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Future Education and Training in Computing: How to Support Learning at Anytime Anywhere

European Evaluation Framework for Computing Education and Training 2020

EEFCET 2020

ERASMUS
THEMATIC NETWORK
Future Education and Training in computing:
How to Support Learning at Anytime Anywhere

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European Evaluation Framework for computing Education and Training 2020 (EEFCET 2020)

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"You will never do anything in this world without courage. It is the greatest quality of the mind next to honour."

Aristotle

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Version 1.2. The revised version after integrating and updating all parts into this document.
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Version 1.4. The final version of the document based on the evaluation results of the consortium partners.

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EXECUTIVE SUMMARY

This document describes Deliverable D4.4, the *European Evaluation Framework for computing Education and Training 2020* (EEFCET 2020) developed within Work Package 4.

This document presents the result of the work done so far in WP4 with regard EEFCET 2020. Based on the preliminary definition of EEFCET 2020 and requirements set by CEQAT group in WP4, the scope and format of the EEFCET 2020 are finalised. In this document the main components of the EEFCET 2020 are presented. Additionally checklists and other complementary material are provided to support different stages of its utilisation at universities.

After presenting the main issues from the literature that has been found relevant for the definition of EEFCET 2020, the state of the art of curriculum evaluation was presented, discussed and used to derive requirements to an evaluation framework, that EEFCET 2020 tries to meet.

When designing an evaluation framework, it is necessary to consider a rich spectrum of aspects that add to the development of sound evaluation systems that would guarantee valid, reliable, viable, informative and objective results. We considered several factors, like requirements for the establishment of an evaluation framework, different stakeholders to engage in different phases of the evaluation process, key elements of such a framework, main questions that an evaluation framework has to answer, several economic, societal and technological impact factors.

Based on the requirements set in the project proposal and on the discussions so far in the project's WP4, we define the general aims of the EEFCET 2020. We recognise two very important functions that EEFCET 2020 has to implement: improvement and accountability. Then, we identify four evaluation objectives for which we defined priority areas that EEFCET 2020 has to focus on.

A guided web-based interactive tool "EEFCET 2020" (http://media.tuwien.ac.at/eefcet) – as described in this deliverable and provided on the CDs distributed – provides additional support for the stakeholders to better and easier establish such an evaluation framework at their universities. Besides guiding the facilitators during the evaluation process, this interface tries to help reduce the effort needed to fill in the necessary evaluation data. The guiding tool "EEFCET 2020" and the framework EEFCET 2020 itself will be object for evaluation and improvement in our future work.

Finally, we introduce and describe EEFCET 2020 in detail and provide a rich description to facilitate its definition, planning, implementation and continuous improvement at higher education institutions. To support the stakeholders who are in charge of implementing EEFCET 2020 at their universities we additionally specify several tools like checklists and surveys.

1 INTRODUCTION

On the basis of the final version of the Deliverable 4.2 (Tellioğlu, H. and W. Bodrow, 2015) and Deliverable 4.3 (Tellioğlu, 2015), a European Evaluation Framework in computing Education and Training (EEFCET 2020) has been developed, printed on paper and produced as a CD. This framework does not only allow the evaluation of the quality of curricula and syllabi, but also the organisation and management of the introduction and implementation of curricula and syllabi; as well as processes for their update in a reflective and timely manner; and systems established for their evaluation and update. The developed framework has been discussed at the 4th meeting, which took place in HTW Berlin on 10.09.2015. The EEFCET 2020 document is printed in 150 copies and provided on 150 CDs. The main idea is that not only every partner receives a copy, but it is also distributed to other universities, libraries, and to policy makers in the field of higher education.

This document presents the result of the work done so far in WP4 with regard to EEFCET 2020. Based on the preliminary definition of EEFCET 2020 and the requirements set by CEQAT group in WP4, the scope and format of the EEFCET 2020 are finalised. In this document the main components of the EEFCET 2020 are presented. Additionally checklists and other complementary materials are provided to support different stages of its utilisation at universities.

Our literature review shows that there are *several computer science curricula established throughout Europe* (Pereira and Meyer, 2013) where the work conditions of academics and legal conditions vary. Several universities created their study program, there is a lot of data about these studies, a huge number of students have already enrolled and many degrees are awarded so far. Extrapolating from precise data in 2013 in specific countries, limited to universities, a rough estimate of over half a million students are enrolled in informatics bachelor's programs across Europe. This number is 200,000 for masters programs. Seeing the importance of informatics in Europe, universities have to take their role as educators very seriously and need to establish quality assurance mechanisms and measures to evaluate their bachelor, master, and PhD programmes. *The success of our alumni* in computer science, no matter in academic or non-academic work, *depends on our well-evaluated, adapted, quality-assured curricula and utilisation of such*.

To create a common understanding in our process we refer to the *computing classification system* provided by ACM (2012). Assessment models we can apply at our higher education institutions must be developed carefully, by considering several factors. We might use industrial quality models to demonstrate effective performance (Calatrava Moreno, 2013). For that reason we need to know the most common quality management frameworks used so far in higher education and evaluate their strengths and weaknesses. The analysis of the results shows that the *360-degree feedback methodology*, which is usually applied in human resources of organisations, *is a valuable approach*. It involves several stakeholders in the assessment process by enabling the consideration of different views on the same subject or person assessed.

One application of the 360-degree evaluation framework in higher education resulted in the definition of *the following steps* (Calatrava Moreno, 2013): identification and selection of groups of stakeholders, evaluation of stakeholders' knowledge by assigning different subsets of criteria to each group, definition of items which are actual survey questions that are classed together into criteria, instrument testing to understand the questions, implementation of the online survey, aggregation process, and the analysis and interpretation of the feedback gathered. This approach is also further developed by including the collection of individuals' perceptions related to an educational programme, a dual-scale assessment by enabling not only the judgement of the fulfilment of each evaluation criterion but also its relevance. These enable considering priorities of programmes and stakeholders in the assessment process.

To design an assessment framework of knowledge, skills, and competencies we found the concept of *competence management* very relevant. Several papers are dedicated to this subject (Dorn et al., 2008; Bodrow and Simon, 2014; De Coi et al, 2007; Hager at al., 1994; Sampson and Fytros, 2008; Shoikova, 2009; Winterton et al., 2006). Some of them focus on the definition of competence management, some others try to model it, and few others also try to create prototypes to

management competencies. When we design an evaluation framework for computer science curricula, we have to consider what "competencies" mean and how they can be "managed" in order to identify issues, which are relevant to their evaluation. Besides knowledge and skills, we need to evaluate competencies with our evaluation framework. We do not want to repeat here the definitions and models of competencies. For our purpose we found the definition by (Shoikova, 2009) most useful (Tellioğlu and Bodrow, 2015, p.12). Three aspects – context, competency in terms of personal characteristics, and proficiency level – build up the concept of competence in interplay. That means that all these aspects need to be considered when it comes to the assessment of someone's competencies.

Besides the definition of competence, we need to identify the parameters, which are relevant to the evaluation of knowledge, skills, and competencies. In this respect we have to focus our attention to the key stakeholders, which are an intrinsic part of the evaluation process. Bodrow and Simon (2014) differentiate between three groups of stakeholders: professors, alumna/alumni/students, and industries. Bodrow and Atisman (2014) identify and structure *evaluation criteria for professors' knowledge* concerning lecturing, research, and development. They also determine how to evaluate professors' knowledge, e.g., by students considering their scientific, administrative, and teaching related performance (Tellioğlu and Bodrow, 2015, p.18ff). Bodrow and Boumehdi (2014) continue developing *evaluation criteria for students' knowledge* concerning their study at the university, industrial placement, activities abroad, knowledge generated outside the university, and show an example of how to evaluate these formally. Bodrow and Valavanis (2014) provide further *evaluation criteria for industry knowledge* from the perspective of university education concerning enterprise knowledge, knowledge generation and utilisation in the firm, firm's knowledge concerning its structural aspects, and firm's knowledge concerning R&D projects. They also show how the final evaluation should look like. All these evaluation criteria and the form of capturing data will be considered in the development of our evaluation framework.

The *assessment of the informatics degree programmes* is another issue that we have to address with our evaluation framework. There are several criteria systems available (see Tellioğlu and Bodrow, 2015). We found EQANIEs (2011) standards and accreditation criteria the most useful for this purpose. The guideline is structured in five areas and consists of the most important factors to assess. These aspects will be considered in the current evaluation framework in relation to the assessment of informatics degree programmes as a whole. In this scope we will also create criteria for the *assessment of administration and IT systems used* in the management of curricula and their application at universities (Glowa, 2013), as well as for the *assessment of online learning materials* (SULSIT, 2014).

In the assessment process several methods need to be applied depending on the subject to be assessed. We will base our *methods on competency-based education and training* aspects and methods given by (Deißinger and Hellwig, 2011) and consider the approaches by Abel (2011), Frezza et al. (2006), NOAA (2009).

In our evaluation framework we will give special attention to the issue of *professional communication*, which contains the following areas (Worrington, 2014):

- Effective professional communication of technical information is rarely an inherited gift, but rather needs to be taught in context throughout the undergraduate curriculum;
- Reading, understanding and summarizing technical material, including source code and documentation;
- Writing effective technical documentation and materials;
- Dynamics of oral, written, and electronic team and group communication;
- Communicating professionally with stakeholders;
- Utilising collaboration tools;
- Dealing with cross-cultural environments;
- Trade-offs of competing risks in software projects, such as technology, structure/process, quality, people, market and financial.

Further aspects that we want to include in our framework are *gender* (Cheryan et al., 2011; Alvarado and Dodds, 2010), *future developments* (Sahami et al., 2010), and *industry point of view* (Simmons and Simmons, 2010).

2 ACRONYMS AND ABBREVIATIONS

CE	Computer Engineering
CS	Computer Science
Computing	CS, CE, SE and IS
EEFCET	European Evaluation Framework in computing Education and Training
EO	Evaluation Objective
EQF	European Qualification Framework
HEI	Higher Education Institutions
IS	Information Systems
O	Output element
PDCA	Plan – Do – Check – Act
SE	Software Engineering

3 FROM THE STATE OF THE ART OF CURRICULUM EVALUATION TO REQUIREMENTS

Curriculum evaluation means a systematic process of collecting and analysing all relevant information for the purpose of assessing the effectiveness of a curriculum to promote its improvement (Al-Jardani, 2014, p.128ff; Nichols et al., 2006). There are different dimensions of evaluation: by focusing on what to evaluate – macro and micro evaluation; by focusing on when to evaluate – pre-use, in-use and post-use evaluation; by focusing on judgement about the quality or adequacy of a curriculum or on forming or shaping the curriculum to improve it – summative and formative evaluation.

The focus of *macro evaluation* is on general issues such as the format of the modules to evaluate, their relations to each other, general issues of achieving the objectives of a curriculum or the approach used for knowledge transition (Tomlinson, 2001). On the other hand, *micro evaluation* looks more at the details of the modules and single courses, the learning material, the exact ways of teaching or assessing the knowledge achieved through the module or courses, steps and sets of methods and teaching materials used within a module or a course, etc. (McGrath, 2002; Ellis, 1997). *Pre-use evaluation* is the most difficult type of evaluation because there is no experience of applying a curriculum to evaluate (Cunningsworth, 1995). The substantial effort and accuracy of this type of evaluation makes its application time-consuming and difficult. *In-use evaluation* aims to check the decision of the module selection in the pre-use stage of a curriculum (Cunningsworth, 1995; McGrath, 2002). It might also address what worked well and what was changed during teaching the modules in the past. This helps to gather information about all teaching stages – from planning, to implementation and new assemblages. *Post-use evaluation* is about evaluating a curriculum after it has been already established and there are experiences with its quality, effectiveness, and results. *Summative evaluation* is the most common type of evaluation and has the purpose of making a summary or judgment about the quality or adequacy of the different aspects of a curriculum. This might result in comparing it with other curricula or with standard curricula available by ACM or other central institutions, or judging if it fulfilling certain criteria or not (Nation and Macalister, 2010; Richards, 2001; Brown, 1995). *Formative evaluation* has the purpose of forming or shaping a curriculum to improve it in order to find out what is working well and what is not and what problems can be identified. Normally with this type, the information collected is used to address problems and ways to improve the delivery of the modules in a curriculum (Nation and Macalister, 2010; Richards, 2001; Brown, 1995).

In EEFCET 2020, we address macro and micro evaluation, we focus mainly on post-use evaluation and at the same time we try to support pre-use and in-use evaluation by introducing phases into our evaluation framework, we support our stakeholders in summative and formative evaluation of the curricula in attention.

Besides helping to develop a sense of ownership, the results of an evaluation might affect not only the curriculum itself but also the teaching environment and the ways of teaching, as well as it might help with the professional development of teachers (Nation and Macalister, 2010). The results of curriculum evaluation must be published in a way that the context and reasoning of the judgement are clearly presented and understandable for all stakeholders addressed. The format can be a combination of oral and written reports. These reports must sum up the main issues and show implications and ways how to improve things. However, there is also a need for a follow-up stage to evaluate the evaluation and to follow-up the possibility for these evaluation recommendations. Moreover, these evaluations and data collected need to be stored in a systematic way by developing a good system of record keeping of data and also of the different types of evaluation conducted (Al-Jardani, 2014, p.131).

In EEFCET 2020, we define how to document and report an evaluation process as well as how to use the results of different evaluation phases to make their future use in further phases of iterative evaluation processes in higher education.

Most of the curriculum evaluation measures are defined as a section of a curriculum framework. It is very difficult to find a framework for curriculum evaluation, especially with related methods and templates to help set up and maintain a continuous evaluation process for curricula at higher education. A framework for curriculum evaluation can be a set of guidelines of requirement analysis, aims, focuses, purposes, types, methods, etc. of curriculum evaluation, which can be used in a certain context in order to evaluate the effectiveness of a curriculum with the purpose of developing, changing or keeping the existing methods, materials and contexts.

EEFCET 2020 is an independent evaluation framework that can be related to different curricula. However, it is related to ESFCET 2020 and can be easily adapted for use in curricula created based on ESFCET 2020.

The European Qualification Framework (EQF) links different national qualification systems from different European countries together (Fetaji et al., 2015). It acts as a translation device to make qualifications more readable, understandable and compatible across countries. The latter provides mobility opportunities for learners and through this a better internationalisation of education and training. The EQF[1] is an 8-level framework; its three highest levels are relevant for FETCH. It defines the concepts of knowledge, skills and competences, which are main aspects in the EEFCET 2020:

- Knowledge: In the context of EQF, knowledge is described as theoretical and/or factual;
- Skills: In the context of EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking), and practical (involving manual dexterity and the use of methods, materials, tools and instruments)
- Competences: In the context of EQF, competence is described in terms of responsibility and autonomy.

[1] EQF – European Qualification Framework, https://ec.europa.eu/ploteus/content/descriptors-page

The top three levels of EQF are summarised as shown in Table 1 (Porta, 2015).

Table 1. EQF top three levels.

EQF Level	Knowledge	Skills	Competence
Level 6 (Bachelor)	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study	Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts; take responsibility for managing professional development of individuals and groups
Level 7 (Master)	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research Critical awareness of knowledge issues in a field and at the interface between different fields	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields	Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams
Level 8 (Doctorate)	Knowledge at the most advanced frontier of a field of work or study and at the interface between fields	The most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice	Demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts including research

EEFCET 2020 is in line with the European Qualification Framework (EQF).

4 KEY CONSIDERATIONS

When designing an evaluation framework, it is necessary to consider a rich spectrum of aspects that add to the development of sound evaluation systems that would guarantee *valid, reliable, viable, informative* and *objective* results.

The establishment of effective evaluation framework for assessing the quality of bachelor, master and doctor level curricula and syllabi in the area of computing, is a challenging task for the following reasons:

- Adequate measurement is to be provided;
- All dimensions of what will be measured are to be included;
- Consistency with the goals of the evaluation is to be achieved;
- End-user orientation (i.e., adaptation to the needs of those who will use the results from the evaluation) is to be provided;
- Cost-effectiveness of the evaluation procedures is to be guaranteed;
- Feasibility of the evaluation procedures is to be met.

In order to design a high-quality evaluation framework oriented towards meeting the needs of a wide range of stakeholders engaged in the planning, design and implementation of bachelor, master and doctor level curricula and syllabi for the education and training of informatics specialists on a large European scale, we were informed by a large variety of existing evaluation frameworks in a number of fields (Research and Evaluation Framework, 2013; Teacher Evaluation, A Conceptual Framework and Examples of Country Policies, 2009; The NSW Department of Education Evaluation Framework and Communities, 2014; Developing and Evaluation Framework, 2015; Framework for Programme Evaluation in Public Health, 1999; Evaluation of Programmes Concerning Education for Entrepreneurship, 2009 etc.). The study and analysis of the conceptual models and underlying features of these evaluation frameworks indicated several key elements that a good evaluation framework needs to possess (Figure 1).

With regard to the key elements presented in Figure 1 below, it has to be noted that when designing a well-thought evaluation framework, which is to be used for the purposes of assessing the merits of digital curricula and syllabi, some essential questions need to be answered:

1. What is the purpose of the evaluation, i.e., what do we want to learn and decide from it?
2. Who or what are we going to assess?
3. Who are the audiences that we want to inform about the results of the evaluation, e.g., key stakeholders, university management and staff, computing educational providers, prospective students, alumni, policy makers, etc.?
4. What kind of information do we need to collect so that we share it with our audiences, e.g., information about the quality of the digital curricula and syllabi planning, the strengths and the weaknesses of the implementation of those digital curricula and syllabi, the benefits of stakeholders as a result of the training of students at bachelor, master and doctor level, etc.?
5. What are the sources from which we need to collect data, e.g., students, academic staff, management staff, stakeholders, etc.?
6. What are the tools to be used for the collection of data, e.g., questionnaires, individual or focus groups interviews, curricula and syllabi document reviews, self-assessment, etc.?
7. By when should the information be collected?
8. Do we need any resources to be used for the collection of the information?
9. Who are we planning to involve in the evaluation process?

Figure 1. Key elements of an evaluation framework.

At the same time it has to be noted that the evaluation of the quality of the planning and improvement of curricula and syllabi at institutional level cannot take place in isolation since higher education institutions nowadays are expected to respond to the wider economic and societal needs and at the same time contribute to the enhancement of the employability of graduates. Therefore, a wide variety of factors need to be considered when designing and implementing a set of evaluation procedures aiming at measuring the relevance, effectiveness and efficiency of the offered programmes at bachelor, master and doctoral level within a university. But which are those factors?

A recent study entitled "Trends 2015: Learning and Teaching at European Universities" (Sursock, 2015) performed by the European University Association gives a detailed insight into the factors that have an effect on the *development of the internationalisation and innovation capacities of universities and their impact on the economic and financial crisis on the European continent* and *on the planning, implementation and revision of curricula at higher education institutions in the EU.* These factors can be grouped into the following main categories:

a) Economic factors (e.g., the economic crisis; the emergence of economies based on knowledge)
b) Societal factors (e.g., the demographic decline of the European population; the changing size of the student population; the changing composition of the human body; diversity of students)
c) National and international education policies and reforms (e.g., globalisation and the cooperative and competitive institutional practices and strategies; internationalisation; e-learning policies and strategies; national qualification frameworks, internal and external quality assurance; transparency of education, recognition and validation of degrees; policy reforms on national and international levels; promoting employability and linking up with employers
d) Technological factors (e.g., rapid innovation in technology including the use of large scope of devices and cloud computing technology; changing attitudes of students and staff to the use of technology in the classroom
e) Innovations in higher education delivery (e.g., implementation of new methods and forms of learning and teaching; implementation of the student-centred approach; enhancing the learning environment; continuous professional development of staff; supporting the progression of students etc.).

On the basis of the survey findings and with respect to the purposes of the current EEFCET 2020 it can be noted that HEIs on European level operate in a highly challenging and competitive environment which poses increasingly high demands on the quality of the offered programmes and their relevance to the labour market, on the one hand, and the knowledge, skills and competences needed by graduate to function successfully in the global world on the other hand (Figure 2).

Figure 2. Factors affecting the role of HEIs as educational institutions in the 21st century.

These factors influence the approach that will be adopted for the evaluation of the quality of planning and implementation of curricula and syllabi for computing students at bachelor, master and doctoral level since they are intrinsically linked with the policy contexts for making EU a smart, sustainable and inclusive economy (as stated in the Europe 2020 Strategy) which addresses the demand for investing in people and skills and which corresponds to the on-going modernisation processes at the universities in Europe that foster the development of the knowledge triangle. The proper and adequate understanding of the range of factors mentioned would result to the development of relevant, effective and efficient evaluation framework and procedures.

Since the EEFCET 2020 is intended to be adopted by a large number of HEIs in Europe (either participants in the FETCH project consortium or interested in adopting the set of criteria and evaluation procedures developed under the FETCH project), it needs to be designed in such a way so that its governing principles:

- Are framed in the context of the overall objectives of the present day state-of-the-art in the training of computer specialists which include innovation in all forms of learning and a relevant focus on the skills and competences required in the labour market;
- Allow for mapping the current state of the quality of HEIs computing curricula and syllabi for bachelor, master and doctor level education and training by providing consistent information on the expectations and needs of key stakeholders;
- Foster the transparency of European higher education in the field of computing by offering a shared and mutually recognised criteria and tools for assessment;
- Account for the review and modification of the digital curricula and syllabi in the light of the evaluation results and in response to the current and future challenges of higher education, enterprises and job markets on local, national and European level.

Given the added value of the EEFCET 2020 to the articulation of the quality of computing curricula and syllabi planned and implemented in HEIs across Europe, there also needs to be a clear link with the ESFCET 2020 which sets the main strategic perspectives for the promotion, support, implementation and assessment of “agile, innovative, flexible, diversified and inclusive European ICT education” (ESFCET 2020, p.27). Such a link would further enhance the efficiency, reliability, validity and accountability of the evaluation procedures and tools described within the EEFCET 2020 by anchoring them with the specific strategic objectives, priority areas and benchmarks for the training and education of ICT specialists included in the ESFCET 2020.

5 AIMS AND OBJECTIVES

"European Evaluation Framework in computing Education and Training 2020 (EEFCET 2020) aligns with EQF (European Qualification Framework), and will evaluate the three factors: Knowledge, Skills and Competences gained from the computing Education and Training. It will propose ways to evaluate the quality of digital curricula, syllabi, and will assess social networks as a medium for education." (FETCH Proposal)

"EEFCET 2020 will consider an evaluation of curricula and syllabi of bachelors, masters, and doctors in computing, and their implementation in European higher education institutions. EEFCET 2020 will appraise three factors: Knowledge, Skills and Competences gained from computing Education and Training." (FETCH Proposal)

Based on the requirements set in the project proposal and on the discussions so far in the project's WP4, the general aims of the EEFCET 2020 can be summarised as follows:

- Serve as tool for the establishment of shared and mutually recognised approaches, methodology, tools and indicators for the assessment of the effectiveness of the computing curricula and syllabi planning, implementation and updating on institutional level;
- Advance the implementation of evidence-informed practices for quality assessment in the field of computing Education and Training by focusing on the knowledge, skills and competences gained by the university graduates at bachelor, master and doctoral level;
- Provide the mechanisms for reporting and recommendation making that will inform the future design, implementation and improvement of computing curricula and syllabi;
- Facilitate the sharing and implementation of changes based on the evaluation findings that will have an important impact on the quality and effectiveness of the computing curricula and syllabi and their sustainability;
- Strengthen the evaluation of computing Education and Training curricula and syllabi by identifying a step-by-step process that links curricula planning, implementation and evaluation.

