUROCONTROL Integrated Risk Picture (IRP) (9)

3.3.8 Continuous safety monitoring

In this course the process for continuous safety monitoring developed in ASCOS is introduced. The benefits of using Continuous Safety Monitoring are compared to the more traditional way of monitoring safety through (multi)-yearly cycles of collecting and analysing safety data. It is explained how CMA can be used as part of the life cycle processes for continued airworthiness of aircraft, maintenance of certificates for air navigation service providers, operators, and manufacturers.

3.3.8.1 Learning Objectives

At the end of the course the student should be able to:

1. Discuss the process for continuous safety monitoring as developed within ASCOS
2. Explain the benefits of CMA as compared to the traditional way of safety monitoring
3. Describe the ICAO Continuous Monitoring Approach
4. Motivate the need for safety monitoring

3.3.8.2 Type of material

- Introductory presentation on the course (1-3)
- Presentation about the ASCOS process for continuous safety monitoring (1)
- Presentation about the benefits of Continuous Safety Monitoring (2, 4)
- ASCOS Deliverable D2.5 (1, 2)
- Information on the ICAO Continuous Monitoring Approach (CMA) (3)

3.3.9 Safety databases

This course introduces the various safety databases existing in aviation. General terminology and taxonomies used for aviation safety databases is identified. The general purpose of these safety databases is introduced. The usage of aviation safety databases in ASCOS is introduced and put in context of the project.

3.3.9.1 Learning Objectives

At the end of the course the student should be able to:

5. Explain the terminology and taxonomies used in the context of aviation safety databases.
6. Explain the purpose of aviation safety databases.
7. Classify the various existing aviation safety databases.
8. Discuss how the aviation safety databases are used in ASCOS.

3.3.9.2 Type of material

- Introductory presentation (1-4)
- Information on CAST/ICAO Common Taxonomy Team (CICTT) (1)
- Information on European Central Coordination Centre for Accident Reporting Systems (ECCAIRS) (3)
- Information on European Central Repository (ECR) (3)
- Information on EASA Internal Occurrence Reporting System (IORS) (3)
- Information on EUROCONTROL Voluntary ATM Incident Reporting System (EVAIR) (3)
- Information on NLR Air Safety Database (3)
- Information on potential other aviation safety databases (3)
- ASCOS deliverable D2.5

3.3.10 Safety methods

This course introduces the wide variety of methods for safety assessment in aviation through existing safety method databases. The methods for safety assessment as developed in ASCOS are explained. Requirements for the ASCOS methods are described. The concept of describing accidents as sequences of causal events is explained as the foundation for the ASCOS safety assessment methods. The steps of the ASCOS safety assessment methods are described. The representation of emerging and future risks in the ASCOS methods is explained.

3.3.10.1 Learning Objectives

At the end of the course the student should be able to:

1. Discuss the applicability of existing methods for safety assessment in aviation
2. Describe existing safety methods that deal with the total aviation system (CATS, FAST, EME1.1)
3. Describe requirements for a total aviation system safety method that deals with future risks
4. Discuss the representation of risk in safety assessment methods

5. Explain the steps of the safety assessment methods used in ASCOS.
6. Describe how emerging and future risks may be represented in safety methods.

3.3.10.2 Type of material

- Introductory presentation for the course (1-6)
- Presentation about the representation of emerging and future risks (3, 6)
- ASCOS Deliverable D3.1 (2, 3)
- Information about the Causal model for Air Transport Safety (CATS) (1, 2)
- Information about the Future Aviation Safety Team (FAST) methodology (1, 2, 3)
- Information about the EME1.1 Methodology to assess future risks (1, 2, 3)
- Technical paper about the ASCOS risk models and accident scenarios (4, 5)

3.3.11 Safety tools

This course introduces the software tools for safety risk assessment of new systems and technologies as developed within the ASCOS initiative. The use of safety tools in the context of certification is explained. The tools themselves are demonstrated and advantages and limitations are discussed. The tools are demonstrated through example cases. Required inputs - as well as the output - of the tools, are explained. The process for external organizations to obtain the software of the tools is shown.

3.3.11.1 Learning Objectives

At the end of the course the student should be able to:

1. Set up the safety tools developed in ASCOS
2. Interpret the output generated by the tools
3. Prepare required input for the tools
4. Describe the methodologies used by the tools to generate output
5. Demonstrate how to use the tools for an example case
6. Identify advantages and shortcomings of the tools

3.3.11.2 Type of material

- Introductory presentation on the course (1-6)
- Presentation about the tool for risk assessment (1-6)
- Presentation about the tool for overall safety impact (1-6)
- User Manual for the tool for risk assessment (ASCOS deliverable D3.3)
- User Manual for the tool for overall safety impact (ASCOS deliverable D3.4)
- Guidance material for external organizations on how to obtain copies of the software of the tools

3.3.12 Safety standards

This course introduces existing safety standards and proposed adaptations of safety standards. An overview of the key acceptable means of compliance in relation to existing regulations and/or certification specifications is given. A unified process to establish acceptable means of compliance is motivated.

3.3.12.1 Learning Objectives

At the end of the course the student should be able to:

1. Describe existing safety standards
2. Summarize the current processes to establish acceptable means of compliance in different domains
3. Explain the proposed adaptation to the existing safety standards
4. Explain the concepts of “acceptable means of compliance”
5. Discuss the necessity of a unified process to establish acceptable means of compliance

3.3.12.2 Type of material

- Introductory presentation on the course (1-5)
- Presentation on current safety standards and acceptable means of compliance (1, 2, 4)
- Presentation about the changes proposed by ASCOS (3, 5)
- ASCOS D3.5 report

3.4 Generation of content

The course content is generated throughout the duration of the ASCOS project. Actual uploading to the e-learning environment is performed by the ASCOS webmaster, after consultation of the ASCOS coordinator.

4 Conclusions and recommendations

4.1 Conclusions

In this work package the e-learning environment to support the certification process has been set up for the use of ASCOS. The e-learning environment presents a structured and accessible way to disseminate the knowledge generated in the ASCOS initiative to potential users, students, and other interested parties. Initially, Blackboard learn was chosen as e-learning platform, as it seems to provide all functionalities expected to be required for the ASCOS e-learning environment. However, implementing the Blackboard environment within the ASCOS public web-site appeared to be more time consuming and technically demanding as initially expected. Therefore, it was decided to discontinue the development in Blackboard and make the course content directly accessible through a separate page on the ASCOS website, at http://www.ascos-project.eu.

Courses covering all relevant topics have been identified and basic e-learning material are being generated and uploaded to the e-learning environment, which is made accessible through the ASCOS public website at:

`http://www.ascos-project.eu/e-learning/`

The e-learning environment provides access to knowledge generated within ASCOS. This concerns 12 courses:

1. Introduction to the e-learning environment
2. ASCOS Initiative
3. Introduction to the total aviation system
4. Existing regulations and certification processes
5. Proposed certification process
6. Safety performance indicators
7. Baseline risk picture
8. Continuous safety monitoring
9. Safety databases
10. Safety methods
11. Safety tools
12. Safety Standards

4.2 Recommendations

The current state of the e-learning environment provides a basic set of courses and materials to support the certification process developed in ASCOS. Evaluation and validation by potential users is planned in follow up ASCOS activities. The evaluation and validation, together with the feedback received from users should lead to a review, and possibly to an expansion of the curriculum and material of the e-learning environment.

E-learning platforms provide a robust way to edit, update and disseminate content. In future work the e-learning could be utilized as a tool for documentation and content distribution as inherent part of a project.

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