The monitoring and evaluation of the quality of computer education and training curricula and syllabi has two main purposes. First, it attempts to improve the quality of education and training of (future) computer specialists by identifying the strengths and weaknesses of the designed and implemented curricula and syllabi used by HEIs – *the improvement function.* Second, it tries to ensure that the implemented curricula and syllabi at institutional level are regularly updated in line with the needs of learners, stakeholders, and the labour market so that they perform at their best and contribute to enhancing the overall learning of students in computingprogrammes – the *accountability function*.

- *The improvement function*
  The evaluation of curricula and syllabi of bachelors, masters and doctors in computing in terms of the three factors: knowledge, skills and competencies. This function focuses exclusively on the effectiveness and efficiency of the planning and implementation phases of the curricula and syllabi as well as on the impact resulting from their application in the activities of HEIs.
- *The accountability function*
  The accountability function focuses on holding all staff (both academic and administrative) involved in the programmes delivery, services and management responsible for their role in achieving the programme's goals and objectives. But it also includes the evaluation of the commitment of the higher educational institution to respond to the needs of learners, stakeholders and the labour market when engaged in its decision-making processes on the planning of curricula and syllabi for computing education and training, as well as in its delivery choices.
- *The link between the improvement and accountability functions*
  The improvement and accountability functions are not isolated from one another; rather they intertwine as they overlap in purpose. They are both trying to encompass the processes through which universities conceptualise, develop, implement, monitor and measure the performance and impact, and review the quality of the education and training offered in the different bachelor, master and doctor level programmes in the area of computing.

Based upon the outcomes of the FETCH work packages and on the foregoing analysis in WP4 as summarised above, we identified the following four evaluation objectives that help create the evaluation framework EEFCET 2020:

EO-1: **Defining** an evaluation procedure with corresponding content to evaluate the quality of curricula and syllabi in computingfor bachelor, master and doctoral programs
EO-2: **Planning** the defined evaluation process for implementation and continuous improvement
EO-3: **Implementing** evaluation procedure in computingfor bachelor, master and doctoral programs in European higher education institutions
EO-4: **Continuous updating** of established evaluation procedure in computingfor bachelor, master and doctoral programs in European higher education institutions

The above evaluation objectives are described in the following sections.

EO-1: **Defining** an evaluation procedure with corresponding content to evaluate the quality of curricula and syllabi in computingfor bachelor, master and doctoral programmes

Table 2. Priority areas for EO-1.

Existing actions - Priority areas to continue work on	
A	Stimulating the already established course evaluation processes in HEIs
B	Stimulating the use of social media in the evaluation processes in HEIs
C	Supporting the maintaining of the completeness and availability of curricula and syllabi in computingfor bachelor, master and doctoral programmes for students and other stakeholders
New actions - Priority area to develop cooperation on	
D	Moving beyond classroom or course evaluation processes to define a holistic post-use evaluation to facilitate a summative and formative evaluation of curricula and syllabi
E	Identifying the strengths and weaknesses of the designed and implemented curricula and syllabi
F	Emphasising on the definition and documentation of the evaluation processes in HEIs
G	Emphasising on the independence of evaluation processes that can be related to changing curricula
H	Emphasising on updating the evaluation processes based on the changes made to curricula and syllabi, especially on the definition level
I	Emphasising on improving the evaluation processes in terms of the three factors: knowledge, skills and competencies
J	Emphasising on the accountability of curricula and syllabi

EO-2: **Planning** the defined evaluation procedure for implementation and continuous improvement

Table 3. Priority areas for EO-2.

Existing actions - Priority areas to continue work on	
A	Stimulating the planning of already established evaluation procedures in HEIs
B	Stimulating the updating and keeping up-to-date of plans of established evaluation processes in HEIs
New actions - Priority area to develop cooperation on	
C	Moving beyond single point planning of evaluation procedures to an overall planning of curricula and syllabi
D	Emphasising on the implementation and continuous improvement of the evaluation procedures in the HEIs
E	Emphasising on referring to the lessons learned from previous evaluations on the planning process and on its improvement
F	Focusing on the effectiveness and efficiency of the planning of the curricula and syllabi

G	Emphasising on the effect the evaluation procedures have on the activities of the HEIs in terms of the decision-making processes on the planning of curricula and syllabi for computing education and training

EO-3: Implementing the evaluation procedures in computingfor bachelor, master and doctoral programs in European higher education institutions

Table 4. Priority areas for EO-3.

Existing actions - Priority areas to continue work on	
A	Stimulating the continuous implementation of the already established evaluation procedures in computingfor bachelor, master and doctoral programs in European HEIs
B	Stimulating the updating of the continuous implementation of already established evaluation processes in computingfor bachelor, master and doctoral programs in European HEIs
C	Stimulating the involvement and motivation of all stakeholders in HEIs for the implementation of evaluation processes
New actions - Priority area to develop cooperation on	
D	Focusing on improving the quality of education and training of computer scientists by implementing updated and well-planned evaluation processes in HEIs
E	Emphasising on contributing to enhancing the overall learning of students in computingfor bachelor, master and doctoral programs in European HEIs
F	Focusing on involving the relevant staff (both academic and administrative) in the programme delivery, services and management with regard to their role in achieving the programme's goals and objectives
G	Focusing on the impact resulting from the application of evaluation processes in the activities of the HEIs
H	Emphasising on the evaluation of the commitment of the HEIs to respond to the needs of learners, stakeholders and the labour market in implementation and delivery choices of curricula and syllabi for computing education and training

EO-4: Continuous updating of the established evaluation procedures in computingfor bachelor, master and doctoral programs in European higher education institutions

Table 5. Priority areas for EO-4.

Existing actions - Priority areas to continue work on	
A	Stimulating the updating of the established evaluation procedures in computingfor bachelor, master and doctoral programs in European HEIs
B	Making all relevant stakeholders aware of the need for continuous updating of the evaluation procedures in HEIs
C	Motivating all relevant stakeholders for updating the evaluation procedures in HEIs
New actions - Priority area to develop cooperation on	
D	Emphasising on the continuous updating of evaluation processes to guarantee ongoing monitoring and evaluation of quality of computer education and training curricula and syllabi in HEIs
E	Ensuring the updating of the implemented curricula and syllabi at institutional level regularly in line with the needs of learners, stakeholders and the labour market

All objectives described above are integrated in a continuous iterative process, based on the *Plan – Do – Check – Act* (PDCA) cycle (also known as the Deming Wheel or Deming Cycle). This process facilitates constant improvement. For details see the next section.

6 EEFCET 2020 – KEY ELEMENTS AND OVERARCHING PRINCIPLES

EEFCET 2020 can be described by means of the following factors:

1. Objectives
2. Input elements
3. Processes described in four phases
4. Tools and resources
5. Output elements

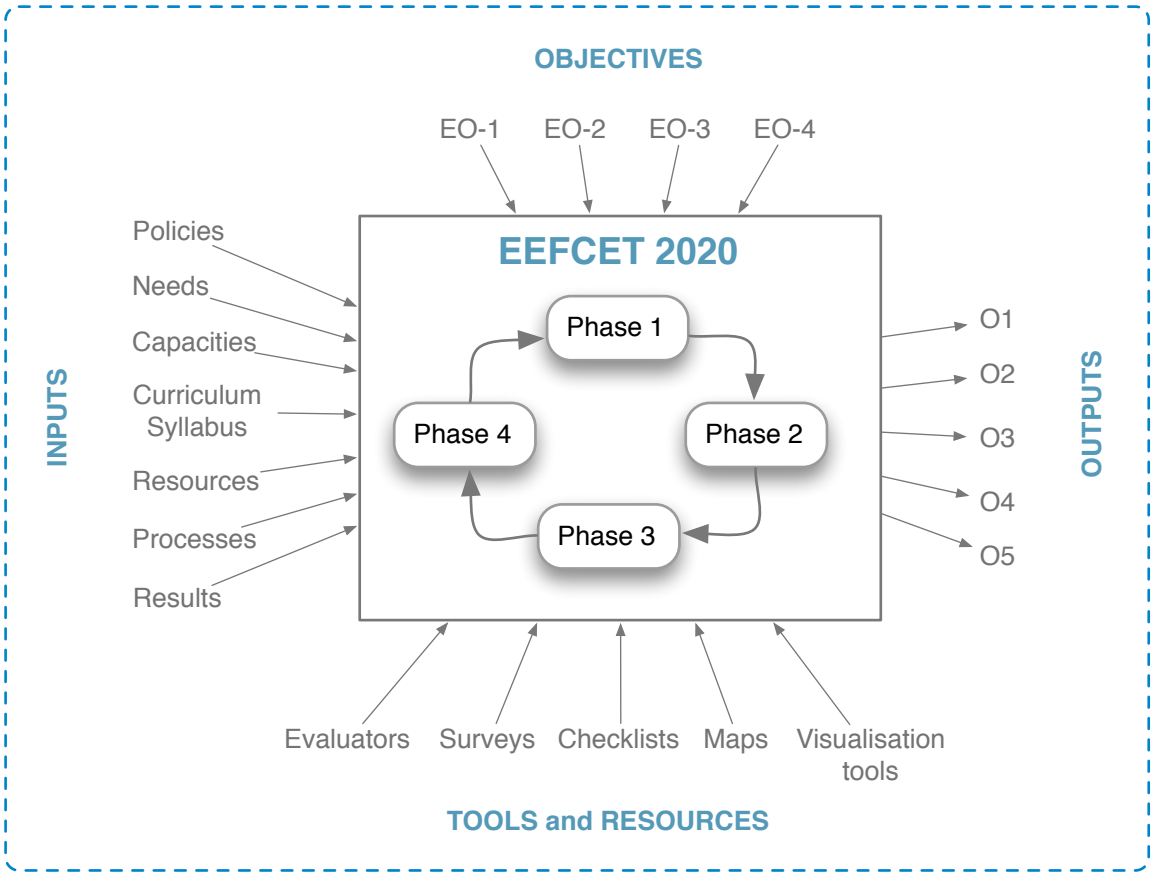

Figure 3. Overview of the EEFCET 2020: Objectives, input and output elements, tools and resources.

6.1 Objectives

EEFCET 2020 objectives are the followings as described in the previous section:

EO-1: Defining an evaluation process with corresponding content to evaluate the quality of curricula and syllabi in computingfor bachelor, master and doctoral programmes
EO-2: Planning the defined evaluation procedure for implementation and continuous improvement
EO-3: Implementing evaluation procedures in computingfor bachelor, master and doctoral programs in European higher education institutions
EO-4: Continuous updating of the established evaluation procedures in computingfor bachelor, master and doctoral programs in European higher education institutions

6.2 Input elements

Policies
National state and local educational policies, priorities and requirements must be identified and described in relation to computer education and training at HEIs.

Needs
Several stakeholders' needs must be considered for setting up the requirements to an evaluation process. As main stakeholders we consider learners, representatives of IT industries, HEIs and their needs related to computer education and training which must be identified and described.

Capacities
HEIs are education and training providers in the field of computing. Unfortunately they have limited capacities – financial and related to the human resources available – which must be considered as input elements in the evaluation framework.

Curriculum / Syllabus

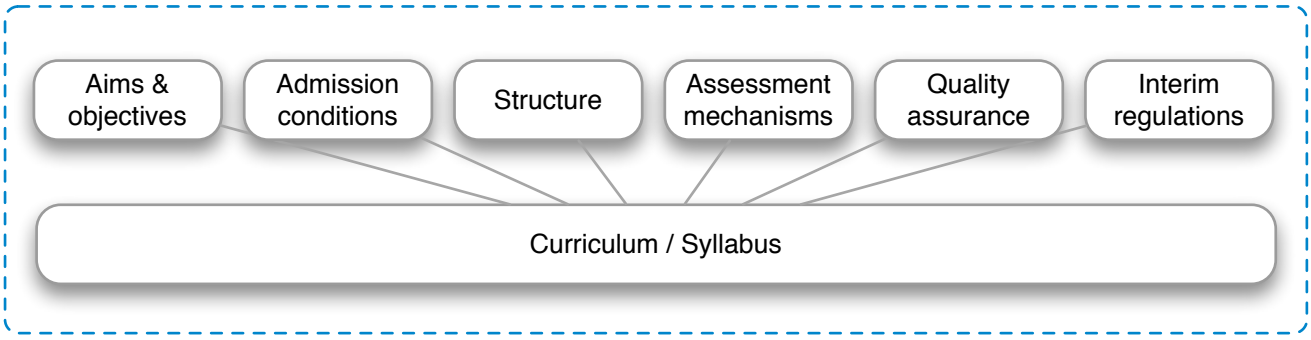

Figure 4. Structure of a curriculum or syllabus.

A curriculum or syllabus is a static and general piece of document that describes different aspects of a curriculum or syllabus (Figure 4). The evaluation considers the following parts:

1. Aims and objectives – This describes the goals of a curriculum, normally structured in three areas: Domain and methodology knowledge; Cognitive and practical skills; Key transversal competences, competences for innovation and creativity. The main question in this area is to which degree the aims and objectives of a curriculum are up-to-date and balanced in terms of knowledge, skills, and competences.
2. Admission conditions – It describes the conditions for the admission for the study of the curriculum. This is relevant in case of master curricula or doctoral studies. bachelor studies usually do not have any restrictions for the admission process.
3. Structure – A curriculum is generally structured into modules, which might be interdependent to each other. The modules have a title, size (in terms of teaching hours of students' study time) and designation (e.g., compulsory, recommended, etc.). They contain:
   - A short summary;
   - The expected learning outcomes in terms of knowledge, skills, and competences;
   - A syllabus;
   - Expected prerequisites (as expected knowledge by students applying for a particular study program);
   - Teaching and learning methods implemented;
   - Adequate assessment procedures for the evaluation of students' knowledge, skills, competences and performance;
   - A list of courses included in the module (type, ECTS credits, size, subject).

   Besides the quality and quantity of the modules and their relevance, considering the aims and objectives of the curriculum, the balance and dependencies among modules must be regarded as a major aspect of evaluation. Additionally, the flexibility for assembling modules by students is another category to assess.

4. Assessment mechanisms – Curricula usually contain several measures for the assessment of students' learning effort and qualification. These might be defined on study level, module level, or course level. All levels are relevant for evaluation purposes.
5. Quality assurance (QA) – QA describes how the quality of the curriculum will be assured during the course of utilisation. It must contain measures for assessment of the curriculum as a whole, as well as issues of adapting its contents, methods, structures, etc. if needed.
6. Interim regulations – They help to define the transitory provisions. A well-designed curriculum considers the previous and similar studies and communicates clearly what the differences are and what the interim regulations can be applied.

Resources, Processes, Results

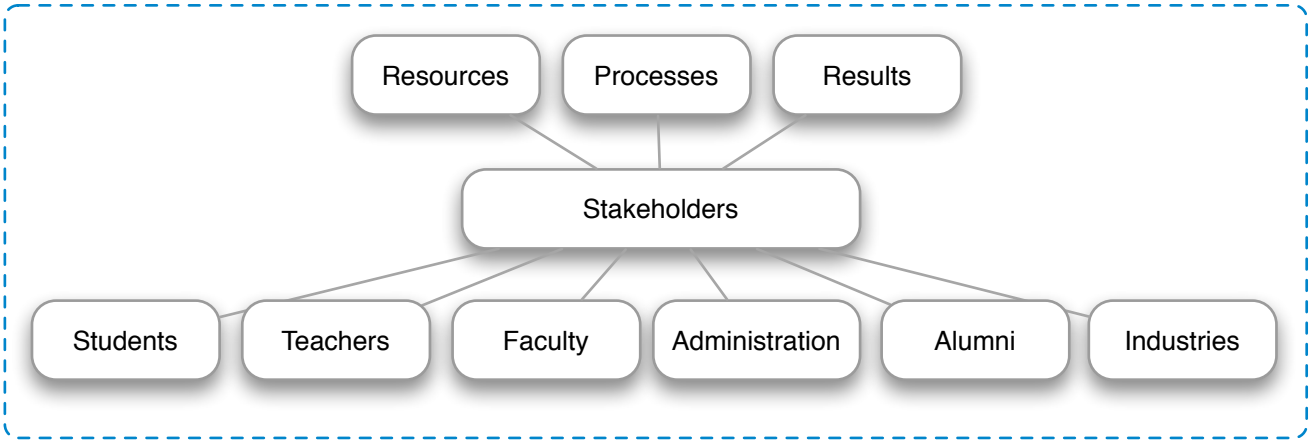

Figure 5. Resources, processes and results connected to several stakeholders.

The instantiation of a curriculum has other qualities for evaluation such as processes carried out and established, resources used, and results achieved for different stakeholders involved in the utilisation of the curriculum at a higher education institution. At this execution or implementation level the curriculum can be seen as a dynamic, specific entity consisting of resources, processes, and results, which are defined in relation to the stakeholders (Figure 5). Stakeholders vary from students, teachers, administration staff, and faculty on the one hand, to alumni and industries, on the other.

1. Resources contain the information provided and the learning materials.
2. Processes contain the general services offered to the learner, learning activities, and training support.
3. Results cover aspects of the course efficiency, knowledge increase, and motivation to learn.

Questionnaires can be used as means for gathering data from the respective stakeholders. The questionnaires need to be filled in before the semi-structured interviews with most key stakeholders are carried out. After analysing the data inquiry discussions can be conducted the feedback from which can be analysed by means of focus groups.

6.3 Processes

The effective monitoring and evaluation of the quality of curricula and syllabi of bachelor, master and doctoral degree students of CS, CE, SE and IS, the organisation and management of the introduction and implementation of these curricula and syllabi, as well as the processes for their update in a reflective and timely manner, and systems established for their evaluation and updating is central to the continuous improvement of the efficiency of computing education and training in Europe. From this perspective, evaluation is considered a vital step in the:

- Drive to improve the effectiveness and rigour of teaching and learning in the respective field;
- Raising of educational standards for what bachelor, master and doctoral students in computingprogrammes and syllabi offered by HEIs in Europe should know and be able to do upon graduation in order to successfully integrate in the competitive and changing economic and social landscape;

- Improving of the relevance to the programmes and syllabi in the respective field to labour market demands and society needs.

This part of the EEFCET 2020 provides a comprehensive account of the key aspects of the framework, which need to be taken into account when planning and organising an evaluation procedure for the quality of computing curricula and syllabi at university level. Figure 3 presents the integral aspects underlying the organisation of the EEFCET 2020.

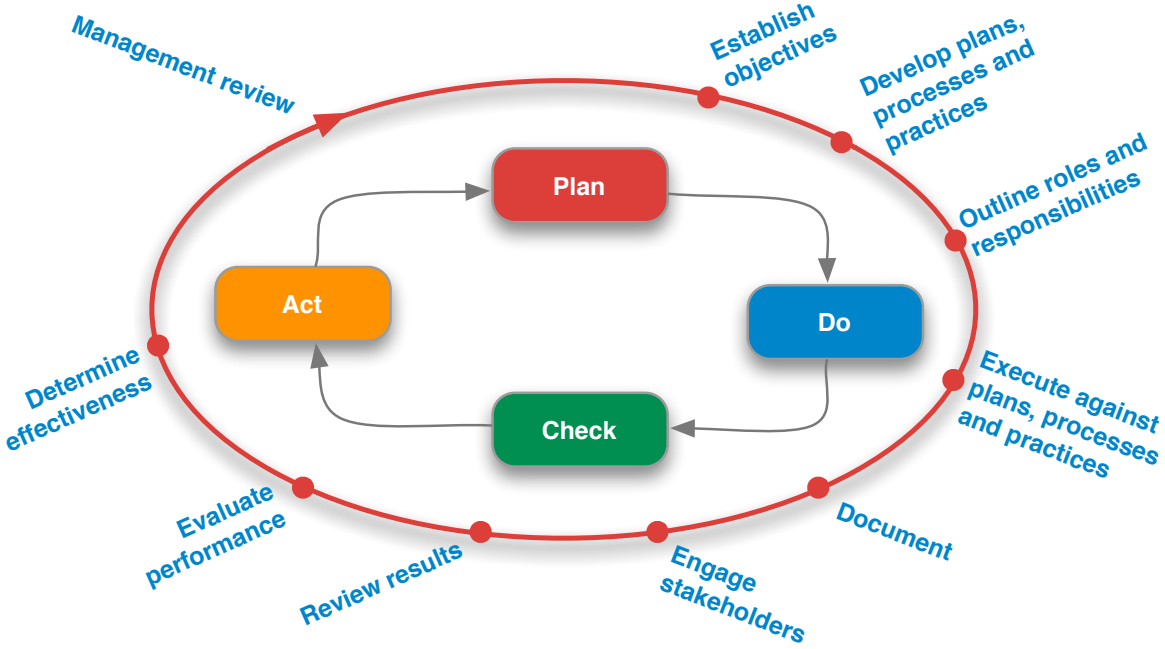

Figure 6. The PDCA cycle as a framework underlying the organisation of EEFCET 2020.

The reason motivating the choice of the *Plan – Do – Check – Act* (PDCA) cycle (also known as the Deming Wheel or Deming Cycle) as an overarching frame for the architecture of EEFCET 2020 are:

- It offers a systematic set of steps for gathering valuable feedback on the quality of the processes of planning, implementing, monitoring their performance and improvement of the curricula and syllabi used in the education and training of BA, MA and doctoral level specialists in the field of computing in Europe;
- It offers opportunities for continuous improvement of the quality of the evaluated programmes and syllabi, thus increasing their sustainability.
- It may be easily applied in the context of higher education institutions across Europe since it can either successfully supplement the internal quality assurance system adopted by the universities or serve as one.

The phases of the PDCA cycle include:

1. **PLAN** – the operational planning of the evaluation procedure. It involves the identification of the goals, the plans, processes and practices of the assessment and the distribution of roles and responsibilities to those involved in the procedure.
2. **DO** – the actual process and operations for measuring quality. It involves the implementation of the plan in order to collect data.
3. **CHECK** – the monitoring and assessment of the targets and the outputs so that the validity of the plan is checked. The gathered data are analysed and the expected and unexpected results are compared with the original goals, indicators and objectives set in the plan.
4. **ACT** – the closing of the generated evaluation process. It integrates the critical review and decision-making on the basis of the results obtained. If the results in the CHECK stage demonstrate a deviation from what was expected (either positive or negative), then it is necessary to adjust the goals, change the methods or introduce new standards.

These four steps can be repeated over and over again since they constitute a cycle of continual improvement.

Correlating the PDCA cycle phases to the evaluation of the quality of the computing curricula and syllabi for bachelor, master and doctor level students in computing, we need to focus attention on three essential aspects:

- The **RELEVANCE** of the planned curricula and syllabi to the outer world (e.g., society, economic landscape, coherence with the recent policy developments and the job market);
- The **EFFECTIVENESS** of the programmes and syllabi in terms of the knowledge and skills they provide for the beneficiaries as well as their contribution to the quality of learning in the field of computing;
- The **EFFICIENCY** of the programmes and syllabi in terms of the established mechanisms for assessing the management and control systems (of human, financial and other resources) applied at institutional level.

The merge of the PDCA cycle and the above-mentioned aspects of programme and syllabi evaluation lead to the following operational phases of the EEFCET 2020:

1. **PHASE 1:** Evaluation of the PLANNING of the computing curricula and syllabi for BA, MA and doctoral level students in the field of computing.

   The main focus of the evaluation at this phase lies upon the assessment of the **relevance** of the planned programmes and syllabi to the priorities and policies of various target groups: external and internal stakeholders, future learners and society, as well as to the national and EU policies in the field of higher education.

2. **PHASE 2**: Evaluation of the IMPLEMENTATION of the computing curricula and syllabi for BA, MA and doctoral level students in the field of computing.

   Central attention in the evaluation procedures contained in Phase 2 is paid to the assessment of the extent to which the computing curricula and syllabi for BA, MA and doctoral level students in the field of computing attain their objectives the factors that have a positive or negative effect on them (e.g., the satisfaction of the beneficiaries with the outputs of the education and training, the programme design and the delivery mechanism, the cost-effectiveness of the programme, etc.).

3. **PHASE 3:** ANALYSING and INTERPRETING the collected data.

   This is the data analysis phase that involves interpretation of the feedback obtained and the completion and synthesis of the findings.

4. **PHASE 4:** REVIEWING the results of the evaluation and MAKING RECOMMENDATIONS for curriculum / syllabus improvement in order to strengthen future practice.

   The last phase of the evaluation offers opportunities for making recommendations for the improvement of the examined curricula and syllabi on the basis of the gathered and analysed data. It is intrinsically linked with PHASE 1 since it also involves the taking of appropriate corrective actions for raising the quality of the curricula and syllabi in focus.

In Section 8 we present the detailed phases with their steps as well as questionnaires that are used for the quantitative data inquiry.

6.4 Tools and resources

Several tools are used to carry out EEFCET 2020 at HEIs:

- **Checklists** guide evaluators and other stakeholders who are involved in the evaluation process with instructions. They support among others decision-making processes. For all four phases of the evaluation process checklists are provided by EEFCET 2020.
- **Surveys** help gather quantitative data from different stakeholders by asking the appropriate questions to the definition and implementation of curricula and syllabi at HEIs. EEFCET 2020 provides surveys for the phase 1 and phase 2 which are focusing on structured data capturing. Besides such questions to which stakeholders can answer with a score between 0 and 5 there are open questions for which text can be entered.
- **Interviews** help understand survey results by asking key stakeholders the rationale and background information for their answer. Interviews deliver qualitative data that can be used in combination with quantitative data captured by surveys for the analysis and interpretation of the data.
- **Visualisation tools** should be used to present the data gathered during the evaluation processes. EEFCET 2020 recommends the use of existing well-established tools for that purpose.
- **Document templates** help creating and adapting documents for own use during the whole evaluation process. EEFCET 2020 provides several document templates.
- **ICT competencies models** based on ICT labour market studies help in aligning ICT curricula towards stakeholders' needs.

In quantitative part of the evaluation several scales can be used to assess the criteria used for the specific evaluation aspects (CDIO, 2015)[2]. The evaluation process ends with a total score that is created by using the scores given to the single evaluation objectives (EO-1, EO-2, EO-3, EO-4). Scores must be in the range 0-5. The total score can be max. 20. Scores and their interpretation are shown in the Table 6.

[2] CDIO (2015). http://www.cdio.org/implementing-cdio/standards/12-cdio-standards

Table 6. Scores used for any type of question asked and for the final scoring in EEFCET 2020.

Score	Interpretation for questions in surveys	Interpretation for final scoring
5 Excellent	Strongly agree Always	The evaluation results successfully address all relevant aspects of the evaluation objectives/criteria. Any shortcomings are minor. Systematic and continuous improvement is based on program evaluation results from multiple sources and gathered by multiple methods.
4 Very good	Agree Often	The evaluation results address the objectives/criteria very well, but a small number of shortcomings are present. Program evaluation methods are being used effectively with all stakeholder groups.
3 Good	Neutral Sometimes	The evaluation results address the objectives/criteria well, but a number of shortcomings are present. Program evaluation methods are being implemented across the program to gather data from students, faculty, program leaders, alumni, and other stakeholders.
2 Fair	Disagree Seldom	The evaluation results broadly address the objectives/criteria, but there are significant weaknesses. A program evaluation plan exists.
1 Poor	Strongly disagree Never	Objectives/criteria are inadequately addressed, or there are serious inherent weaknesses. The need for program evaluation is recognised and benchmarking of evaluation methods is in process.
0	Undecided Not possible to answer	The evaluation results fail to address the objectives/criteria or cannot be assessed due to missing or incomplete information. Program evaluation is inadequate or inconsistent.

6.5 Output elements

Reports are the main results of the evaluation process. There are five different reports:

O1: Report on needs, capacities and policy analysis
O2: Evaluation report on the curriculum on definition level
O3: Evaluation report on the curriculum on execution level, including resources, processes and results from different stakeholders' points of view
O4: Detailed evaluation report
O5: Evaluation summary report with recommendations for improvement including a score for each criterion and a total score for the whole computing education and training program

Besides textual descriptions of evaluation results based on the analysis and interpretation of the gathered data, different types of visualisations like graphs, diagrams, maps, lists, etc., are used in the reports.

6.6 The overview of the framework

EEFCET 2020 (Part 1)						
Objectives	Phases	Processes	Input Elements	Tools and Resources	Output Elements	
EO-1	1	Planning	Policies	Template for Step 1: Evaluation of the logical model underlying the planned curriculum	O1	Report on needs, capacities and policy analysis
				Checklist for Step 1: Evaluation of the national, local and European policy context and priorities		
			Needs	Checklist for Step 2: Evaluation of the needs of the key stakeholders		
				Survey for Step 2: Evaluation of the needs of the key stakeholders		
			Capacities	Checklist for Step 3: Evaluation of the capacity to operate the curriculum / syllabus		
				Survey for Step 3: Evaluation of the capacity to operate the curriculum / syllabus		
			Curriculum / Syllabus	Checklist for Step 4: Evaluation of the curriculum / syllabus architecture	O2	Evaluation report on the curriculum on definition level
				Survey for Step 4: Evaluation of the curriculum / syllabus architecture		
				Checklist for Step 5: Evaluation of the curriculum / syllabus impact and outcomes		
				Survey for Step 5: Evaluation of the curriculum / syllabus impact and outcomes		

EEFCET 2020 (Part 2)						
Objectives	Phases	Processes	Input Elements	Tools and Resources	Output Elements	
EO-2 EO-3	2	Implementing	Resources	Checklist for Step 1: Evaluation of the resources	O3	Evaluation report on the curriculum on execution level, including resources, processes and results from different stakeholders' points of view
				Survey for Step 1: Evaluation of the resources		
			Processes	Checklist for Step 2: Evaluation of the processes		
				Survey for Step 2: Evaluation of the processes		
			Results	Checklist for Step 3: Evaluation of the results		
				Survey for Step 3: Evaluation of the results		
EO-4	3	Analysing and Interpreting	O2 O3	Phase 3 - Checklist for analysing and interpreting	O4	Detailed evaluation report
				Analysis and visualisation of the survey results and (qualitative and quantitative) data gathered		
EO-4	4	Reviewing	O1 O4	Phase 4 – Reporting tool for reviewing	O5	Evaluation summary report with recommendations for improvement including a score for each criterion and a total score for the whole computing education and training program
				Maps of needs and requirements to evaluation results with recommendations for improvement if needed		

7 IMPLEMENTATION OF EEFCET 2020

In this section we present detailed information about the phases with their steps as well as questionnaires suggested to capture data from all stakeholders.

The following phases and steps will be described:

- Phase 1: Evaluation of the planning of computing curricula and syllabi for bachelor, master and doctor level
  - Step 1: Evaluation of the national, local and European policy context and priorities
  - Step 2: Evaluation of the needs of the key stakeholders
  - Step 3: Evaluation of the capacity to operate the curriculum / syllabus
  - Step 4: Evaluation of the curriculum / syllabus architecture
  - Step 5: Evaluation of the curriculum / syllabus impact and outcomes
- Phase 2: Evaluation of the implementation of computing curricula and syllabi for bachelor, master and doctor level
  - Step 1: Evaluation of the resources
  - Step 2: Evaluation of the processes
  - Step 3: Evaluation of the results
- Phase 3: Analysing and interpreting the data from the evaluation of computing curricula and syllabi for bachelor, master and doctor level
- Phase 4: Reviewing the results of the evaluation of computing curricula and syllabi for bachelor, master and doctor level and making recommendations

PHASE 1: Evaluation of the planning of computing curricula and syllabi for bachelor, master and doctor level

Introduction

The planning of computing curricula and syllabi for bachelor, master and doctoral level students is an integral process of the provision of quality education and training. It involves the following key elements:

- The identification of national state and local educational policies, priorities and requirements;
- The identification of level and content descriptors (i.e. knowledge, competencies and skills);
- The assessment of the labour market needs;
- The assessment of the needs of stakeholders;
- The assessment of the needs of learners;
- The assessment of the needs of the HEI as education and training provider in the field of computing;
- The specification of the curricula and syllabi aims and objectives;
- The specification of the curricula and syllabi structure, overall logical organisation and contents.

This section of the EEFCET 2020 specifies the steps of evaluating the level of computingbachelor, master and doctor level curricula and syllabi planning at university level.

Aims

Steps 1 – 5 evaluate whether there is a correspondence between the needs of the target group learners, key stakeholders, the university, as well as the policy context, the business model underlying the planning of the respective curricula and syllabi and the capacity that the HEI has to implement them.

Outcome

The result of the needs analysis and the analysis of the policy context will be the evaluation of the curricula and syllabi-planning model, which entails relevant objectives and strategies for their implementation.

Timeline and responsibilities

The university is free to decide which of its academic structures and staff will be involved in the evaluation of the planning phase of the respective computingbachelor, master and doctor level curricula and syllabi. It is also the HEI that will make an informed choice about:

- The responsibilities of the different academic members participating in this phase;
- The overall organisation of the evaluation of the planning process in compliance with the institutional and national regulations for the development of academic programmes and all relevant documentation;
- The timeline of the different steps with regard to the planned implementation of the designed curricula and syllabi at the university.

Evaluating the logical model of curricula and syllabi planning

The evaluation of the logical model of computing curricula and syllabi planning results contains the detailed evaluation of the following aspects:

- **Context / Inputs:** the human, financial, organisational and community resources that are used in the curricula and syllabi planning, as well as the context in which they will operate;
- **Design and architecture:** the curriculum / syllabus contains a clear description of the objectives, target groups, learning outcomes, as well as the overall organisation of the curriculum / syllabus;
- **Impacts:** the expected short-term changes and benefits for the key stakeholders and the HEI;
- **Outcomes:** the long-term changes that are envisaged to appear as a result of the education and training of computing specialists. These outcomes could be changed in the target group status, community, educational policies etc.

Evaluation tool

Evaluation Tool 1 – Evaluation of the logical model underlying the planned curriculum / syllabus is described in following 5 steps and the according checklists.

STEP 1: Evaluation of the national, local and European policy context and priorities

The planned curriculum / syllabus needs to demonstrate its relevance to the national, state, local and European level priorities in the field of higher education. Therefore, the first step of the evaluation process is to focus on this.

Phase 1 – Step 1 – Template A – Evaluation of the logical model underlying the planned curriculum / syllabus			
Context / Inputs	**Activities / Outputs**	**Impacts**	**Outcomes**
Needs, evidence and capacity that justify the proposed curriculum / syllabus within the current national / local / EU policy context for CE	Link of the curriculum / syllabus to the target groups Outputs to be delivered	Short-term and medium-term media changes (Knowledge, skills and competencies)	Long-term impacts
Policy context: Need for the curriculum / syllabus: Capacity to implement the curriculum / syllabus:	Target groups: Outputs:	Short-term impact: Medium-term impact:	Long-term impact:

Phase 1 – Step 1 – Checklist			
1.1	**Higher educational policy and priorities correspondence**		**Comments / Evidence**
1.1.1	The planned curriculum / syllabus corresponds to the identified educational priorities in the area of computing on: a) National level b) Regional level c) European level d) Other: _____ (Please, specify)	a) ☐ b) ☐ c) ☐ d) ☐	
1.1.4 The curriculum / syllabus complies with the national standards for CE. ☐5 Strongly agree ☐4 Agree ☐3 Neutral ☐2 Disagree ☐1 Strongly disagree ☐0 Undecided			

STEP 2: Evaluation of the needs of the key stakeholders

An important aspect of the planning of a relevant, effective and efficient curriculum / syllabus is the identification of the needs of the key stakeholders. This initial information plays an essential role in the design of the curriculum / syllabus goals, objectives and components and the evaluation of the correspondence between the identified target group needs a curriculum / syllabus overall architecture would give evidence of its possible capacity.

Phase 1 – Step 2 – Summarising checklist				
1.2	**Needs assessment correspondence**		**Statements**	**Comments / Evidence**
	Learner needs correspondence	☐	1.2.1 – 1.2.2	
	Stakeholder needs correspondence	☐	1.2.3 – 1.2.7	
	HEIs needs correspondence	☐	1.2.8 – 1.2.9	

Phase 1 – Step 2 – Survey					
1.2	**Needs assessment correspondence**				
Learner needs assessment correspondence					
1.2.1 The planned curriculum / syllabus corresponds to the general needs of learners for education and training in the area of computing.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.2.2 The planned curriculum / syllabus comprises of the specific subject based knowledge, skills and competencies as identified by the learners in the field of computing					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Stakeholder needs correspondence					
1.2.3 The planned curriculum / syllabus corresponds to identified skills shortages of new recruits in the sector of IT.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.2.4 The planned curriculum / syllabus corresponds to identified future skills needs in the sector of IT.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.2.5 The planned curriculum / syllabus corresponds to the expectations of employers in the sector of IT in terms of knowledge, skills and competences of their employees.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.2.6 The planned curriculum / syllabus clearly demonstrates a match between the current labour market needs and stakeholder expectations.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.2.7 The planned curriculum / syllabus is strongly related to the current ICT labour market standard competencies model					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
HEI needs correspondence					
1.2.8 The planned curriculum / syllabus corresponds to the subject areas that demand the steering of curricula / syllabi reforms at the university.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

1.2.9 The planned curriculum / syllabus corresponds to the identified needs by the university to change the current or introduce new curricula / syllabi in the area of computing to comply with real demands (e.g., labour market / community / stakeholder / learner's needs etc.)

☐5	☐4	☐3	☐2	☐1	☐0
Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Undecided

STEP 3: Evaluation of the capacity to operate the curriculum / syllabus

The next step involves the evaluation of the available capacity of the HEI, which would be used in the implementation of the planned curriculum / syllabus.

Phase 1 – Step 3 – Summarising checklist				
1.3	**Capacity to implement the curriculum / syllabus**		**Statements**	**Comments / Evidence**
	Human resources	☐	1.3.1 – 1.3.6	
	Equipment and didactic tools	☐	1.3.7 – 1.3.11	
	Physical resources	☐	1.3.12 – 1.3.13	
	Business model	☐	1.3.14 – 1.3.18	
	Key partnership	☐	1.3.19 – 1.3.22	

Phase 1 – Step 3 – Survey					
1.3	**Capacity to implement the curriculum / syllabus**				
Human resources					
1.3.1 The university has sufficient administrative resources to offer the respective planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.2 The university has sufficient teaching staff to offer the respective planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.3 The teaching staff at the university possesses the necessary methodological skills for teaching the courses in the planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.4 The teaching staff at the university possesses the necessary subject specific knowledge, skills and competencies for offering innovative and up-to-date education and training in the area of the planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.5 The teaching staff at the university possesses the necessary foreign language skills to offer education and training in the area of the planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.6 The teaching staff at the university possesses the necessary teaching skills in order to match the requirements of the labour market / community needs / national and / or European educational priorities					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Equipment and didactic tools					
1.3.7 The university possesses the necessary equipment for conducting the education and training of computing specialists under the planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.8 The university possesses the necessary methodological materials and tools for the successful implementation of the planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

1.3.9 There is / are (a) clearly identified department / university unit and teaching staff responsible for the development and / or updating of the methodological tools and training materials required for the implementation of the planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.10 There is / are (a) clearly identified steps of keeping the methodological tools and training materials up-to-date.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.11 There is / are (a) clearly identified steps of keeping the bank of methodological and training materials compiled.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Physical resources					
1.3.12 The university possesses enough physical assets (e.g., buildings, facilities, etc.) to successfully implement the planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.13 The university has identified all other relevant physical resources necessary for the implementation of the planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Business model					
1.3.14 The planned curriculum / syllabus is supplemented with a developed business model plan.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.15 The business model plan contains a clear vision of the pricing strategies for financing the suggested education and training under the planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.16 The business model plan contains a description of the dissemination channels that will be used for awareness raising and for reaching potential learners.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.17 The business model plan contains a cost structure of the education and training of computing specialists under the planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.18 The business model plan contains revenue streams and cost recovery alternatives for the financing of the education and training of the computing specialists under the planned curriculum / syllabus.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Key partnership					
1.3.19 The curriculum / syllabus planning is based on the existing partnership between the HEI and the enterprises.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.20 The curriculum / syllabus planning is a result of a newly established partnership with the enterprises.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

1.3.21 The curriculum / syllabus planning is a result of the consultancy with key stakeholders (e.g., learners, NGOs, employers, business companies, etc.).					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.3.22 The curriculum / syllabus planning is a result of the shared collaboration and exchange of ideas of the HEI and the strategic stakeholders.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

STEP 4: Evaluation of the curriculum / syllabus architecture

Having gained evidence of the context, priority areas and needs that the curriculum / syllabus addresses, it is necessary to focus on its general architecture, objectives, attainment targets and mechanisms for certification of the acquired knowledge, skills and competencies.

Phase 1 – Step 4 – Summarising checklist				
1.4	**Design and architecture**		**Statements**	**Comments / Evidence**
	Design architecture	☐	1.4.1 – 1.4.2	
	Objectives and target groups	☐	1.4.3 – 1.4.4	
	Content areas	☐	1.4.5 – 1.4.5	
	Curriculum / syllabus structure and organisation	☐	1.4.6 – 1.4.12	
	Attainment targets – entrance level knowledge, skills and competencies	☐	1.4.13 – 1.4.15	
	Attainment targets – learning outcomes	☐	1.4.16 – 1.4.19	
	Application procedures	☐	1.4.20 – 1.4.21	
	Evaluation and certification	☐	1.4.22 – 1.4.23	

Phase 1 – Step 4 – Survey					
1.4	**Design and architecture**				
Design architecture					
1.4.1 The planned curriculum / syllabus corresponds to the national requirements for curricula / syllabi preparation for the respective level.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.2 The planned curriculum / syllabus adheres to the required standard for the development of academic documents accepted by the HEI.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Objectives and target group					
1.4.3 The planned curriculum / syllabus contains well-formulated and relevant strategic objectives.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.4 The planned curriculum / syllabus addresses a specific customer segment (i.e., target group of learners).					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Content areas					
1.4.5 The planned curriculum / syllabus contains a description of the content areas that will be covered in the design of the respective courses.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Curriculum / syllabus structure and organisation					
1.4.6 The structure of the curriculum / syllabus gives an account of the courses that will be covered during the timeline of the education and training.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.7 The structure of the curriculum / syllabus gives an account of the assessment procedures that will applied for each course.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

1.4.8 The structure of the curriculum / syllabus gives an account of the credits that each course would give.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.9 The structure of the curriculum / syllabus gives an account of the distribution between the compulsory and elective courses.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.10 The structure of the curriculum / syllabus corresponds to the teaching method that will be used for the delivery of the courses (e.g., on-line, blended etc.).					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.11 The time structure of the planned curriculum / syllabus complies with the national degree regulations.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.12 The time structure of the planned curriculum / syllabus complies with the academic calendar of the institution.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Attainment targets – entrance level knowledge, skills and competencies					
1.4.13 The planned curriculum / syllabus contains a description of the entrance level of target groups' general and subject specific knowledge.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.14 The planned curriculum / syllabus contains a description of the entrance level of target groups' general and subject specific skills.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.15 The planned curriculum / syllabus contains a description of the entrance level of target groups' general and subject specific competencies acquired as a result of the education and training.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Attainment targets – learning outcomes					
1.4.16 The planned curriculum / syllabus contains a description of the learning outcomes in terms of general and subject specific **knowledge** acquired as a result of the education and training.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.17 The planned curriculum / syllabus contains a description of the learning outcomes in terms of general and subject specific **skills** acquired as a result of the education and training.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.18 The planned curriculum / syllabus contains a description of the learning outcomes in terms of general and subject specific **competencies** acquired as a result of the education and training.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.19 The planned curriculum / syllabus contains a clear reference to the relevant European **ICT-competency profiles.**					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Application procedures					
1.4.20 The planned curriculum / syllabus is supplemented with an application procedures description.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

1.4.21 The planned curriculum / syllabus is supplemented with application procedures requirements.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Evaluation and certification					
1.4.22 The planned curriculum / syllabus complies with the national requirements for evaluation and certification.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.4.23 The planned curriculum / syllabus contains a description of the evaluation procedures that will be applied for measuring learners' progress.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

STEP 5: Evaluation of the curriculum / syllabus impact and outcomes

The evaluation of the quality of the curriculum / syllabus planning process involves also the taking into consideration of the impacts and outcomes that are expected as a result of the future training of the bachelor, master or doctor level student of computing.

Phase 1 – Step 5 – Summarising checklist				
1.5.a	**Impacts**		**Statements**	**Comments / Evidence**
	Short-term changes and benefits	☐	1.5.a.1 – 1.5.a.2	
1.5.b	**Outcomes**		**Statements**	**Comments / Evidence**
	Long-term changes	☐	1.5.b.1 – 1.5.b.1	

Phase 1 – Step 5 – Survey					
1.5.a	**Impacts**				
1.5.a.1 The planned curriculum /syllabus contains a specification of the expected short-term changes that will be a result of the education and training of the computing specialists in the relevant degrees.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.5.a.2 The planned curriculum /syllabus contains a specification of the expected short-term benefits that will be a result of the education and training of the computing specialists in the relevant degrees.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
1.5.b	**Outcomes**				
1.5.b.1 The planned curriculum /syllabus contains a specification of the expected long-term changes that will be a result of the education and training of the computing specialists in the relevant degrees.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

PHASE 2: Evaluation of the implementation of computing curricula and syllabi for bachelor, master and doctor level

Introduction

The process of implementation involves the provision of specific information about WHAT needs to be done, HOW it will be done, WHO will do it and WHERE it will be done.

The evaluation of the implementation of computing curricula and syllabi for bachelor, master and doctoral level students focuses on the collection of evidence of whether the respective curriculum / syllabus is operating as it was intended. It assesses the functioning of the curriculum / syllabus to the legal and institutional regulatory requirements, the design architecture, the teaching and learning methods and approaches used, the assessment methods and procedures applied, the cost-effectiveness mechanism used, etc.

This section of the EEFCET 2020 specifies the steps of evaluating the level of computingbachelor, master and doctor level curricula and syllabi implementation at university level.

Aims

To evaluate the quality of implementation of the planned curriculum / syllabus in the area of computing within the respective HEI in terms of the effectiveness, efficiency and flexibility of the development of the curriculum / syllabus:

- As a whole, and of its components, with regard to the context and circumstances of their implementation;
- As a whole, and of its components, with regard to the objectives of the curriculum/ syllabus, timelines, activities, teaching and admission processes.

Outcome

The planned curriculum / syllabus is operating as intended; changes to the initial plan are documented.

Timeline and responsibilities

The university is free to decide which of its academic structures and staff will be involved in the evaluation of the implementation phase of the respective computingbachelor, master and doctor level curricula and syllabi. It is also the HEI that will make an informed choice about:

- The responsibilities of the different academic members participating in this phase;
- The overall organisation of the evaluation of the implementation process in compliance with the institutional and national regulations for the development of academic programmes and all relevant documentation;
- The timeline of the performance of the evaluation.

Evaluating the implementation of the curricula and syllabi in the area of computing

The evaluation of the implementation of the planned computing curricula and syllabi gives evidence about the following aspects:

- Legal framework and procedures for the implementation of the planned curricula and syllabi on institutional level;
- Admission and graduation processes and procedures;
- Student support;
- Format of delivery;
- Teaching methods;
- Student assessment methods;
- Selection of teaching staff involved in the education and training under the respective curriculum / syllabus;
- Compliance of the curriculum / syllabus objectives with the components of the curriculum / syllabus;
- Certification and validation of the obtained degree;
- Cost-effectiveness.

Evaluation tool

Evaluation Tool 2 – Evaluation of the implementation of the curriculum / syllabus is described in the following 3 steps and the according checklists.

STEP 1: Evaluation of the resources

The evaluation of the resources contains several aspects like the quality of the information provided as well as availability and quality of learning materials. These questions are meant for students, teachers, faculty, and administration staff.

Phase 2 – Step 1 – Summarising checklist				
2.1	**Evaluation of the resources**		**Statements**	**Comments / Evidence**
	Information on the learning provider	☐	2.1.1 – 2.1.3	
	Availability	☐	2.1.4 – 2.1.5	
	Pedagogical aspects of the learning contents	☐	2.1.6 – 2.1.20	
	Usability and accessibility	☐	2.1.21 – 2.1.25	
	Instructional design	☐	2.1.26 – 2.1.32	
	Multimediality and interaction	☐	2.1.33 – 2.1.35	

Phase 2 – Step 1 – Survey					
2.1	**Evaluation of the resources**				
Information on the learning provider					
2.1.1 Information about the teacher and their services is provided.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.2 The teacher has good references.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.3 Details of teacher's quality procedures and certifications are provided.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Availability					
2.1.4 Learning materials were provided as required.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.5 Additional complementary materials were provided as required.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Pedagogical aspects of the learning contents					
2.1.6 The learning objectives were clearly defined.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.7 The prerequisites were defined in the learning content.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.8 The course content was relevant to the student's learning objectives.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.9 The course content is at the right level.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.10 The student was able to assess his/her existing/previous knowledge.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

2.1.11 The course content is consistent with his/her prerequisites.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.12 The course content was relevant to his/her current job.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.13 The course content was relevant to his/her future career plans.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.14 The course encourages the creation of new relationships among users.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.15 The course content addresses practical issues.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.16 Self-assessment tools are provided.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.17 Self-assessment tools are related to the learning content.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.18 The learning materials contain several examples and demonstrations.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.19 The learning materials reflect the practical knowledge I need to do his/her job.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.20 Learning materials gave you support, advice and guidance.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Usability and accessibility					
2.1.21 Navigation is easy.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.22 I almost always know my current place in the course ("where am I?").					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.23 System feedback is appropriate.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.24 Hyperlinks (Internet and internal within the course) are correct.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.25 The help system is clear and helpful.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Instructional design					
2.1.26 Teaching methods and strategies take into account the learning objectives.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.27 Different motivation techniques were applied and were efficient.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

2.1.28 Attention focus techniques were used.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.29 The learning materials matched the know-how required in the job.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.30 The learning materials reflected methods of knowledge integration.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.31 The system of feedback was clear and supportive.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.32 There was sufficient (not too much/not too little) information in learning materials.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Multimediality and interaction					
2.1.33 The interactive solutions included in the learning material had a clear added value.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.34 The contents were user-friendly.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.1.35 The course content was supported through different media according to various delivery needs.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

STEP 2: Evaluation of the processes

The evaluation of the processes is concerned with the quality and quantity of general services offered to the learner, support provided for learning activities and training support.

Phase 2 – Step 2 – Summarising checklist				
2.2	**Evaluation of the processes**		**Statements**	**Comments / Evidence**
	Guidance in the choice and selection of course	☐	2.2.1 – 2.2.4	
	Registration process	☐	2.2.5 – 2.2.8	
	Welcoming on the course	☐	2.2.9 – 2.2.12	
	Time management	☐	2.2.13 – 2.2.15	
	Access to resources	☐	2.2.16 – 2.2.29	
	Pedagogical models	☐	2.2.30 – 2.2.34	
	Blended approach (face-to-face + eLearning)	☐	2.2.35 – 2.2.39	
	Collaboration and self-study	☐	2.2.40 – 2.2.58	
	Planning of training support	☐	2.2.59 – 2.2.61	
	Quality of training support	☐	2.2.62 – 2.2.74	
	Online communication	☐	2.2.75 – 2.2.77	
	Peer online communication	☐	2.2.78 – 2.2.81	
	Group learning support	☐	2.2.82 – 2.2.85	
	Respect of the contract by the training provider	☐	2.2.86 – 2.2.97	
	Respect of the contract by the student	☐	2.2.98 – 2.2.102	

Phase 2 – Step 2 – Survey					
2.2	**Evaluation of the processes**				
Guidance in the choice and selection of course					
2.2.1 The student was given guidance in choosing which course to attend.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.2 The student was able to choose his/her learning course.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.3 The student received help with course administration.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.4 The student's questions relating to financial queries were answered.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Registration process					
2.2.5 Registration on the course was conducted smoothly.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.6 Registration on the course was quick and without delay.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.7 Notifications related to the registration process were clear and prompt.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

2.2.8 It was possible to discuss (negotiate) the level of support and services on the course.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Welcoming on the course					
2.2.9 The learning provider of the course was clearly introduced.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.10 The services offered by the learning provider were clearly explained.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.11 The training staff of the course was properly introduced.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.12 All the participants in the course were properly introduced.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Time management					
2.2.13 Students knew in advance how long the learning activities would take them.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.14 Students knew time by time what they would be expected to do.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.15 The time allocated to the different learning activities was sufficient.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Access to resources					
2.2.16 It is easy to go through the course content.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.17 It is easy to retrieve any wanted resource.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.18 The course contents are available at any time.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.19 Additional learning resources are available.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.20 Supporting facilities such as a glossary or (a) calendar are available.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.21 Available communication tools are effective.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.22 Downloading options are easy.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.23 A glossary of crucial terms is available.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.24 A summary of the course is available.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

2.2.25 Terms and conditions for using the learning resources are included.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.26 Back navigation to previous pages is possible.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.27 Skipping from page to page is easy without getting lost.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.28 Any practice exercise or self-assessment is always available.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.29 It is possible to see one's own progression in the course.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Pedagogical models					
2.2.30 The course activities are appropriate for online settings.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.31 The teachers are competent in their subject.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.32 The teachers are reactive to out-coming needs.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.33 The course activities help to learn easily.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.34 The course activities are stimulating.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Blended approach (face-to-face + eLearning)					
2.2.35 The course provides both face-to-face sessions and eLearning.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.36 There is a good balance between online and face-to-face activities.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.37 The timetable of the different learning activities is useful.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.38 Online sessions and face-to-face activities integrate each other effectively.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.39 Case studies benefit from good mix between online and face-to-face activities.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Collaboration and self-study					
2.2.40 The course includes a proper mix of collaborative work and self-study.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.41 The work group objectives are clear.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

2.2.42 There is a good balance in time between self-study and group work.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.43 Self-study and group work profitably integrate each other.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.44 Collaborative work created new knowledge.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.45 Collaborative work is useful to learn.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.46 Case studies benefit from collaborative work.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.47 It is easy to understand what to do and with whom during the collaborative activities.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.48 Sharing content with other students is easy with the tools provided.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.49 Sharing content with others students was useful for learning.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.50 Online collaboration is useful for learning.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.51 Online communication plays an important role during the learning activities.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.52 To develop collaborative content online helps learning.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.53 The collaborative work online plays an important role in managing own learning.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.54 Online collaboration facilitates the group work.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.55 The assignments set for collaborative work are meaningful for learning.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.56 The assignments provided for collaborative work are representative of real job activities.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.57 Joining virtual teams helps problem setting and problem solving with other students.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.58 The course proposes team assignments properly.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Planning of training support					
2.2.59 The online support was planned and contractualised.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

2.2.60 The teacher is able to change the timetable and the activities if necessary.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.61 The teacher promptly advises on any change in the personal learning plan.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Quality of training support					
2.2.62 The tutoring service is well balanced and sized according to needs.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.63 The answers got from the training staff are satisfactory.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.64 The training staff is able to monitor the students' progress.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.65 The training staff is able to give proper advice and guidance when necessary.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.66 The training staff provides complementary resources when needed.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.67 The complementary resources provided by the training staff are useful in order to improve learning.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.68 The tutor sensibly encourages the learning activities.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.69 The tutor helps identify reliable resources outside the platform and on the Internet.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.70 The tutor gives feedback on the student's self-assessment results.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.71 The tutor is reactive in providing feedback.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.72 The tutor's feedback enables learning progression to be tracked.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.73 The tutor's feedback enables the next learning steps to be planned.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.74 The tutor's feedback helps maintain motivation throughout the course.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Online communication					
2.2.75 The training staff uses the online communication tools in an appropriate way.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.76 The training staff is a model for good practice in the use of online communication tools.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

2.2.77 The training staff is reachable when needed.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Peer online communication					
2.2.78 Online communication among peers is possible.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.79 The communication among peers is efficient.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.80 The online tools effectively support the communication among peers.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.81 Both asynchronous and synchronous tools are correctly configured for communicating with peers.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Group learning support					
2.2.82 The training staff provides support for activities with other students.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.83 The training staff encourages the students to work together.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.84 The training staff provides help and methodology in getting the most out of activities with other students.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.85 The tools available online to ask questions are used appropriately by the learning community.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Respect of the contract by the training provider					
2.2.86 The training provider respected the terms of the contract made for the delivery of the course.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.87 The training provider respected the terms of the contract made with the student in order for him/her to follow the course in satisfactory conditions.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.88 The online support is provided as planned in the initial contract.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.89 Tutor's answers respected deadlines stipulated in the contract.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.90 The ICT provision mentioned in the initial contract is respected by the provider.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.91 The ICT help and hot-line is respected by the provider's services in accordance with the initial contract.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

2.2.92 The number of pedagogical resources made available by the training provider respects the initial contract.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.93 The tools and facilities made available by the eLearning provider during the delivery of the course respects the initial contract.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.94 The assessment process carried out during the course was consistent with initial plans.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.95 The modes of assessment during the eLearning course respects what was stipulated in the contract.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.96 The treatment of personal data during the eLearning course respects what was stipulated in the contract.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.97 Tutors' feedback satisfies the Service Level Agreement (SLA).					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Respect of the contract by the student					
2.2.98 The student diligently completes the expected activities during the course.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.99 The student follows the time-schedule of the course.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.100 The student systematically replies to the tutor when contacted.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.101 The student makes the tutor aware of any difficulty encountered during the course.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.2.102 The student makes the tutor aware of any change and need during the course.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

STEP 3: Evaluation of the results

The evaluation of the results is concerned with the perceived quality, overall knowledge at the end of courses, evaluation of training goals, perspective of others than students, learning preferences, learning management, and self-motivation.

Phase 2 – Step 3 – Summarising checklist				
2.3	**Evaluation of the results**		**Statements**	**Comments / Evidence**
	Perceived quality (training staff, recourses, services)	☐	2.3.1 – 2.3.6	
	Overall knowledge at the end of the course	☐	2.3.7 – 2.3.13	
	Evaluation of training goals	☐	2.3.14 – 2.3.17	
	Perspective of others than students	☐	2.3.18 – 2.3.25	
	(Awareness of) Learning preferences	☐	2.3.26 – 2.3.35	
	Learning management	☐	2.3.36 – 2.3.41	
	Self-motivation	☐	2.3.42 – 2.3.48	

Phase 2 – Step 3 – Survey					
2.3	**Evaluation of the results**				
Perceived quality (training staff, recourses, services)					
2.3.1 The training staff's quality has been perceived positively.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.2 The resources' quality has been perceived positively.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.3 The general services' quality has been perceived positively.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.4 On the whole, the training's quality has been considered satisfactory.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.5 On the whole, the general services' quality has been considered satisfactory.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.6 On the whole, the resources' quality has been considered satisfactory.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Overall knowledge at the end of the course					
2.3.7 The knowledge acquired about the course's subject is at a beginner level.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.8 The knowledge acquired about the course's subject integrated successfully some new aspects.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.9 The knowledge acquired about the course's subject facilitated the reaching of a deep understanding of some aspects.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

2.3.10 The knowledge acquired about the course's subject facilitated the reaching of a deep understanding in all its aspects.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.11 Learning achievements have been consistent with expectations.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.12 The majority of the attendees have obtained top grades on completing the course. (Only for teachers)					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.13 On completion of the course, the distribution of attendees' final results among top, medium and low grades has been consistent with the forecast. (Only for teachers)					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Evaluation of training goals					
2.3.14 The planned training goals have been achieved.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.15 The training goals' achievement has been measured through quantitative indicators.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.16 The training goals' achievement has been measured through qualitative indicators.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.17 The training goals' achievement has been measured through quantitative and qualitative indicators.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Perspective of others than students					
2.3.18 The skills / knowledge gained during the course have been easily transferred into practice. (Only for teachers)					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.19 The skills / knowledge gained during the course have been helpful to solve job's problems. (Only for teachers)					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.20 The skills / knowledge gained during the course have been a stimulus for continuous learning, even after the course itself. (Only for teachers)					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.21 The skills / knowledge gained during the course have had a positive influence on problem solving's behaviour. (Only for teachers)					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.22 The skills / knowledge gained during the course have had a positive impact on the whole team. (Only for teachers)					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.23 The percentage of help requests during the course didn't exceed the expected maximum threshold. (Only for teachers)					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

2.3.24 The distribution over time of help requests matches expectations. (Only for teachers)					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.25 The distribution of help requests per category of problems (i.e., organisation, technical, content, ergonomics, navigation) matches expectations. (Only for teachers)					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
(Awareness of) Learning preferences					
2.3.26 The course enables one's most appropriate way of learning to be chosen.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.27 The course provides activities and materials that can satisfy different learning styles.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.28 The learning activities and tools proposed during the training allowed identifying one's own personal learning style. (Only for teachers)					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.29 Self-learning activities contributed to motivation.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.30 Feedback and encouragement from the support staff have played an important role in maintaining motivation.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.31 Group learning activities have been helpful.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.32 The opportunity to practice at work what was learnt during the course increased motivation to learn.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.33 Self-evaluation of progress had a positive impact on motivation to learn.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.34 Peer interaction played an important role on motivation to learn.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.35 Use of social networks played an important role in motivation to learn.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Learning management					
2.3.36 Timetable, scheduling and structured activities have been important for successful learning.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.37 The flexibility offered to choose which activity to do next had a positive impact on motivation.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.38 The pace of the course and its clear deadlines had a positive impact on motivation.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.39 The possibility to work at one's own pace within clear and definite deadlines had a positive impact on motivation.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

2.3.40 The possibility to decide what to learn, to set one's own pace and deadlines had a positive impact on motivation.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.41 Deadlines were met without problems.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
Self-motivation					
2.3.42 It was easy to find ways to maintain self-motivation.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.43 The clarity and effectiveness of the course's objectives kept the motivation high.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.44 Reflecting about the learning outcomes already achieved and those that could be achieved next was a motivation booster.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.45 It was possible to speak to someone when demotivation set in.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.46 It was always possible to get help from the training support staff before demotivation set in.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.47 Sharing with other students has been helpful to cope with demotivation feelings.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided
2.3.48 Peer relations helped overcome demotivation.					
☐5 Strongly agree	☐4 Agree	☐3 Neutral	☐2 Disagree	☐1 Strongly disagree	☐0 Undecided

PHASE 3: Analysing and interpreting the data from the evaluation of computing curricula and syllabi for bachelor, master and doctor level

Introduction

This phase entails the analysis and interpretation of the collected evaluation data so that the effectiveness and efficiency of the planned and implemented curricula and syllabi is assessed. The analysis provides essential information about whether the curriculum and syllabus meets its objectives and the planned impact, of its strengths and weaknesses.

Aims

To analyse and interpret the data findings from the evaluation of the planning and implementation of the computing curricula and syllabi for bachelor, master and doctor level.

Outcome

The collected data are analysed and interpreted.

Timeline and responsibilities

The university is free to decide which of its academic structures and staff will be involved in the analysis and interpretation of the results from the evaluation of the planning and implementation of the respective computingbachelor, master and doctor level curriculum and syllabus. It is also the HEI that will make an informed choice about:

- The responsibilities of the different academic members participating in this phase;
- The overall organisation of the phase;
- The timeline of the performance of the evaluation.

Evaluation Tool

The Evaluation Tool to be used in Phase 3 is oriented towards analysing and summarising the issues identified in the evaluation data gathered in Phase 1 and Phase 2. The snapshot provided serves as input for Phase 4 – the recommendations process. The evaluation tool will use checklists from Phase 1 and Phase 2 to identify weaknesses in the process.

The issues identified through the survey results analysis in Phase 1 and Phase 2 should be checked in the corresponding tables below and detailed in the column “Issues identified”. This way input for Phase 4 will be created for further consideration.

Evaluation Tool 3 – Evaluation of the logical model underlying the planned curriculum / syllabus is described in following steps and the according checklists.

PHASE 1 – STEP 1: IDENTIFICATION OF ISSUES

Identification of issues in Phase 1 – Step 1			
1.1	**Higher educational policy and priorities correspondence**		**Issues identified**
1.1.1	The planned curriculum / syllabus corresponds to the identified educational priorities in the area of computing on: a) National level b) Regional level c) European level d) Other: _____(Please, specify)	a) ☐ b) ☐ c) ☐ d) ☐	

PHASE 1 – STEP 2: IDENTIFICATION OF ISSUES

Identification of issues in Phase 1 – Step 2				
1.2	**Needs assessment correspondence**		**Statements**	**Issues identified**
	Learner needs correspondence	☐	1.2.1 – 1.2.2	
	Stakeholder needs correspondence	☐	1.2.3 – 1.2.6	
	HEIs needs correspondence	☐	1.2.6 – 1.2.8	

PHASE 1 – STEP 3: IDENTIFICATION OF ISSUES

Identification of issues in Phase 1 – Step 3				
1.3	**Capacity to implement the curriculum / syllabus**		**Statements**	**Issues identified**
	Human resources	☐	1.3.1 – 1.3.6	
	Equipment and didactic tools	☐	1.3.7 – 1.3.11	
	Physical resources	☐	1.3.12 – 1.3.13	
	Business model	☐	1.3.14 – 1.3.18	
	Key partnership	☐	1.3.19 – 1.3.22	

PHASE 1 – STEP 4: IDENTIFICATION OF ISSUES

Phase 1 – Step 4 – Summarising checklist				
1.4	**Design and architecture**		**Statements**	**Issues identified**
	Design architecture	☐	1.4.1 – 1.4.2	
	Objectives and target groups	☐	1.4.3 – 1.4.4	
	Content areas	☐	1.4.5 – 1.4.5	
	Curriculum / syllabus structure and organisation	☐	1.4.6 – 1.4.12	
	Attainment targets – entrance level knowledge, skills and competencies	☐	1.4.13 – 1.4.15	
	Attainment targets – learning outcomes	☐	1.4.16 – 1.4.19	
	Application procedures	☐	1.4.20 – 1.4.21	
	Evaluation and certification	☐	1.4.22 – 1.4.23	

PHASE 1 – STEP 5: IDENTIFICATION OF ISSUES

Identification of issues in Phase 1 – Step 5				
1.5.a	**Impacts**		**Statements**	**Issues identified**
	Short-term changes and benefits	☐	1.5.a.1 – 1.5.a.2	
1.5.b	**Outcomes**		**Statements**	**Issues identified**
	Long-term changes	☐	1.5.b.1 – 1.5.b.1	

PHASE 2 – STEP 1: IDENTIFICATION OF ISSUES

Identification of issues in Phase 2 – Step 1				
2.1	**Evaluation of the resources**		**Statements**	**Issues identified**
	Information on the learning provider	☐	2.1.1 – 2.1.3	
	Availability	☐	2.1.4 – 2.1.5	
	Pedagogical aspects of the learning contents	☐	2.1.6 – 2.1.20	
	Usability and accessibility	☐	2.1.21 – 2.1.25	
	Instructional design	☐	2.1.26 – 2.1.32	
	Multimediality and interaction	☐	2.1.33 – 2.1.35	

PHASE 2 – STEP 2: IDENTIFICATION OF ISSUES

Identification of issues in Phase 2 – Step 2				
2.2	**Evaluation of the processes**		**Statements**	**Issues identified**
	Guidance in the choice and selection of course	☐	2.2.1 – 2.2.4	
	Registration process	☐	2.2.5 – 2.2.8	
	Welcoming on the course	☐	2.2.9 – 2.2.12	
	Time management	☐	2.2.13 – 2.2.15	
	Access to resources	☐	2.2.16 – 2.2.29	
	Pedagogical models	☐	2.2.30 – 2.2.34	
	Blended approach (face-to-face + eLearning)	☐	2.2.35 – 2.2.39	
	Collaboration and self-study	☐	2.2.40 – 2.2.58	
	Planning of training support	☐	2.2.59 – 2.2.61	
	Quality of training support	☐	2.2.62 – 2.2.74	
	Online communication	☐	2.2.75 – 2.2.77	
	Peer online communication	☐	2.2.78 – 2.2.81	
	Group learning support	☐	2.2.82 – 2.2.85	
	Respect of the contract by the training provider	☐	2.2.86 – 2.2.97	
	Respect of the contract by the student	☐	2.2.98 – 2.2.102	

PHASE 2 – STEP 3: IDENTIFICATION OF ISSUES

Identification of issues in Phase 2 – Step 3				
2.3	**Evaluation of the results**		**Statements**	**Issues identified**
	Perceived quality (training staff, recourses, services)	□	2.3.1 – 2.3.6	
	Overall knowledge at the end of the course	□	2.3.7 – 2.3.13	
	Evaluation of training goals	□	2.3.14 – 2.3.17	
	Perspective of others than students	□	2.3.18 – 2.3.25	
	(Awareness of) Learning preferences	□	2.3.26 – 2.3.35	
	Learning management	□	2.3.36 – 2.3.41	
	Self-motivation	□	2.3.42 – 2.3.48	

COMMENTARY (on the identified issues in Phase 1 and Phase 2).

In your commentary please focus on the following aspects:

- Relevance of the curriculum / syllabus to:
  - the needs of the key stakeholders (e.g., students, the university and future employers)
  - the future professional careers of graduates and the demands of the ICT job market for skilled professionals;
  - learning outcomes specified;
  - the competencies planned in relation to those identified in the ICT job profiles and the EQF;
- Depth and progression of the curriculum / syllabus in terms of:
  - the way in which the curriculum / syllabus outcomes cover the knowledge and abilities in the main area of study as well as generic skills;
  - the internal links between the components of the curriculum / syllabus and the relation of the curriculum / syllabus to other relevant curricula / syllabi in the course of education (in the same or in other EU HEIs training bachelor, master and PhD students in the field of computing);
  - the link between students' prior knowledge and the expected outcomes in the relevant cycle degree and in the continuum of education;
  - the competences and skills of the academic staff involved and their contribution to the overall attainment of the curriculum aims and objectives;
  - the quality of teaching and learning.
- Sustainable funding strategy;
- Adequate resources (human resources, facilities and materials);
- Administrative capacity and accessibility (incl. student recruitment, follow-up and student support);
- The greatest strengths of the curriculum / syllabus;
- The greatest weaknesses of the curriculum / syllabus.

PHASE 4: Reviewing the results of the evaluation of computing curricula and syllabi for bachelor, master and doctor level and making recommendations

Introduction

The review of the results of the evaluation of the planning and implementation of the computing curricula and syllabi for bachelor, master and doctor level plays a significant role in the making of adjustment and the taking of corrective actions for the improvement of the curriculum / syllabus.

The lessons learnt from the obtained findings can contribute to the better shaping of the curriculum / syllabus and its better adjustment to stakeholder needs.

Aims

To review the data findings from the evaluation of the planning and implementation of the computing curricula and syllabi for bachelor, master and doctor level, discuss the implications they have and make recommendations for the future improvement of the curricula and syllabi.

Outcome

A curriculum / syllabus report, which summarises the results of the evaluation and provides recommendations for its strengthening, is filled in Evaluation Tool 4.

Timeline and responsibilities

The university is free to decide which of its academic structures and staff will be involved in the review of the results from the evaluation of the planning and implementation of the respective computingbachelor, master and doctor level curriculum and syllabus. It is also the HEI that will make an informed choice about:

- The responsibilities of the different academic members participating in this phase;
- The overall organisation of the review phase;
- The timeline of the performance of the evaluation.

Evaluation Tool

Evaluation Tool 4 – Reporting Tool.

REPORTING TOOL

1. Identify the strengths, weaknesses, opportunities and threats that support or impede the planning or implementation process of the curriculum.

Strengths	Weaknesses	Opportunities	Threats

2. How will the HEI use the results of the evaluation to inform the decision making on institutional level and improve the quality of:

- the respective curriculum / syllabus?
- the teaching / learning / student learning outcomes?

3. Which of the identified problems require deeper reflection and will lead to changes or restructuring of some of the following aspects:

- curriculum /syllabus planning
- curriculum / syllabus implementation
- key stakeholder involvement and cooperation

4. What did your institution learn from the evaluation carried?

5. Is it necessary to change, revise, adapt any of the evaluation tools used? Which ones? Why?

6. How adequate is the evaluation undertaken? What evidence do you have?

7. What are the responses to previous curriculum / syllabi review recommendations?

8. What follow-up actions will be taken (if any)?

9. Who will be responsible for the follow-up actions?

8 CONCLUSIONS AND FUTURE WORK

The European Evaluation Framework for computing Education and Training 2020 (EEFCET 2020) is an evaluation framework described by means of objectives, input elements, processes described in four phases, tools and resources as well as output elements. It shows how to define, plan, implement and continuously improve the created evaluation framework at higher education institutions. It provides several tools like checklists and surveys to support the different stakeholders involved in the evaluation process.

To summarise, EEFCET 2020 defines how to document and report an evaluation process as well as how to use the results of different evaluation phases to make their future use in further phases of iterative evaluation processes in higher education. It is an independent evaluation framework that can be related to different curricula. However, it is related to ESFCET 2020 and can be easily adapted for use in curricula created based on ESFCET 2020. EEFCET 2020 is in line with the European Qualification Framework (EQF).

A guided web-based interactive tool “EEFCET 2020” (http://media.tuwien.ac.at/eefcet) – as described in this deliverable and provided on the CDs distributed – provides additional support for the stakeholders to better and easier establish such an evaluation framework at their universities. Besides guiding the facilitators during the evaluation process, this interface tries to help reduce the effort needed to fill in the necessary evaluation data. The guiding tool “EEFCET 2020” and the framework EEFCET 2020 itself will be object for evaluation and improvement in our future work.

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10 ANNEX 1 – EEFCET2020 CHECKLISTS

10.1 Phase 1 – Checklist for planning

Phase 1 – Step 1 – Checklist			
1.1	**Higher educational policy and priorities correspondence**		**Comments / Evidence**
1.1.1	The planned curriculum / syllabus corresponds to the identified educational priorities in the area of computing on: a) National level b) Regional level c) European level d) Other: _____ (Please, specify)	a) ☐ b) ☐ c) ☐ d) ☐	
1.1.4 The curriculum / syllabus complies with the national standards for CE. ☐5 Strongly agree ☐4 Agree ☐3 Neutral ☐2 Disagree ☐1 Strongly disagree ☐0 Undecided			

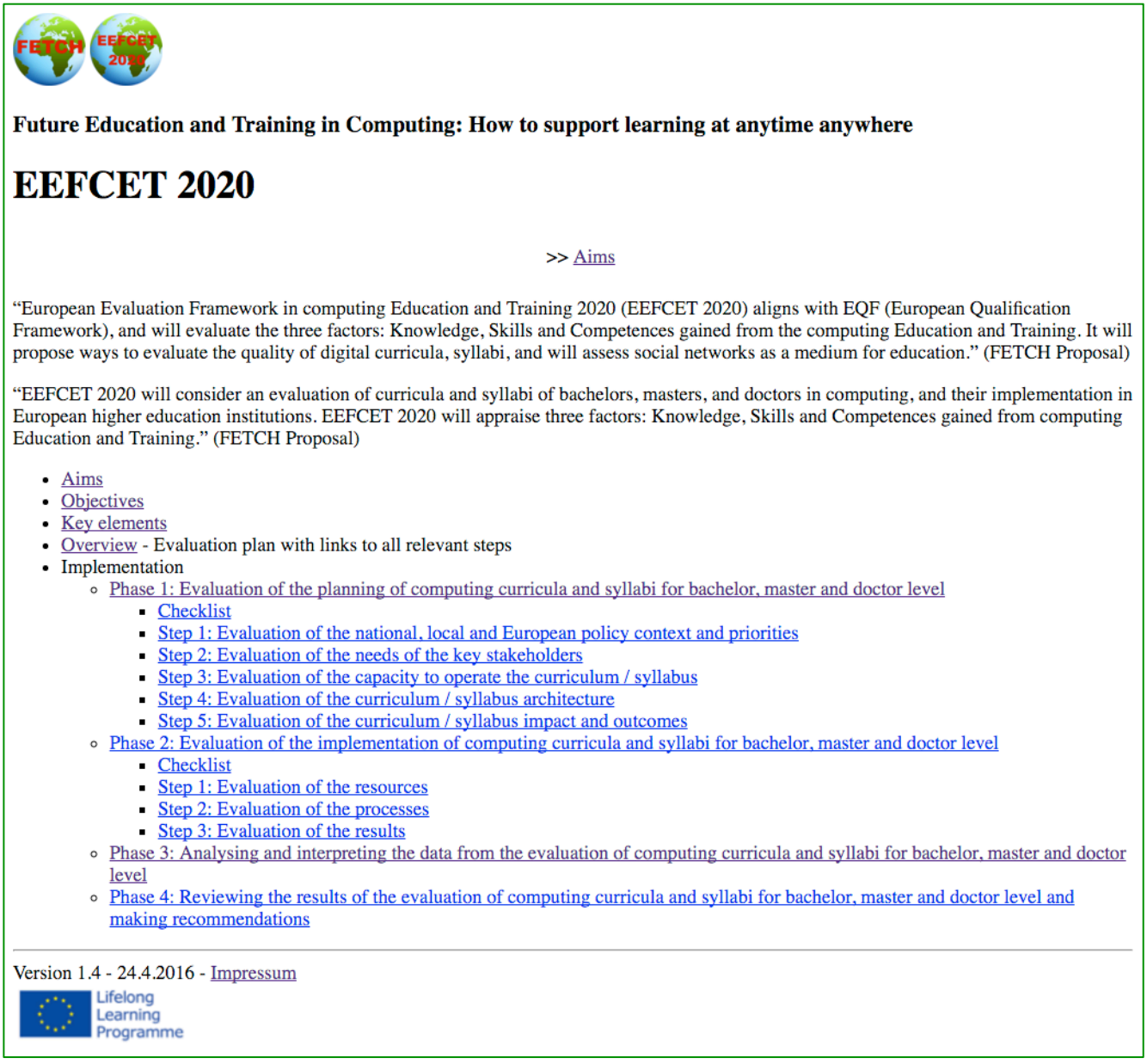
Phase 1 – Step 1 – Summarising checklist				
1.2	**Needs assessment correspondence**		**Statements**	**Comments / Evidence**
	Learner needs correspondence	☐	1.2.1 – 1.2.2	
	Stakeholder needs correspondence	☐	1.2.3 – 1.2.7	
	HEIs needs correspondence	☐	1.2.8 – 1.2.9	
Phase 1 – Step 3 – Summarising checklist				
1.3	**Capacity to implement the curriculum / syllabus**		**Statements**	**Comments / Evidence**
	Human resources	☐	1.3.1 – 1.3.6	
	Equipment and didactic tools	☐	1.3.7 – 1.3.11	
	Physical resources	☐	1.3.12 – 1.3.13	
	Business model	☐	1.3.14 – 1.3.18	
	Key partnership	☐	1.3.19 – 1.3.22	
Phase 1 – Step 4 – Summarising checklist				
1.4	**Design and architecture**		**Statements**	**Comments / Evidence**
	Design architecture	☐	1.4.1 – 1.4.2	
	Objectives and target groups	☐	1.4.3 – 1.4.4	
	Content areas	☐	1.4.5 – 1.4.5	
	Curriculum / syllabus structure and organisation	☐	1.4.6 – 1.4.12	
	Attainment targets – entrance level knowledge, skills and competencies	☐	1.4.13 – 1.4.15	
	Attainment targets – learning outcomes	☐	1.4.16 – 1.4.19	
	Application procedures	☐	1.4.20 – 1.4.21	
	Evaluation and certification	☐	1.4.22 – 1.4.23	

10.2 Phase 2 – Checklist for implementing

Phase 2 – Step 1 – Summarising checklist				
2.1	**Evaluation of the resources**		**Statements**	**Comments / Evidence**
	Information on the learning provider	☐	2.1.1 – 2.1.3	
	Availability	☐	2.1.4 – 2.1.5	
	Pedagogical aspects of the learning contents	☐	2.1.6 – 2.1.20	
	Usability and accessibility	☐	2.1.21 – 2.1.25	
	Instructional design	☐	2.1.26 – 2.1.32	
	Multimediality and interaction	☐	2.1.33 – 2.1.35	
Phase 2 – Step 2 – Summarising checklist				
2.2	**Evaluation of the processes**		**Statements**	**Comments / Evidence**
	Guidance in the choice and selection of course	☐	2.2.1 – 2.2.4	
	Registration process	☐	2.2.5 – 2.2.8	
	Welcoming on the course	☐	2.2.9 – 2.2.12	
	Time management	☐	2.2.13 – 2.2.15	
	Access to resources	☐	2.2.16 – 2.2.29	
	Pedagogical models	☐	2.2.30 – 2.2.34	
	Blended approach (face-to-face + eLearning)	☐	2.2.35 – 2.2.39	
	Collaboration and self-study	☐	2.2.40 – 2.2.58	
	Planning of training support	☐	2.2.59 – 2.2.61	
	Quality of training support	☐	2.2.62 – 2.2.74	
	Online communication	☐	2.2.75 – 2.2.77	
	Peer online communication	☐	2.2.78 – 2.2.81	
	Group learning support	☐	2.2.82 – 2.2.85	
	Respect of the contract by the training provider	☐	2.2.86 – 2.2.97	
	Respect of the contract by the student	☐	2.2.98 – 2.2.102	
Phase 2 – Step 3 – Summarising checklist				
2.3	**Evaluation of the results**		**Statements**	**Comments / Evidence**
	Perceived quality (training staff, recourses, services)	☐	2.3.1 – 2.3.6	
	Overall knowledge at the end of the course	☐	2.3.7 – 2.3.13	
	Evaluation of training goals	☐	2.3.14 – 2.3.17	
	Perspective of others than students	☐	2.3.18 – 2.3.25	
	(Awareness of) Learning preferences	☐	2.3.26 – 2.3.35	
	Learning management	☐	2.3.36 – 2.3.41	
	Self-motivation	☐	2.3.42 – 2.3.48	

11 ANNEX 2 – THE WEB-BASED TOOL EEFCET 2020

In this annex we show an overview of the interactive web-based EEFCET 2020 in form of screenshots. It is also provided on a CD and on http://media.tuwien.ac.at/eefcet. It provides additional support for the stakeholders to better and easier establish such an evaluation framework at their universities. Besides guiding the facilitators during the evaluation process, this interface tries to help reduce the effort needed to fill in the necessary evaluation data.



Future Education and Training in Computing: How to support learning at anytime anywhere

EEFCET 2020 Overview

Aims

Home << >> Objectives

- Serve as tool for the establishment of shared and mutually recognised approaches, methodology, tools and indicators for the assessment of the effectiveness of the computing curricula and syllabi planning, implementation and updating on institutional level;
- Advance the implementation of evidence-informed practices for quality assessment in the field of computing Education and Training by focusing on the knowledge, skills and competences gained by the university graduates at bachelor, master and doctoral level;
- Provide the mechanisms for reporting and recommendation making that will inform the future design, implementation and improvement of computing curricula and syllabi;
- Facilitate the sharing and implementation of changes based on the evaluation findings that will have an important impact on the quality and effectiveness of the computing curricula and syllabi and their sustainability;
- Strengthen the evaluation of computing Education and Training curricula and syllabi by identifying a step-by-step process that links curricula planning, implementation and evaluation.

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Lifelong Learning Programme

Future Education and Training in Computing: How to support learning at anytime anywhere

EEFCET 2020 Overview

Objectives

Aims << >> Key elements

EO-1: Defining an evaluation procedure with corresponding content to evaluate the quality of curricula and syllabi in computingfor bachelor, master and doctoral programs

Existing actions - Priority areas to continue work on

- Stimulating the already established course evaluation processes in higher education institutions
- Stimulating the use of social media in the evaluation processes in higher education institutions
- Supporting the maintaining of the completeness and availability of curricula and syllabi in computingfor bachelor, master and doctoral programmes for students and other stakeholders

New actions - Priority area to develop cooperation on

- Moving beyond classroom or course evaluation processes to define a holistic post-use evaluation to facilitate a summative and formative evaluation of curricula and syllabi
- Identifying the strengths and weaknesses of the designed and implemented curricula and syllabi
- Emphasising on the definition and documentation of the evaluation processes in higher education institutions
- Emphasising on the independence of evaluation processes that can be related to changing curricula
- Emphasising on updating the evaluation processes based on the changes made to curricula and syllabi, especially on the definition level
- Emphasising on improving the evaluation processes in terms of the three factors: knowledge, skills and competencies
- Emphasising on the accountability of curricula and syllabi

EO-2: Planning the defined evaluation process for implementation and continuous improvement

Existing actions - Priority areas to continue work on

- Stimulating the planning of already established evaluation procedures in higher education institutions
- Stimulating the updating and keeping up-to-date of plans of established evaluation processes in higher education institutions

New actions - Priority area to develop cooperation on

- Moving beyond single point planning of evaluation procedures to an overall planning of curricula and syllabi
- Emphasising on the implementation and continuous improvement of the evaluation procedures in the higher education institutions
- Emphasising on referring to the lessons learned from previous evaluations on the planning process and on its improvement
- Focusing on the effectiveness and efficiency of the planning of the curricula and syllabi

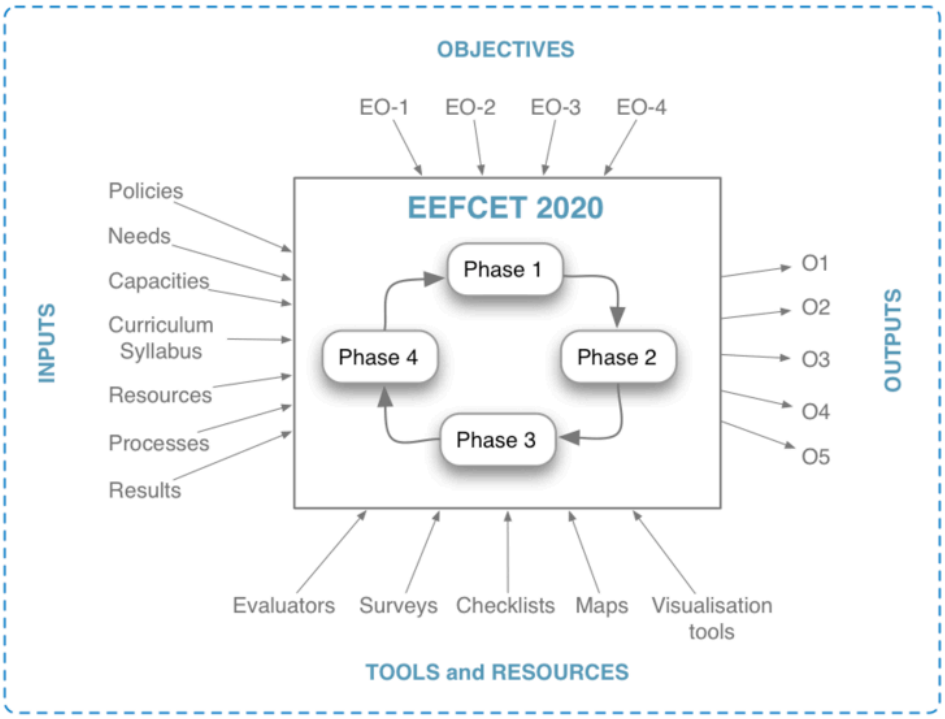
Future Education and Training in Computing: How to support learning at anytime anywhere

EEFCET 2020 Overview

Key Elements

Objectives << >> Overview

EEFCET 2020 can be described by means of the following factors:



Objectives

- EO-1: Defining an evaluation process with corresponding content to evaluate the quality of curricula and syllabi in computingfor

Future Education and Training in Computing: How to support learning at anytime anywhere

EEFCET 2020 Overview

Overview

Objectives	Phases	Processes	Input Elements - Tools and Resources - Output Elements		
EO-1: Defining an evaluation process with corresponding content to evaluate the quality of curricula and syllabi in computingfor bachelor, master and doctoral programmes	Phase 1	Planning Checklist	Policies	Template for Step 1: Evaluation of the logical model underlying the planned curriculum Checklist for Step 1: Evaluation of the national, local and European policy context and priorities	O1: Report on needs, capacities and policy analysis
			Needs	Checklist for Step 2: Evaluation of the needs of the key stakeholders Survey for Step 2: Evaluation of the needs of the key stakeholders	O1: Report on needs, capacities and policy analysis
			Capacities	Checklist for Step 3: Evaluation of the capacity to operate the curriculum / syllabus Survey for Step 3: Evaluation of the capacity to operate the curriculum / syllabus	O1: Report on needs, capacities and policy analysis
			Curriculum / Syllabus	Checklist for Step 4: Evaluation of the curriculum / syllabus architecture Survey for Step 4: Evaluation of the curriculum / syllabus architecture Checklist for Step 5: Evaluation of the curriculum / syllabus impact and outcomes Survey for Step 5: Evaluation of the curriculum / syllabus impact and outcomes	O2: Evaluation report on the curriculum on definition level

EO-2: Planning the defined evaluation procedure for implementation and continuous improvement EO-3: Implementing evaluation procedures in computingfor bachelor, master and doctoral programs in European higher education institutions	Phase 2	Implementing Checklist	Resources	Checklist for Step 1: Evaluation of the resources Survey for Step 1: Evaluation of the resources>	O3: Evaluation report on the curriculum on execution level, including resources, processes and results from different stakeholders' points of view
			Processes	Checklist for Step 2: Evaluation of the processes Survey for Step 2: Evaluation of the processes	O3: Evaluation report on the curriculum on execution level, including resources, processes and results from different stakeholders' points of view
			Results	Checklist for Step 3: Evaluation of the results Survey for Step 3: Evaluation of the results	O3: Evaluation report on the curriculum on execution level, including resources, processes and results from different stakeholders' points of view
EO-4: Continuous updating of the established evaluation procedures in computingfor bachelor, master and doctoral programs in European higher education institutions	Phase 3	Analysing and Interpreting	O2: Evaluation report on the curriculum on definition level O3: Evaluation report on the curriculum on execution level, including resources, processes and results from different stakeholders' points of view	Phase 3 - Checklist for analysing and interpreting Analysis and visualisation of the survey results and (qualitative and quantitative) data gathered	O4: Detailed evaluation report
EO-4: Continuous updating of the established evaluation procedures in computingfor bachelor, master and doctoral programs in European higher education institutions	Phase 4	Reviewing	O1: Report on needs, capacities and policy analysis O4: Detailed evaluation report	Phase 4 - Reporting tool for reviewing Maps of needs and requirements to evaluation results with recommendations for improvement if needed	O5: Evaluation summary report with recommendations for improvement including a score for each criterion and a total score for the whole computing education and training program

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Lifelong Learning Programme

Future Education and Training in Computing: How to support learning at anytime anywhere

EEFCET 2020 Overview

Impressum

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Responsible for the content

Project FETCH
ERASMUS THEMATIC NETWORK
Future Education and Training in computing: How to Support Learning at Anytime Anywhere
Work Package 4

12 ANNEX 3 – EUROPEAN ICT-COMPETENCIES STANDARD INTRODUCED BY CEN

12.1 Introduction

An extensive effort to develop a standard European ICT-competencies model has in recent years been undertaken by CEN (Comiteé Européen de Normalisation - European Committee for Standardisation[3]), in collaboration with a large group of European organisations and industrial companies. Among about 100 participating European companies and organisations we find AIRBUS, Association Pasc@line, ATI, ATT, British Computer Society, IBM UK, IG Metall, Cap Gemini, CIGREF, CPI Competenze per l'Innovazione, Deutsche Telekom, e-skills UK, EURO CIO, EXIN International, Fondazione Politecnico di Milano, Institut PI, La Poste, Michelin, Pôle Emploi, PSA Peugeot Citroen, and others.

As a result of this collaboration, two frameworks have been published by CEN in 2014:

- A framework describing European ICT Professional Profiles[4]
- A framework describing ICT-competencies (e-Competencies) identified within the mainstream European ICT professional activities[5]

The objective of this effort has been, according to[4]:

> "… As a response to the huge number of ICT Profile Frameworks and Profile descriptions used today in European ICT Business and Qualification systems, it was decided to create a number of representative ICT Profiles covering, at their level of granularity, the full ICT Business process. The profiles may be used for reference, or for the basis to develop further profile generations, by European stakeholders. Structured from six main **ICT Profile families**, these Profiles reflect the top of a **European ICT Profiles family tree**. The concept devised is broadly analogous to human genetics where the genes of one generation pass down to the next. In the same way it is envisaged that the core components of the 23 Generation 2 Profiles will pass down to profiles constructed to meet specific stakeholder requirements. The 23 Profiles constructed in this CWA combined with e-competences from the e-CF, provide a gene pool for the development of tailored profiles that may be developed by European ICT sector players in specific contexts and with higher levels of granularity. …"

The following sections highlight more details of the approach and descriptions introduced by CEN in the areas of European ICT professional profiles and European ICT-competencies (e-Competencies), which form today the core of European ICT professional activities.

12.2 Description of the CEN ICT job profiles tree

The standard ICT job profiles model introduced by CEN is based on a generic five-phase description of the ICT activities within a business process, consisting of the stages:[4]

MANAGE – PLAN – BUILD – RUN – ENABLE

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[3] CEN (Comité Européen de Normalisation -European Committee for Standardisation) https://www.cen.eu/Pages/default.aspx

[4] CEN (2014). European ICT Professional Profiles - updated by e-CF version 3.0 competences, *CEN Workshop Agreement (CWA)* (http://www.ecompetences.eu/ict-professional-profiles/), published by CEN (European Committee for Standardisation) in 2014 , last accessed on 2015/12/03.

[5] CEN (2014). *European e-Competence Framework 3.0*, published by CEN (European Committee for Standardisation) in 2014, (http://www.ecompetences.eu/e-cf-3-0-download/), last accessed on 2015/12/03.

Its final structure is refined by mapping these five phases onto more detailed business activities as follows:

MANAGE	→	Business management ICT job profiles
	→	Technical management ICT job profiles
PLAN	→	Design ICT job profiles
BUILD	→	Development ICT job profiles
RUN	→	Service and operation ICT job profiles
ENABLE	→	Support ICT job profiles

The result of this approach a "CEN tree" of 23 ICT job profiles shown below in Figure 1.

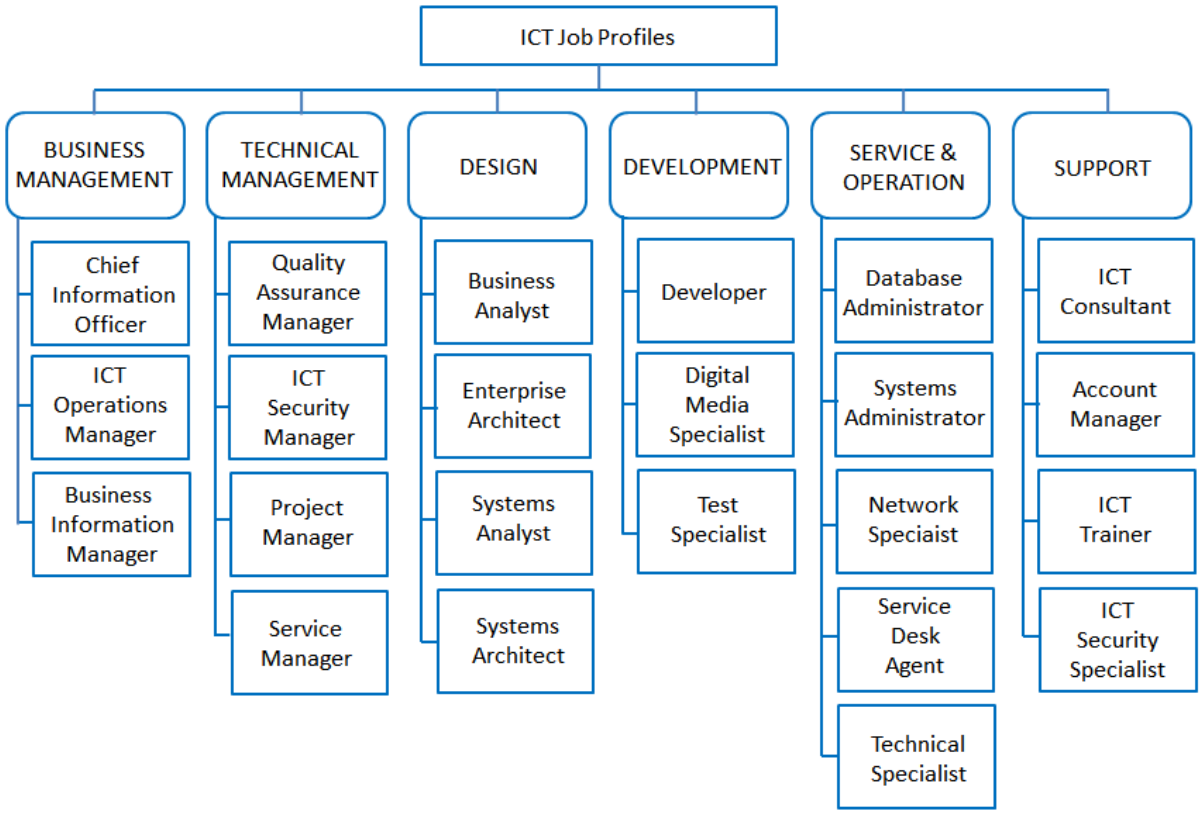

Figure 1. European ICT job profiles tree introduced by CEN[4]

The CEN tree of European ICT job profiles shown in this figure has six ICT activity categories, and the number of profiles per activity category is as follows:

i. Business management 3 ICT job profiles
ii. Technical management 4 ICT job profiles
iii. Design 4 ICT job profiles
iv. Development 3 ICT job profiles
v. Service and operation 5 ICT job profiles
vi. Support 4 ICT job profiles

This way CEN introduces 23 standard ICT job profiles.[4] Table 1 summarises ICT profile descriptions as specified by the CEN report published in 2014.

Table 1. Categories and descriptions of ICT job profiles defined by CEN[4]

Nr	ICT JOB PROFILE	Description	Alternative names
i. Business management			
1	Business Information Manager	Proposes plans and manages functional and technical evolutions of the Information System within the relevant business domain	*Business Intelligence Developer* *Business/ Systems Analyst*
2	Chief Information Officer	Develops and maintains Information Systems compliant to business and organisation's needs	*Head of computing*
3	ICT Operations Manager	Manages operations, people and further resources for the ICT activity	*IS Service Manager* *Service Advisor*
ii. Technical management			
4	Quality Assurance Manager	Guarantees that Information Systems are delivered according to organisation policies (quality, risks, Service Level Agreement)	*Quality Management Coordinator* *Quality Manager*
5	ICT Security Manager	Manages the Information System security policy	*Security Advisor* *Security Analyst* *Security Service Personal* *Security Services Specialist* *Security Specialist* *Security Technician*
6	Project Manager	Manages project to achieve optimal performance that conforms to original specifications	*IS Project Manager* *Project Coordinator* *Web Project Manager*
7	Service Manager	Plans, implements and manages solution provision	*Service Advisor* *IS Service Manager*
iii. Design			
8	Business Analyst	Analyses Information System for improving business performance	*Business Development Manager*
9	Systems Analyst	Analyses requirements and specifies software and systems	*Information Scientist* *Information Systems Analyst*
10	Enterprise Architect	Designs and maintains the Enterprise Architecture	
11	Systems Architect	Plans and is accountable for the implementation and integration of software and/ or ICT systems	*Telecommunications Architect*
iv. Development			
12	Developer	Builds/codes ICT solutions and specifies ICT products according to the customer needs	*Component Developer* *Application Developer* *Programmer*
13	Digital Media Specialist	Creates websites and multimedia applications combining the power of digital technology with effective use	*Front-End Web Developer* *User Experience Designer* *Web & Multimedia Master* *Web Content Manager*

		of graphics, audio, photographic and video images	*Web Developer* *Web Editor* *Digital Media Developer* *Multimedia Designer* *Multimedia Developer*
14	Test Specialist	Designs and performs testing plans	*Software Tester* *Systems Integration & Testing Engineer* *Test Specialist* *Tester*
v. Service and operation			
15	Database Administrator		
15	Systems Administrator	Administers ICT System components to meet service requirements	*Network Administrator* *Server Administrator* *System Administrator* *Database Administrator* *Enterprise Administrator* *Enterprise Messaging Administrator* *Web Server Administrator*
17	Network Specialist	Ensures the alignment of the network, including telecommunication and/or computer infrastructure to meet the organisation's communication needs	*Network Engineer* *Network Manager* *Network Services Specialist* *Network Support* *Network Administrator*
18	Service Desk Agent	Provides first line telephone or email support to clients with technical issues	*Help Desk Supervisor* *Helpdesk Professional*
19	Technical Specialist	Maintains and repairs hardware and software on client premises	*Computer Service and Repair Technician* *Consumer Support Technician* *Service Engineer* *Customer Engineer*
vi. Support			
20	ICT Consultant	Supports understanding of how new ICT technologies add value to a business	*Consultant* *Consultant and Contractor* *Enterprise Solutions Consultant* *Logistics & Automation Consultant* *Sales & Application Consultant* *Technical Consultant*
21	Account manager	Senior focal point for client sales and customer satisfaction	*Sales Advisor* *Customer Representative*
22	ICT Trainer	Educates and trains ICT professionals and practitioners to reach predefined standards of ICT technical /business competence	*Technical Trainer* *Instructor*
23	ICT Security Specialist	Ensures the implementation of the organisations security policy	*Security Service Personal* *Security Services Specialist* *Security Specialist* *Security Technician*

12.3 Description of the standardised CEN ICT-competencies framework (e-CF 3.0)

Each of the 23 ICT job profiles discussed in the previous section comprises several ICT competencies, which are crucial for efficient and professional functioning of an ICT worker in the assumed role. The present version of the CEN e-CF framework is version 3.0.[5] It contains 40 ICT-competencies, which are classified according to already mentioned five main business phases PLAN–BUILD–RUN–ENABLE–MANAGE. Table 2 presents the summary of these 40 ICT-competencies as described by CEN.[5]

Table 2. 40 ICT-competencies introduced by CEN[5]

Business Activity	Competence
A.PLAN	
A.1	IS and Business Strategy Alignment
A.2	Service Level Management
A.3	Business Plan Development
A.4	Product / Service Planning
A.5	Architecture Design
A.6	Application Design
A.7	Technology Trend Monitoring
A.8	Sustainable Development
A.9	Innovating
B.BUILD	
B.1	Application Development
B.2	Component Integration
B.3	Testing
B.4	Solution Deployment
B.5	Documentation Production
B.6	Systems Engineering
C.RUN	
C.1	User Support
C.2	Change Support
C.3	Service Delivery
C.4	Problem Management
D.ENABLE	
D.1	Information Security Strategy Development
D.2	ICT Quality Strategy Development
D.3	Education and Training Provision
D.4	Purchasing
D.5	Sales Proposal Development
D.6	Channel Management
D.7	Sales Management
D.8	Contract Management
D.9	Personnel Development
D.10	Information and Knowledge Management
D.11	Needs Identification
D.12	Digital Marketing
E.MANAGE	
E.1	Forecast Development
E.2	Project and Portfolio Management
E.3	Risk Management
E.4	Relationship Management
E.5	Process Improvement
E.6	ICT Quality Management
E.7	Business Change Management
E.8	Information Security Management
E.9	IS Governance

Each CEN ICT-competence specified in Table 2 has a standard structure of properties being the "slots" taking specific values depending on a particular competence. This way, an ontology-like relations set is created for each competence. Table 3 presents this standard set of properties together with an example for the competency "B.6 Documentation production". Another full example is shown in Table 4, for one of the major competencies on the European ICT jobs market being "B.1 Application development".

Table 3. The standard set of CEN ICT-competence relations[5] with an example of competence "Documentation production"

Competence property	Example of competence property value	
1. Business area	B. Build	
2. ID code, name and description	B.6 Documentation production Produces documents describing products, services, components or applications to establish compliance with relevant documentation requirements. Selects appropriate style and media for presentation materials. Creates templates for document-management systems. Ensures that functions and features are documented in an appropriate way. Ensures that existing documents are valid and up to date.	
3. Required proficiency level	L1	Uses and applies standards to define document structure.
	L2	Determines documentation requirements taking into account the purpose and environment to which it applies.
	L3	Adapts the level of detail according to the objective of the documentation and the targeted audience.
	L4	-
	L5	-
4. Required knowledge and skills K: aware of S: able to	K1 tools for production, editing and distribution of professional documents K2 tools for multimedia presentation creation K3 different technical documents required for designing, developing and deploying products, applications and services K4 version control of documentation production	
	S1 observe and deploy effective use of corporate standards for publications S2 prepare templates for shared publications S3 organise and control content management workflow S4 keep publications aligned to the solution during the entire lifecycle	

Table 4. ICT competence "B.1 Application development" according to CEN standard[5]

1. Business area	B. Build	
2. ID code, name and description	B.1 Application development Interprets the application design to develop a suitable application in accordance with customer needs. Adapts existing solutions by, e.g., porting an application to another operating system. Codes, debugs, tests and documents and communicates product development stages. Selects appropriate technical options for development such as reusing, improving or reconfiguration of existing components. Optimises efficiency, cost and quality. Validates results with user representatives, integrates and commissions the overall solution	
3. Required proficiency level	L1	Acts under guidance to develop, test and document applications.
	L2	Systematically develops and validates applications.
	L3	Acts creatively to develop applications and to select appropriate technical options. Accounts for others development activities. Optimises application development, maintenance and performance by employing design patterns and by reusing proved solutions.

	L4	-
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 appropriate software programs / modules K2 hardware components, tools and hardware architectures K3 functional & technical designing K4 state of the art technologies K5 programming languages K6 Power consumption models of software and / or hardware K7 DBMS K8 operating systems and software platforms K9 Integrated development environment (IDE) K10 rapid application development (RAD) K11 intellectual property rights issues K12 modelling technology and languages K13 interface definition languages (IDL) K14 security	
	S1 explain and communicate the design / development to the customer S2 perform and evaluate test results against product specifications S3 apply appropriate software and / or hardware architectures S4 develop user interfaces, business software components and embedded software components S5 manage and guarantee high levels of cohesion and quality S6 use data models S7 perform and evaluate test in the customer or target environment S8 cooperate with development team and with application designers	

12.4 Examples of ICT-competencies as key elements of ICT job profiles

CEN highlights in detail the relation between each of the 23 standard ICT job profiles and the ICT-competencies. [5] Each of the 23 ICT job profiles has the following components[5]

- A name of the ICT job profile
- A summary indicating the main purpose of the profile
- A mission statement to describe the rationale of the profile
- A list of its main work results / deliverables, with mention of the level of responsibility (accountable, responsible or contributor)
- A list of typical tasks to be performed by the profile
- A list of necessary e-competences (from the e-CF) to carry out the mission
- A KPI (Key Performance Indicator) area to inspire how to deduce specific KPIs allowing the measurement of the mission performance and its outputs.

To illustrate the semantics of this structure we look at 2 examples of standard ICT job profiles “Digital Media Specialist” and “Developer”, shown in Tables 5.and 6.

Table 5. CEN ICT job profiles example: DIGITAL MEDIA SPECIALIST[5]

Profile name	DIGITAL MEDIA SPECIALIST		
Summary statement	Creates websites and multimedia applications combining the power of digital technology with effective use of graphics, audio, photographic and video images.		
Mission	Designs, lays out and codes, multimedia applications and websites to maximise information presentation, including marketing messages. Makes recommendations on technical interfaces and ensures sustainability through application of appropriate content management systems.		
Deliverables	Accountable • Multimedia component	Responsible • Integrated Solution	Contributor • Solution in Operation

Main tasks	- Design web and multimedia content to provide clear and visually attractive solution in line with customer needs - Test and resolve any technical issues - Ensure accessibility for disabled users and for accessibility via a range of browsers - Ensure compliance with privacy, legal requirements and environmental constraints	
e-competences	A.6. Application Design	Level 2
	B.1. Application Development	Level 3
	B.3. Testing	Level 2
	B.4. Solution Deployment	Level 3
	D.12. Digital Marketing	Level 2
KPI (Key Performance Indicator)	Fully functional web components	

Table 6. CEN ICT job profiles example: DEVELOPER[5]

Profile name	DEVELOPER		
Summary statement	Builds/codes ICT solutions and specifies ICT products according to customer needs.		
Mission	Ensures building and implementing of ICT applications. Contributes to planning, low level design. Compiles diagnostic programs and designs and writes code for operating systems and software to ensure optimum efficiency and functionality.		
Deliverables	Accountable • Hardware Component • Software Component	Responsible • Solution Documentation	Contributor • Software Design Description • Test Procedure • Solution in Operation
Main tasks	-Develop component -Engineer component -Shape documentation -Provide component support		
e-competences	B.1. Application Development		Level 3
	B.2. Component Integration		Level 2
	B.3. Testing		Level 2
	B.5. Documentation Production		Level 3
	C.4. Problem Management		Level 3
KPI (Key Performance Indicator)	Fully functional ICT components		

12.5 An ICT-competencies evaluation tool for ICT curricula

The ICT-competencies included in e-CF 3.0 frameworks form a relevant knowledge base, which can be used to study the alignment of ICT education towards the ICT market needs.

The ICT competencies tool presented below consists of 40 questions arranged in 5 questionnaires (respectively PART A, B, C, D, E) which correspond to the CEN e-CF 3 structure PLAN–BUILD–RUN–ENABLE–MANAGE. For each competence instance, a scale from 0 to 5 can be used to assess its presence in the educational process. A detailed explanation of each competence instance can be found in the summary of e-CF 3.0 presented in next section.

ICT Competencies Tool - PART A

A. ICT competencies within the curriculum related to activity A “PLAN”							
CURRICULUM NAME							
5-Strongly agree 4-Agree 3-Neutral 2-Disagree 1-Strongly disagree 0-Undecided							
A.PLAN	Competence	5	4	3	2	1	0
A.1	IS and Business Strategy Alignment						
A.2	Service Level Management						
A.3	Business Plan Development						
A.4	Product / Service Planning						
A.5	Architecture Design						
A.6	Application Design						
A.7	Technology Trend Monitoring						
A.8	Sustainable Development						
A.9	Innovating						

ICT Competencies Tool - PART B

B. ICT competencies within the curriculum related to activity B “BUILD”							
CURRICULUM NAME							
5-Strongly agree 4-Agree 3-Neutral 2-Disagree 1-Strongly disagree 0-Undecided							
B.BUILD	Competence	5	4	3	2	1	0
B.1	Application Development						
B.2	Component Integration						
B.3	Testing						
B.4	Solution Deployment						
B.5	Documentation Production						
B.6	Systems Engineering						

ICT Competencies Tool - PART C

C. ICT competencies within the curriculum related to activity C “RUN”							
CURRICULUM NAME							
5-Strongly agree 4-Agree 3-Neutral 2-Disagree 1-Strongly disagree 0-Undecided							
C.RUN	Competence	5	4	3	2	1	0
C.1	User Support						
C.2	Change Support						
C.3	Service Delivery						
C.4	Problem Management						

ICT Competencies Tool - PART D

D. ICT competencies within the curriculum related to ICT activity D “ENABLE”							
CURRICULUM NAME							
5-Strongly agree 4-Agree 3-Neutral 2-Disagree 1-Strongly disagree 0-Undecided							
D.ENABLE	Competence	5	4	3	2	1	0
D.1	Information Security Strategy Development						
D.2	ICT Quality Strategy Development						
D.3	Education and Training Provision						
D.4	Purchasing						
D.5	Sales Proposal Development						
D.6	Channel Management						
D.7	Sales Management						

D.8	Contract Management						
D.9	Personnel Development						
D.10	Information and Knowledge Management						
D.11	Needs Identification						
D.12	Digital Marketing						

ICT Competencies Tool - PART E

E. ICT competencies within the curriculum related to activity E “MANAGE”							
CURRICULUM NAME							
5-Strongly agree 4-Agree 3-Neutral 2-Disagree 1-Strongly disagree 0-Undecided							
E.MANAGE		5	4	3	2	1	0
E.1	Forecast Development						
E.2	Project and Portfolio Management						
E.3	Risk Management						
E.4	Relationship Management						
E.5	Process Improvement						
E.6	ICT Quality Management						
E.7	Business Change Management						
E.8	Information Security Management						
E.9	IS Governance						

12.6 An overview of 40 ICT-competence profiles as defined in e-CF 3.0 framework

This section summarises all ICT-competence profiles described in e-CF 3.0 [3]. The competences are categorised according to ICT activities PLAN–BUILD–RUN–ENABLE–MANAGE.

12.6.1 A.PLAN

A.1 IS and Business Strategy Alignment

1 Business area	A. Plan	
2. ID code, name and description	A.1 IS and Business Strategy Alignment Anticipates long-term business requirements, influences improvement of organisational process efficiency and effectiveness. Determines the IS model and the enterprise architecture in line with the organisation’s policy and ensures a secure environment. Makes strategic IS policy decisions for the enterprise, including sourcing strategies.	
3. Required proficiency level	L1	-
	L2	-
	L3	-
	L4	Provides leadership for the construction and implementation of long term innovative IS solutions.
	L5	Provides IS strategic leadership to reach consensus and commitment from the management team of the enterprise.
4. Required knowledge and skills K: is aware of S: is able to	K1 business strategy concepts K2 trends and implications of ICT internal or external developments for typical organisations K3 the potential and opportunities of relevant business models K4 the business aims and organisational objectives K5 the issues and implications of sourcing models K6 the new emerging technologies (e.g., distributed systems, virtualisation, mobility, data sets) K7 architectural frameworks K8 security	

	S1 analyse future developments in business process and technology application S2 determine requirements for processes related to ICT services S3 identify and analyse long term user / customer needs S4 contribute to the development of ICT strategy and policy, including ICT security and quality S5 contribute to the development of the business strategy S6 analyse feasibility in terms of costs and benefits S7 review and analyse effects of implementations S8 understand the impact of new technologies on business (e.g., open / big data, dematerialisation opportunities and strategies) S9 understand the business benefits of new technologies and how this can add value and provide competitive advantage (e.g., open / big data, dematerialisation opportunities and strategies) S10 understand the enterprise architecture S11 understand the legal & regulatory landscape in order to factor into business requirements

A.2 Service Level Management

1 Business area	A. Plan	
2. ID code, name and description	A.2 Service Level Management Defines, validates and makes applicable service level agreements (SLAs) and underpinning contracts for services offered. Negotiates service performance levels taking into account the needs and capacity of stakeholders and business.	
3. Required proficiency level	L1	-
	L2	-
	L3	Ensures the content of the SLA.
	L4	Negotiates revision of SLAs, in accordance with the overall objectives. Ensures the achievement of planned results.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 SLA documentation K2 how to compare and interpret management data K3 the elements forming the metrics of service level agreements K4 how service delivery infrastructures work K5 impact of service level non-compliance on business performance K6 ICT security standards K7 ICT quality standards	
	S1 analyse service provision records S2 evaluate service provision against SLA S3 negotiate realistic service level targets S4 use relevant quality management techniques S5 anticipate and mitigate against potential service disruptions	

A.3 Business Plan Development

1 Business area	A. Plan	
2. ID code, name and description	A.3 Business Plan Development Addresses the design and structure of a business or product plan including the identification of alternative approaches as well as return on investment propositions. Considers the possible and applicable sourcing models. Presents cost benefit analysis and reasoned arguments in support of the selected strategy. Ensures compliance with business and technology strategies. Communicates and sells business plan to relevant stakeholders and addresses political, financial, and organisational interests.	
3. Required proficiency	L1	-
	L2	-

level	L3	Exploits specialist knowledge to provide analysis of market environment etc.
	L4	Provides leadership for the creation of an information system strategy that meets the requirements of the business (e.g., distributed, mobility-based) and includes risks and opportunities.
	L5	Applies strategic thinking and organisational leadership to exploit the capability of Information Technology to improve the business.
4. Required knowledge and skills K: is aware of S: is able to	K1 business plan elements and milestones K2 the present and future market size and needs K3 competition and SWOT analysis techniques (for product features and also the external environment) K4 value creation channels K5 profitability elements K6 the issues and implications of sourcing models K7 financial planning and dynamic K8 new emerging technologies K9 risk and opportunity assessment techniques	
	S1 explain and communicate the design / development to the customer S1 address and identify essential elements of product or solution value propositions S2 define the appropriate value creation channels S3 build a detailed SWOT analysis S4 generate short and long term performance reports (e.g., financial, profitability, usage and value creation) S5 identify main milestones of the plan	

A.4 Product / Service Planning

1 Business area	A. Plan	
2. ID code, name and description	A.4 Product / Service Planning Analyses and defines current and target status. Estimates cost effectiveness, points of risk, opportunities, strengths and weaknesses, with a critical approach. Creates structured plans; establishes time scales and milestones, ensuring optimisation of activities and resources. Manages change requests. Defines delivery quantity and provides an overview of additional documentation requirements. Specifies correct handling of products, including legal issues, in accordance with current regulations.	
3. Required proficiency level	L1	-
	L2	Acts systematically to document standard and simple elements of a product.
	L3	Exploits specialist knowledge to create and maintain complex documents.
	L4	Provides leadership and takes responsibility for, developing and maintaining overall plans.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 effective frameworks and methodologies for governance plans K2 typical KPI (key performance indicators) K3 basic decision-making methods K4 IPR principles and regulation K5 agile techniques K6 structured Project Management Methodologies (e.g., agile techniques) K7 optimisation methods (e.g., lean management) K8 new emerging technologies	
	S1 identify all potential targets for the product or service S2 define the communication plan; identify key users and create related documentation S3 produce quality plans S4 ensure and manage adequate information for decision makers S5 manage the change request process S6 manage the product / service development management lifecycle (inclusive of	

	the formal change request process)

A.5 Architecture Design

1 Business area	A. Plan	
2. ID code, name and description	A.5 Architecture Design Specifies, refines, updates and makes available a formal approach to implement solutions, necessary to develop and operate the IS architecture. Identifies change requirements and the components involved: hardware, software, applications, processes, information and technology platform. Takes into account interoperability, scalability, usability and security. Maintains alignment between business evolution and technology developments.	
3. Required proficiency level	L1	-
	L2	-
	L3	Exploits specialist knowledge to define relevant ICT technology and specifications to be deployed in the construction of multiple ICT projects, applications or infrastructure improvements.
	L4	Acts with wide ranging accountability to define the strategy to implement ICT technology compliant with business need. Takes account of the current technology platform, obsolescent equipment and latest technological innovations.
	L5	Provides ICT strategic leadership for implementing the enterprise strategy. Applies strategic thinking to discover and recognise new patterns in vast datasets and new ICT systems, to achieve business savings.
4. Required knowledge and skills K: is aware of S: is able to	K1 architecture frameworks, methodologies and systems design tools K2 systems architecture requirements: performance, maintainability, extendibility, scalability, availability, security and accessibility K3 costs, benefits and risks of a system architecture K4 the company's enterprise architecture and internal standards K5 new emerging technologies (e.g., distributed systems, virtualisation models, datasets, mobile systems)	
	S1 provide expertise to help solve complex technical problems and ensure best architecture solutions are implemented S2 use knowledge in various technology areas to build and deliver the enterprise architecture S3 understand the business objectives / drivers that impact the architecture component (data, application, security, development, etc.) S4 assist in communication of the enterprise architecture and standards, principles and objectives to the application teams S5 develop design patterns and models to assist system analysts in designing consistent applications	

A.6 Application Design

1 Business area	A. Plan	
2. ID code, name and description	A.6 Application Design Analyses, specifies, updates and makes available a model to implement applications in accordance with IS policy and user / customer needs. Selects appropriate technical options for application design, optimising the balance between cost and quality. Designs data structures and builds system structure models according to analysis results through modelling languages. Ensures that all aspects take account of interoperability, usability and security. Identifies a common reference framework to validate the models with representative users, based upon development models (e.g., iterative approach).	
3. Required proficiency	L1	Contributes to the design and general functional specification and interfaces.
	L2	Organises the overall planning of the design of the application.

level	L3	Accounts for own and others actions in ensuring that the application is correctly integrated within a complex environment and complies with user / customer needs.
	L4	-
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 appropriate software programs / modules K1 requirements modelling and need analysis techniques K2 software developments methods and their rationale (e.g., prototyping, agile methods, reverse engineering, etc.) K3 metrics related to application development K4 user interface design principles K5 languages for formalising functional specification K6 existing applications and related architecture K7 DBMS, Data Warehouse, DSS … etc. K8 mobile technologies K9 threat modelling techniques	
	S1 identify customers, users & stakeholders S2 collect, formalise and validate functional and no-functional requirements S3 apply estimation models and data to evaluate costs of different software lifecycle phases S4 evaluate the use of prototypes to support requirements validation S5 design, organise and monitor the overall plan for the design of application S6 design functional specification starting from defined requirements S7 evaluate the suitability of different application development methods for the current scenario S8 establish systematic and frequent communication with customers, users and stakeholders S9 ensure that controls & functionality are built in to the design	

A.7 Technology Trend Monitoring

1 Business area	A. Plan	
2. ID code, name and description	A.7 Technology Trend Monitoring Investigates latest ICT technological developments to establish understanding of evolving technologies. Devises innovative solutions for integration of new technology into existing products, applications or services or for the creation of new solutions.	
3. Required proficiency level	L1	-
	L2	-
	L3	-
	L4	Exploits wide ranging specialist knowledge of new and emerging technologies, coupled with a deep understanding of the business, to envision and articulate solutions for the future. Provides expert guidance and advice, to the leadership team to support strategic decision-making.
	L5	Makes strategic decisions envisioning and articulating future ICT solutions for customer-oriented processes, new business products and services; directs the organisation to build and exploit them.
4. Required knowledge and skills K: is aware of S: is able to	K1 emerging technologies and the relevant market applications K2 market needs K3 relevant sources of information (e.g., magazines, conferences and events, newsletters, opinion leaders, on-line forum, etc.) K4 the rules of discussions in web communities K5 applied research programme approaches	
	S1 monitor sources of information and continuously follow the most promising S2 identify vendors and providers of the most promising solutions; evaluate, justify and propose the most appropriate.	

	S3 identify business advantages and improvements of adopting emerging technologies

A.8 Sustainable Development

1 Business area	A. Plan	
2. ID code, name and description	A.8 Sustainable Development Estimates the impact of ICT solutions in terms of eco responsibilities including energy consumption. Advises business and ICT stakeholders on sustainable alternatives that are consistent with the business strategy. Applies an ICT purchasing and sales policy, which fulfils eco-responsibilities.	
3. Required proficiency level	L1	-
	L2	Promotes awareness, training and commitment for the deployment of sustainable development and applies the necessary tools for piloting this approach.
	L3	Defines objective and strategy of sustainable IS development in accordance with the organisation's sustainability policy.
	L4	-
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 metrics and indicators related to sustainable development K2 corporate social responsibility (CSR) of stakeholders within the IS infrastructure	
	S1 monitor and measure the ICT energy consumption S2 apply recommendations in projects to support latest sustainable development strategies S3 master regulatory constraints and international standards related to ICT sustainability	

A.9 Innovating

1 Business area	A. Plan	
2. ID code, name and description	A.9 Innovating Devises creative solutions for the provision of new concepts, ideas, products or services. Deploys novel and open thinking to envision exploitation of technological advances to address business / society needs or research direction.	
3. Required proficiency level	L1	-
	L2	-
	L3	-
	L4	Applies independent thinking and technology awareness to lead the integration of disparate concepts for the provision of unique solutions.
	L5	Challenges the status quo and provides strategic leadership for the introduction of revolutionary concepts.
4. Required knowledge and skills K: is aware of S: is able to	K1 existing and emerging technologies and market applications K2 business, society and / or research habits, trends and needs K3 innovation processes techniques	
	S1 identify business advantages and improvements of adopting emerging technologies S2 create a proof of concept S3 think out of the box S4 identify appropriate resources	

12.6.2 B.BUILD

B.1 Application development

1 Business area	B. Build	
2. ID code, name and description	B.1 Application development Interprets the application design to develop a suitable application in accordance with customer needs. Adapts existing solutions by, e.g., porting an application to another operating system. Codes, debugs, tests and documents and communicates product development stages. Selects appropriate technical options for development such as reusing, improving or reconfiguration of existing components. Optimises efficiency, cost and quality. Validates results with user representatives, integrates and commissions the overall solution	
3. Required proficiency level	L1	Acts under guidance to develop, test and document applications.
	L2	Systematically develops and validates applications.
	L3	Acts creatively to develop applications and to select appropriate technical options. Accounts for others development activities. Optimises application development, maintenance and performance by employing design patterns and by reusing proved solutions.
	L4	-
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 appropriate software programs / modules K2 hardware components, tools and hardware architectures K3 functional & technical designing K4 state of the art technologies K5 programming languages K6 Power consumption models of software and / or hardware K7 DBMS K8 operating systems and software platforms K9 Integrated development environment (IDE) K10 rapid application development (RAD) K11 intellectual property rights issues K12 modelling technology and languages K13 interface definition languages (IDL) K14 security	
	S1 explain and communicate the design / development to the customer S2 perform and evaluate test results against product specifications S3 apply appropriate software and / or hardware architectures S4 develop user interfaces, business software components and embedded software components S5 manage and guarantee high levels of cohesion and quality S6 use data models S7 perform and evaluate test in the customer or target environment S8 cooperate with development team and with application designers	

B.2 Component Integration

1 Business area	B. Build	
2. ID code, name and description	B.2 Component Integration Integrates hardware, software or sub system components into an existing or a new system. Complies with established processes and procedures such as, configuration management and package maintenance. Takes into account the compatibility of existing and new modules to ensure system integrity, system interoperability and information security. Verifies and tests system capacity and performance and documentation of successful integration.	
3. Required	L1	-

proficiency level	L2	Acts systematically to identify compatibility of software and hardware specifications. Documents all activities during installation and records deviations and remedial activities.
	L3	Accounts for own and others actions in the integration process. Complies with appropriate standards and change control procedures to maintain integrity of the overall system functionality and reliability.
	L4	Exploits wide ranging specialist knowledge to create a process for the entire integration cycle, including the establishment of internal standards of practice. Provides leadership to marshal and assign resources for programmes of integration.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 appropriate software programs / modules	
	S1 explain and communicate the design / development to the customer	

B.3 Testing

1 Business area	B. Build	
2. ID code, name and description	B.3 Testing Constructs and executes systematic test procedures for ICT systems or customer usability requirements to establish compliance with design specifications. Ensures that new or revised components or systems perform to expectation. Ensures meeting of internal, external, national and international standards; including health and safety, usability, performance, reliability or compatibility. Produces documents and reports to evidence certification requirements.	
3. Required proficiency level	L1	Performs simple tests in strict compliance with detailed instructions.
	L2	Organises test programmes and builds scripts to stress test potential vulnerabilities. Records and reports outcomes providing analysis of results.
	L3	Exploits specialist knowledge to supervise complex testing programmes. Ensures tests and results are documented to provide input to subsequent process owners such as designers, users or maintainers. Accountable for compliance with testing procedures including a documented audit trail.
	L4	Exploits wide ranging specialist knowledge to create a process for the entire testing activity, including the establishment of internal standard of practices. Provides expert guidance and advice to the testing team.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 techniques, infrastructure and tools to be used in the testing process K2 the lifecycle of a testing process K3 the different sorts of tests (functional, integration, performance, usability, stress etc.) K4 national and international standards defining quality criteria for testing K5 web, cloud and mobile technologies and environmental requirements	
	S1 explain and communicate the design / development to the customer S1 create and manage a test plan S2 manage and evaluate the test process S3 design tests of ICT systems S4 prepare and conduct tests of ICT systems S5 report and document tests and results	

B.4 Solution Deployment

1 Business area	B. Build
2. ID code,	B.4 Solution Deployment

name and description	Following predefined general standards of practice carries out planned necessary interventions to implement solution, including installing, upgrading or decommissioning. Configures hardware, software or network to ensure interoperability of system components and debugs any resultant faults or incompatibilities. Engages additional specialist resources if required, such as third party network providers. Formally hands over fully operational solution to user and completes documentation recording all relevant information, including equipment addressees, configuration and performance data.	
3. Required proficiency level	L1	Removes or installs components under guidance and in accordance with detailed instructions.
	L2	Acts systematically to build or deconstruct system elements. Identifies failing components and establishes root cause failures. Provides support to less experienced colleagues.
	L3	Accounts for own and others actions for solution provision and initiates comprehensive communication with stakeholders. Exploits specialist knowledge to influence solution construction providing advice and guidance.
	L4	-
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 performance analysis techniques K2 techniques related to problem management (operation, performance, compatibility) K3 software packaging and distribution methods and techniques K4 the impacts of deployment on the current architecture K5 the technologies and standards to be used during the deployment K6 web, cloud and mobile technologies and environmental requirements	
	S1 explain and communicate the design / development to the customer S1 organise deployment workflow and product roll-out activities S2 organise and plan beta-test activities, testing solution in its final operational environment S3 configure components at any level to guarantee correct overall interoperability S4 identify and engage expertise needed to solve interoperability problems S5 organise and control initial support service provision including user training during system start-up S6 organise population of data bases and manage data migration S7 collaborate to modify 3rd party code; support and maintain modified software	

B.5 Documentation Production

1 Business area	B. Build	
2. ID code, name and description	B.5. Documentation Production Produces documents describing products, services, components or applications to establish compliance with relevant documentation requirements. Selects appropriate style and media for presentation materials. Creates templates for document-management systems. Ensures that functions and features are documented in an appropriate way. Ensures that existing documents are valid and up to date.	
3. Required proficiency level	L1	Uses and applies standards to define document structure.
	L2	Determines documentation requirements taking into account the purpose and environment to which it applies.
	L3	Adapts the level of detail according to the objective of the documentation and the targeted population.
	L4	-
	L5	-
4. Required knowledge and skills	K1 appropriate software programs / modules K1 tools for production, editing and distribution of professional documents K2 tools for multimedia presentation creation	

K: is aware of S: is able to	K3 different technical documents required for designing, developing and deploying products, applications and services K4 version control of documentation production
	S1 observe and deploy effective use of corporate standards for publications S2 prepare templates for shared publications S3 organise and control content management workflow S4 keep publications aligned to the solution during the entire lifecycle

B.6 Systems Engineering

1 Business area	B. Build	
2. ID code, name and description	B.6 Systems Engineering Engineers software and / or hardware components to meet solution requirements such as specifications, costs, quality, time, energy efficiency, information security and data protection. Follows a systematic methodology to analyse and build the required components and interfaces. Builds system structure models and conducts system behaviour simulation. Performs unit and system tests to ensure requirements are met.	
3. Required proficiency level	L1	-
	L2	Systematically develops and validates applications.
	L3	Ensures interoperability of the system components. Exploits wide ranging specialist knowledge to create a complete system that will satisfy the system constraints and meet the customer's expectations.
	L4	Handles complexity by developing standard procedures and architectures in support of cohesive product development. Establishes a set of system requirements that will guide the design of the system. Identifies which system requirements should be allocated to which elements of the system.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 appropriate software programs / modules, DBMS and programming languages K2 hardware components, tools and hardware architectures K3 functional & technical designing K4 state of the art technologies K5 programming languages K6 power consumption models of software and / or hardware K7 information Security Basics K8 prototyping	
	S1 explain and communicate the design / development to the customer S2 perform and evaluate test results against product specifications S3 apply appropriate software and / or hardware architectures S4 design and develop hardware architecture, user interfaces, business software components and embedded software components S5 manage and guarantee high levels of cohesion and quality in complex software developments S6 use data models S7 apply appropriate development and / or process models, to develop effectively and efficiently	

12.6.3 C.RUN

C.1 User Support

1 Business area	C. Run
2. ID code, name and description	C.1 User Support Responds to user requests and issues, recording relevant information. Assures resolution or escalates incidents and optimises system performance in accordance

	with predefined service level agreements (SLAs). Understands how to monitor solution outcome and resultant customer satisfaction.	
3. Required proficiency level	L1	Interacts with users, applies basic product knowledge to respond to user requests. Solves incidents, following prescribed procedures.
	L2	Systematically interprets user problems and identifies solutions and possible side effects. Uses experience to address user problems and interrogates database for potential solutions. Escalates complex or unresolved incidents. Records and tracks issues from outset to conclusion.
	L3	Manages the support process and accountable for agreed SLA. Plans resource allocation to meet defined service level. Acts creatively, and applies continuous service improvement. Manages the support function budget.
	L4	-
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 appropriate software programs / modules, DBMS and programming languages K1 relevant ICT user applications K2 database structures and content organisation K3 corporate escalation procedures K4 software distribution methods and procedures for fix application and file transmission methodologies applicable to software fixes K5 sources of information for potential solutions	
	S1 explain and communicate the design / development to the customer S1 effectively interrogate users to establish symptoms S2 analyse symptoms to identify broad area of user error or technical failure S3 deploy support tools to systematically trace source of error or technical failure S4 clearly communicate with end users and provide instructions on how to progress issues S5 record and code issues to support growth and integrity of online support tools	

C.2 Change Support

1 Business area	C. Run	
2. ID code, name and description	C.2 Change Support Implements and guides the evolution of an ICT solution. Ensures efficient control and scheduling of software or hardware modifications to prevent multiple upgrades creating unpredictable outcomes. Minimises service disruption as a consequence of changes and adheres to defined service level agreement (SLA). Ensures consideration and compliance with information security procedures.	
3. Required proficiency level	L1	-
	L2	During change, acts systematically to respond to day by day operational needs and react to them, avoiding service disruptions and maintaining coherence to (SLA) and information security requirements.
	L3	Ensures the integrity of the system by controlling the application of functional updates, software or hardware additions and maintenance activities. Complies with budget requirements.
	L4	-
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 functional specifications of the information system K2 the existing ICT application technical architecture K3 how business processes are integrated and their dependency upon ICT applications K4 change management tools and technique K5 the best practices and standards in information security management	
	S1 explain and communicate the design / development to the customer S1 share functional and technical specifications with ICT teams in charge of the	

	maintenance and evolution of ICT solutions S2 manage communications with ICT teams in charge of the maintenance and the evolution of information systems solutions S3 analyse the impact of functional / technical changes on users S4 anticipate all actions required to mitigate the impact of changes (training, documentation, new processes, …).

C.3 Service Delivery

1 Business area	C. Run	
2. ID code, name and description	C.3 Service Delivery Ensures service delivery in accordance with established service level agreements (SLA's). Takes proactive action to ensure stable and secure applications and ICT infrastructure to avoid potential service disruptions, attending to capacity planning and to information security. Updates operational document library and logs all service incidents. Maintains monitoring and management tools (i.e. scripts, procedures). Maintains IS services. Takes proactive measures.	
3. Required proficiency level	L1	Acts under guidance to record and track reliability data.
	L2	Systematically analyses performance data and communicates findings to senior experts. Escalates potential service level failures and security risks, recommends actions to improve service reliability. Tracks reliability data against SLA.
	L3	Programmes the schedule of operational tasks. Manages costs and budget according to the internal procedures and external constraints. Identifies the optimum number of people required to resource the operational management of the IS infrastructure.
	L4	-
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 how to interpret ICT service delivery requirements K2 best practices and standards in ICT service delivery. K3 how to monitor service delivery K4 how to record service delivery actions and able to identify failures K5 the best practices and standards in information security management K6 web, cloud and mobile technologies	
	S1 explain and communicate the design / development to the customer S1 apply the processes which comprise the organisation's ICT service delivery strategy S2 fill in and complete documentation used in ICT service delivery S3 analyse service delivery provision and report outcomes to senior colleagues S4 plan and apply manpower workload / requirements for efficient and cost effective service provision	

C.4 Problem Management

1 Business area	C. Run	
2. ID code, name and description	C.4. Problem Management Identifies and resolves the root cause of incidents. Takes a proactive approach to avoidance or identification of root cause of ICT problems. Deploys a knowledge system based on recurrence of common errors. Resolves or escalates incidents. Optimises system or component performance.	
3. Required proficiency level	L1	-
	L2	Identifies and classifies incident types and service interruptions. Records incidents cataloguing them by symptom and resolution.
	L3	Exploits specialist knowledge and in-depth understanding of the ICT

		infrastructure and problem management process to identify failures and resolve with minimum outage. Makes sound decisions in emotionally charged environments on appropriate action required to minimise business impact. Rapidly identifies failing component, selects alternatives such as repair, replace or reconfigure.
	L4	Provides leadership and is accountable for the entire problem management process. Schedules and ensures well-trained human resources, tools, and diagnostic equipment are available to meet emergency incidents. Has depth of expertise to anticipate critical component failure and make provision for recovery with minimum downtime. Constructs escalation processes to ensure that appropriate resources can be applied to each incident.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 the organisation's overall ICT infrastructure and key components K2 the organisation's reporting procedures K3 the organisation's critical situation escalation procedures K4 the application and availability of diagnostic tools K5 the link between system infrastructure elements and impact of failure on related business processes.	
	S1 monitor progress of issues throughout lifecycle and communicate effectively S2 identify potential critical component failures and take action to mitigate effects of failure S3 conduct risk management audits and act to minimise exposures S4 allocate appropriate resources to maintenance activities, balancing cost and risk S5 communicate at all levels to ensure appropriate resources are deployed internally or externally to minimise outages	

12.6.4 D.ENABLE

D.1 Information Security Strategy Development

1 Business area	D. Enable	
2. ID code, name and description	D.1. Information Security Strategy Development Defines and makes applicable a formal organisational strategy, scope and culture to maintain safety and security of information from external and internal threats, i.e. digital forensic for corporate investigations or intrusion investigation. Provides the foundation for Information Security Management, including role identification and accountability. Uses defined standards to create objectives for information integrity, availability, and data privacy.	
3. Required proficiency level	L1	-
	L2	
	L3	-
	L4	Exploits depth of expertise and leverages external standards and best practices.
	L5	Provides strategic leadership to embed information security into the culture of the organisation.
4. Required knowledge and skills K: is aware of S: is able to	K1 the potential and opportunities of relevant standards and best practices K2 the impact of legal requirements on information security K3 the information strategy of the organisation K4 possible security threats K5 the mobility strategy K6 the different service models (SaaS, PaaS, IaaS) and operational translations (i.e., Cloud computing)	
	S1 develop and critically analyse the company strategy for information security S2 define, present and promote an information security policy for approval by the	

	senior management of the organisation S3 apply relevant standards, best practices and legal requirements for information security S4 anticipate required changes to the organisation's information security strategy and formulate new plans S5 propose effective contingency measures

D.2 ICT Quality Strategy Development

1 Business area	D. Enable	
2. ID code, name and description	D.2. ICT Quality Strategy Development Defines, improves and refines a formal strategy to satisfy customer expectations and improve business performance (balance between cost and risks). Identifies critical processes influencing service delivery and product performance for definition in the ICT quality management system. Uses defined standards to formulate objectives for service management, product and process quality. Identifies ICT quality management accountability.	
3. Required proficiency level	L1	-
	L2	-
	L3	-
	L4	Exploits wide-ranging specialist knowledge to leverage and authorise the application of external standards and best practices.
	L5	Provides strategic leadership to embed ICT quality (i.e. metrics and continuous improvement) into the culture of the organisation.
4. Required knowledge and skills K: is aware of S: is able to	K1 appropriate software programs / modules, DBMS and programming languages K1 the major information technology industry frameworks, e.g., COBIT, ITIL, CMMI, ISO – and their implications for corporate IS governance K2 the information strategy of the organisation K3 the different service models (SaaS, PaaS, IaaS) and operational translations (i.e. Cloud computing)	
	S1 explain and communicate the design / development to the customer S1 define an ICT quality policy to meet the organisation's standards of performance and customer satisfaction objectives S2 identify quality metrics to be used S3 apply relevant standards and best practices to maintain information quality	

D.3 Education and Training Provision

1 Business area	D. Enable	
2. ID code, name and description	D.3. Education and Training Provision Defines and implements ICT training policy to address organisational skill needs and gaps. Structures, organises and schedules training programmes and evaluates training quality through a feedback process and implements continuous improvement. Adapts training plans to address changing demand.	
3. Required proficiency level	L1	-
	L2	Organises the identification of training needs; collates organisation requirements, identifies, selects and prepares schedule of training interventions.
	L3	Organises the identification of training needs; collates organisation requirements, identifies, selects and prepares schedule of training interventions. Acts creatively to analyse skills gaps; elaborates specific requirements and identifies potential sources for training provision. Has specialist knowledge of the training market and establishes a feedback mechanism to assess the added value of alternative training programmes.
	L4	-

	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 appropriate pedagogical approaches and education delivery methods e.g., classroom, online, text, DVD K2 the competitive market for educational offering K3 training needs analysis methodologies K4 empowerment techniques	
	S1 organise training and education schedules to meet market needs S2 identify and maximise use of resources required to deliver a cost effective schedule S3 promote and market education and training provision S4 analyse feedback data and use it to drive continuous improvement of education and training delivery S5 design curricula and training programmes to meet customer ICT education needs S6 address CPD needs of staff to meet organisational requirements	

D.4 Purchasing

1 Business area	D. Enable	
2. ID code, name and description	D.4. Purchasing Applies a consistent procurement procedure, including deployment of the following sub processes: specification requirements, supplier identification, proposal analysis, evaluation of the energy efficiency and environmental compliance of products, suppliers and their processes, contract negotiation, supplier selection and contract placement. Ensures that the entire purchasing process is fit for purpose, adds business value to the organisation compliant to legal and regulatory requirements.	
3. Required proficiency level	L1	-
	L2	Understands and applies the principles of the procurement process; places orders based on existing supplier contracts. Ensures the correct execution of orders, including validation of deliverables and correlation with subsequent payments.
	L3	Exploits specialist knowledge to deploy the purchasing process, ensuring positive commercial relationships with suppliers. Selects suppliers, products and services by evaluating performance, cost, timeliness and quality. Decides contract placement and complies with organisational policies.
	L4	Provides leadership for the application of the organisation's procurement policies and makes recommendations for process enhancement. Applies experience and procurement practice expertise to make ultimate purchasing decisions.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 typical purchase contract terms and conditions K2 own organisation purchasing policies K3 financial models, e.g., discount structures K4 the current market for relevant products or services K5 the issues and implications of outsourcing services K6 different service models (SaaS, PaaS, IaaS) and operational translations (e.g., Cloud computing)	
	S1 interpret product / service specifications S2 negotiate terms, conditions and pricing S3 analyse received proposals / offers S4 manage the purchasing budget S5 lead purchase process improvement S6 analyse the energy efficiency and environmental-related aspects of a proposal S7 verify that purchasing processes respect legal issues including IPR	

D.5 Sales Proposal Development

1 Business area	D. Enable	
2. ID code, name and description	D.5. Sales Proposal Development Develops technical proposals to meet customer solution requirements and provide sales personnel with a competitive bid. Underlines the energy efficiency and environmental impact related to a proposal. Collaborates with colleagues to align the service or product solution with the organisation's capacity to deliver.	
3.Required proficiency level	L1	-
	L2	Organises collaboration between relevant internal departments, for example, technical, sales and legal. Facilitates comparison between customer requirement and available 'off the shelf' solutions.
	L3	Acts creatively to develop proposal incorporating a complex solution. Customises solution in a complex technical and legal environment and ensures feasibility, legal and technical validity of customer offer.
	L4	-
	L5	-
4.Required knowledge and skills K: is aware of S: is able to	K1 appropriate software programs / modules, DBMS and programming languages K1 customer needs K2 internally adopted sales and marketing techniques K3 legal requirements K4 internal business practices K5 product or service unique selling points K6 the different service models (SaaS, PaaS, IaaS) and operational translations (e.g., Cloud computing)	
	S1 construct the framework for proposal documentation S2 co-ordinate and facilitate multidisciplinary teams contributing to the proposal S3 interpret the terms and conditions of the tender documentation S4 evaluate the strengths and weaknesses of potential competitors S5 ensure that a proposal is of high quality and is submitted on time S6 communicates the energy efficiency and environmental-related aspects of a proposal S7 ensure that proposals meet compliance requirements	

D.6 Channel Management

1 Business area	D. Enable	
2. ID code, name and description	D.6. Channel Management Develops the strategy for managing third party sales outlets. Ensures optimum commercial performance of the value-added resellers (VARs) channel through the provision of a coherent business and marketing strategy. Defines the targets for volume, geographic coverage and the industry sector for VAR engagements and structures incentive programmes to achieve complimentary sales results.	
3.Required proficiency level	L1	-
	L2	-
	L3	Acts creatively to influence the establishment of a VAR network. Manages the identification and assessment of potential VAR members and sets up support procedures. VARs managed to maximise business performance.
	L4	Exploits wide ranging skills in marketing and sales to create the organisation's VAR strategy. Establishes the processes by which VARs will be managed to maximise business performance.
	L5	-
4.Required knowledge and skills	K1 the competition (what and where) K2 the market distribution across the field K3 sales channel typologies (e.g., direct sales, VAR, web marketing)	

K: is aware of S: is able to	K4 incentive policies K5 user experience of each channel type K6 legal issues relating to channels and VAR organisations
	S1 choose the best sales channel according to the product or solution being delivered S2 define discounts according to the competitive environment S3 select value added retailers based on thorough analyses, plan and make contacts S4 monitor and supervise channel performances in line with sales forecast and able to define corrective actions if necessary S5 apply digital marketing methods

D.7 Sales Management

1 Business area	D. Enable	
2. ID code, name and description	D.7. Sales Management Drives the achievement of sales results through the establishment of a sales strategy. Demonstrates the added value of the organisation's products and services to new or existing customers and prospects. Establishes a sales support procedure providing efficient response to sales enquiries, consistent with company strategy and policy. Establishes a systematic approach to the entire sales process, including understanding customer needs, forecasting, prospect evaluation, negotiation tactics, and sales closure.	
3.Required proficiency level	L1	-
	L2	-
	L3	Contributes to the sales process by effectively presenting products or services to customers.
	L4	Assesses and estimates appropriate sales strategies to deliver company results. Decides and allocates annual sales targets and adjusts incentives to meet market conditions.
	L5	Assumes ultimate responsibility for the sales performance of the organisation. Authorises resource allocation, prioritises product and service promotions, advises board directors of sales performance.
4. Required knowledge and skills K: is aware of S: is able to	K1 customer organisation (needs, budget allocation and decision makers) K2 company specific processes (sales, ITIL, etc.) K3 market trends and own service offering portfolio K4 legal, financial and contractual rules K5 project management procedures K6 current market imperatives, e.g., risks, changes, innovation	
	S1 explain and communicate the design / development to the customer S1 develop strong co-operation between customers and own organisation S2 keep abreast of market news, e.g., risks, changes, innovations and communicate to internal business units, to improve service and product portfolio S3 react proactively to customer business changes and communicate them internally S4 generate sustainable customer relationships S5 analyse sales performance to build forecasts and develop a tactical sales plan	

D.8 Contract Management

1 Business area	D. Enable
2. ID code, name and	D.8. Contract Management Provides and negotiates contract in accordance with organisational processes.

description	Ensures that contract and deliverables are provided on time, meet quality standards, and conform to compliance requirements. Addresses non-compliance, escalates significant issues, drives recovery plans and if necessary amends contracts. Maintains budget integrity. Assesses and addresses supplier compliance to legal, health and safety and security standards. Actively pursues regular supplier communication.	
3. Required proficiency level	L1	-
	L2	Acts systematically to monitor contract compliance and promptly escalate defaults.
	L3	Evaluates contract performance by monitoring performance indicators. Assures performance of the complete supply chain. Influences the terms of contract renewal.
	L4	Evaluates contract performance by monitoring performance indicators. Assures performance of the complete supply chain. Influences the terms of contract renewal.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 applicable SLA K2 company policy for contract management K3 legal regulations applicable to ICT contracts K4 legal issues including IPR K5 different service models (SaaS, PaaS, IaaS), service levels and contractual translations (e.g., Cloud computing)	
	S1 foster positive relationships with stakeholders S2 negotiate contract terms and conditions S3 apply judgment and flexibility in contract negotiations compliant with internal rules and policies	

D.9 Personnel Development

1 Business area	D. Enable	
2. ID code, name and description	D.9. Personnel Development Diagnoses individual and group competence, identifying skill needs and skill gaps. Reviews training and development options and selects appropriate methodology taking into account the individual, project and business requirements. Coaches and / or mentors individuals and teams to address learning needs..	
3. Required proficiency level	L1	-
	L2	Briefs / trains individuals and groups, holds courses of instruction.
	L3	Monitors and addressees the development needs of individuals and teams.
	L4	Takes proactive action and develops organisational processes to address the development needs of individuals, teams and the entire workforce.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 competence development methods K2 competence and skill needs analysis methodologies K3 learning and development support methods (e.g., coaching, teaching) K4 technology and processes K5 empowerment techniques	
	S1 identify competence and skill gaps S2 identify and recommend work based development opportunities S3 incorporate within routine work processes, opportunities for skills development S4 coach S5 address professional development needs of staff to meet organisational requirements	

D.10 Information and Knowledge Management.

1 Business area	D. Enable

2. ID code, name and description	D.10. Information and Knowledge Management. Identifies and manages structured and unstructured information and considers information distribution policies. Creates information structure to enable exploitation and optimisation of information. Understands appropriate tools to be deployed to create, extract, maintain, renew and propagate business knowledge in order to capitalise from the information asset.	
3. Required proficiency level	L1	-
	L2	-
	L3	Analyses business processes and associated information requirements and provides the most appropriate information structure.
	L4	Integrates the appropriate information structure into the corporate environment.
	L5	Correlates information and knowledge to create value for the business. Applies innovative solutions based on information retrieved.
4. Required knowledge and skills K: is aware of S: is able to	K1 appropriate software programs / modules, DBMS and programming languages K1 methods to analyse information and business processes K2 ICT devices and tools applicable for the storage and retrieval of data K3 challenges related to the size of data sets (e.g., big data) K4 challenges related to unstructured data (e.g., data analytics)	
	S1 explain and communicate the design / development to the customer S1 gather internal and external knowledge and information needs S2 formalise customer requirements S3 translate / reflect business behaviour into structured information S4 make information available S5 ensure that IPR and privacy issues are respected S6 capture, storage, analyse, data sets, that are complex and large, not structured and in different formats S7 apply data mining methods	

D.11 Needs Identification

1 Business area	D. Enable	
2. ID code, name and description	D.11. Needs Identification Actively listens to internal / external customers, articulates and clarifies their needs. Manages the relationship with all stakeholders to ensure that the solution is in line with business requirements. Proposes different solutions (e.g., make-or-buy), by performing contextual analysis in support of user centred system design. Advises the customer on appropriate solution choices. Acts as an advocate engaging in the implementation or configuration process of the chosen solution.	
3. Required proficiency level	L1	-
	L2	-
	L3	Establishes reliable relationships with customers and helps them clarify their needs.
	L4	Exploits wide ranging specialist knowledge of the customers business to offer possible solutions to business needs. Provides expert guidance to the customer by proposing solutions and supplier.
	L5	Provides leadership in support of the customers' strategic decisions. Helps customer to envisage new ICT solutions, fosters partnerships and creates value propositions.
4. Required knowledge and skills K: is aware of S: is able to	K1 emerging technologies and the relevant market applications K2 business needs K3 organisation processes and structures K4 customer need analysis techniques K5 communication techniques K6 "Story telling" techniques	
	S1 analyse and formalise business processes	

	S2 analyse customer requirements S3 present ICT solution cost / benefit

D.12 Digital Marketing

1 Business area	D. Enable	
2. ID code, name and description	D.12. Digital Marketing Understands the fundamental principles of digital marketing. Distinguishes between the traditional and digital approaches. Appreciates the range of channels available. Assesses the effectiveness of the various approaches and applies rigorous measurement techniques. Plans a coherent strategy using the most effective means available. Understands the data protection and privacy issues involved in the implementation of the marketing strategy.	
3. Required proficiency level	L1	-
	L2	Understands and applies digital marketing tactics to develop an integrated and effective digital marketing plan using different digital marketing areas such as search, display, e-mail, social media and mobile marketing.
	L3	Exploits specialist knowledge to utilise analytical tools and assess the effectiveness of websites in terms of technical performance and download speed. Evaluates the user engagement by the application of a wide range of analytical reports. Knows the legal implications of the approaches adopted.
	L4	Develops clear meaningful objectives for the Digital Marketing Plan. Selects appropriate tools and sets budget targets for the channels adopted. Monitors, analyses and enhances the digital marketing activities in an on-going manner.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 marketing strategy K2 web technologies K3 search engine marketing (PPC) K4 search engine optimisation (SEO) K5 mobile marketing (e.g., Pay Per Click) K6 social media marketing K7 e-mail marketing K8 display marketing K9 legal issues / requirements	
	S1 understand how web technology can be used for marketing purposes S2 understand User Centric Marketing S3 use and interpret web analytics S4 understand the on-line environment	

12.6.5 E.MANAGE

E.1 Forecast Development

1 Business area	E. Manage	
2. ID code, name and description	E.1. Forecast Development Interprets market needs and evaluates market acceptance of products or services. Assesses the organisation's potential to meet future production and quality requirements. Applies relevant metrics to enable accurate decision making in support of production, marketing, sales and distribution functions.	
3. Required proficiency level	L1	-
	L2	-
	L3	Exploits skills to provide short-term forecast using market inputs and assessing the organisation's production and selling capabilities.
	L4	Acts with wide ranging accountability for the production of a long-term forecast. Understands the global marketplace, identifying and evaluating relevant inputs

		from the broader business, political and social context.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 market size and relevant fluctuations K2 accessibility of the market according to current conditions (e.g., government policies, emerging technologies, social and cultural trends, etc.) K3 the extended supply chain operation K4 large scale data analysis techniques (data mining)	
	S1 apply what-if techniques to produce realistic outlooks S2 generate sales forecasts in relation to current market share S3 generate production forecasts taking into account manufacturing capacity S4 compare sales and production forecasts and analyse potential mismatches S5 interpret external research data and analyse information	

E.2 Project and Portfolio Management

1 Business area	E. Manage	
2. ID code, name and description	E.2. Project and Portfolio Management Implements plans for a programme of change. Plans and directs a single or portfolio of ICT projects to ensure co-ordination and management of interdependencies. Orchestrates projects to develop or implement new, internal or externally defined processes to meet identified business needs. Defines activities, responsibilities, critical milestones, resources, skills needs, interfaces and budget, optimises costs and time utilisation, minimises waste and strives for high quality. Develops contingency plans to address potential implementation issues. Delivers project on time, on budget and in accordance with original requirements. Creates and maintains documents to facilitate monitoring of project progress.	
3. Required proficiency level	L1	-
	L2	Understands and applies the principles of project management and applies methodologies, tools and processes to manage simple projects, Optimises costs and minimises waste.
	L3	Accounts for own and others activities, working within the project boundary, making choices and giving instructions, optimising activities and resources. Manages and supervises relationships within the team; plans and establishes team objectives and outputs and documents results.
	L4	Manages complex projects or programmes, including interaction with others. Influences project strategy by proposing new or alternative solutions and balancing effectiveness and efficiency. Is empowered to revise rules and choose standards. Takes overall responsibility for project outcomes, including finance and resource management and works beyond project boundary.
	L5	Provides strategic leadership for extensive interrelated programmes of work to ensure that Information Technology is a change-enabling agent and delivers benefit in line with overall business strategic aims. Applies extensive business and technological mastery to conceive and bring innovative ideas to fruition.
4. Required knowledge and skills K: is aware of S: is able to	K1 a project methodology, including approaches to define project steps and tools to set up action plans K2 technologies to be implemented within the project K3 company business strategy and business processes K4 development and compliance to financial plans and budgets K5 IPR principles and regulation K6 structured project management methodologies (e.g., agile techniques)	
	S1 identify project risks and define action plans to mitigate S2 define a project plan by breaking it down into individual project tasks S3 communicate project progress to all relevant parties reporting on topics such as cost control, schedule achievements, quality control, risk avoidance and	

	changes to project specifications S4 delegate tasks and manage team member contributions appropriately S5 manage external, contracted resources to achieve project objectives S6 optimise project portfolio timelines and delivery objectives by achieving consensus on stakeholder priorities

E.3 Risk Management

1 Business area	E. Manage	
2. ID code, name and description	E.3. Risk Management Implements the management of risk across information systems through the application of the enterprise defined risk management policy and procedure. Assesses risk to the organisation's business, including web, cloud and mobile resources. Documents potential risk and containment plans.	
3. Required proficiency level	L1	-
	L2	Understands and applies the principles of risk management and investigates ICT solutions to mitigate identified risks.
	L3	Decides on appropriate actions required to adapt security and address risk exposure. Evaluates, manages and ensures validation of exceptions; audits ICT processes and environment.
	L4	Provides leadership to define and make applicable a policy for risk management by considering all the possible constraints, including technical, economic and political issues. Delegates assignments.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 corporate values and interests to apply risk analysis taking into account corporate values and interests K2 the return on investment compared to risk avoidance K3 good practices (methodologies) and standards in risk analysis	
	S1 develop risk management plan to identify required preventative actions S2 communicate and promote the organisation's risk analysis outcomes and risk management processes S3 design and document the processes for risk analysis and management S4 apply mitigation and contingency actions	

E.4 Relationship Management

1 Business area	E. Manage	
2. ID code, name and description	E.4. Relationship Management Establishes and maintains positive business relationships between stakeholders (internal or external) deploying and complying with organisational processes. Maintains regular communication with customer / partner / supplier, and addresses needs through empathy with their environment and managing supply chain communications. Ensures that stakeholder needs, concerns or complaints are understood and addressed in accordance with organisational policy.	
3. Required proficiency level	L1	-
	L2	
	L3	Accounts for own and others actions in managing a limited number of stakeholders.
	L4	Provides leadership for large or many stakeholder relationships. Authorises investment in new and existing relationships. Leads the design of a workable procedure for maintaining positive business relationships.
	L5	-
4. Required	K1 organisation processes including, decision making, budgets and management	

knowledge and skills K: is aware of S: is able to	structure K2 business objectives, own and of other stakeholders K3 how to measure and apply resources to meet stakeholder requirements K4 business challenges and risks
	S1 deploy empathy to customer needs S2 identify potential win-win opportunities for customer and own organisation S3 establish realistic expectations to support development of mutual trust S4 monitor on-going commitments to ensure fulfilment S5 communicate good and bad news to avoid surprises

E.5 Process Improvement

1 Business area	E. Manage	
2. ID code, name and description	E.5. Process Improvement Measures effectiveness of existing ICT processes. Researches and benchmarks ICT process design from a variety of sources. Follows a systematic methodology to evaluate, design and implement process or technology changes for measurable business benefit. Assesses potential adverse consequences of process change.	
3. Required proficiency level	L1	-
	L2	
	L3	Exploits specialist knowledge to research existing ICT processes and solutions in order to define possible innovations. Makes recommendations based on reasoned arguments.
	L4	Provides leadership and authorises implementation of innovations and improvements that will enhance competitiveness or efficiency. Demonstrates to senior management the business advantage of potential changes.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 research methods, benchmarks and measurements methods K2 evaluation, design and implementation methodologies K3 existing internal processes K4 relevant developments in ICT (e.g., virtualisation, open data, etc.), and the potential impact on processes K5 web, cloud and mobile technologies K6 resource optimisation and waste reduction	
	S1 compose, document and catalogue essential processes and procedures S2 propose process changes to facilitate and rationalise improvements S3 implement process changes	

E.6 ICT Quality Management

1 Business area	E. Manage	
2. ID code, name and description	E.6. ICT Quality Management Implements ICT quality policy to maintain and enhance service and product provision. Plans and defines indicators to manage quality with respect to ICT strategy. Reviews quality measures and recommends enhancements to influence continuous quality improvement.	
3. Required proficiency level	L1	-
	L2	Communicates and monitors application of the organisation's quality policy.
	L3	Evaluates quality management indicators and processes based on ICT quality policy and proposes remedial action.
	L4	Assesses and estimates the degree to which quality requirements have been met and provides leadership for quality policy implementation. Provides cross-functional leadership for setting and exceeding quality standards.
	L5	-

4. Required knowledge and skills K: is aware of S: is able to	K1 marketing strategy K1 which methods, tools and procedure are applied within the organisation and where they should be applied K2 the IS internal quality audit approach K3 regulations and standards in energy efficiency and e-waste
	S1 illustrate how methods, tools and procedures can be applied to implement the organisation's quality policy S2 evaluate and analyse process steps to identify strengths and weaknesses S3 assist process owners in the choice and use of measures to evaluate effectiveness and efficiency of the overall process S4 monitor, understand and act upon quality indicators S5 perform quality audits

E.7 Business Change Management

1 Business area	E. Manage	
2. ID code, name and description	E.7. Business Change Management Assesses the implications of new digital solutions. Defines the requirements and quantifies the business benefits. Manages the deployment of change taking into account structural and cultural issues. Maintains business and process continuity throughout change, monitoring the impact, taking any required remedial action and refining approach.	
3. Required proficiency level	L1	-
	L2	Evaluates change requirements and exploits specialist skills to identify possible methods and standards that can be deployed.
	L3	Provides leadership to plan, manage and implement significant ICT led business change.
	L4	Applies pervasive influence to embed organisational change.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 digital strategies K2 the impact of business changes on the organisation and human resources K3 the impact of business changes on legal issues	
	S1 analyse costs and benefits of business changes S2 select appropriate ICT solutions based upon benefit, risks and overall impact S3 construct and document a plan for implementation of process enhancements S4 apply project management standards and tools	

E.8 Information Security Management

1 Business area	E. Manage	
2. ID code, name and description	E.8. Information Security Management Implements information security policy. Monitors and takes action against intrusion, fraud and security breaches or leaks. Ensures that security risks are analysed and managed with respect to enterprise data and information. Reviews security incidents, makes recommendations for security policy and strategy to ensure continuous improvement of security provision	
3. Required proficiency level	L1	-
	L2	Systematically scans the environment to identify and define vulnerabilities and threats. Records and escalates noncompliance.
	L3	Evaluates security management measures and indicators and decides if compliant to information security policy. Investigates and instigates remedial measures to address any security breaches.

	L4	Provides leadership for the integrity, confidentiality and availability of data stored on information systems and complies with all legal requirements.
	L5	-
4. Required knowledge and skills K: is aware of S: is able to	K1 the organisation's security management policy and its implications for engagement with customers, suppliers and subcontractors K2 the best practices and standards in information security management K3 the critical risks for information security management K4 the ICT internal audit approach K5 security detection techniques, including mobile and digital K6 cyber attack techniques and counter measures for avoidance K7 computer forensics	
	S1 document the information security management policy, linking it to business strategy S2 analyse the company critical assets and identify weaknesses and vulnerability to intrusion or attack S3 establish a risk management plan to feed and produce preventative action plans S4 perform security audits S5 apply monitoring and testing techniques S6 establish the recovery plan S7 implement the recovery plan in case of crisis	

E.9 IS Governance

1 Business area	E. Manage	
2. ID code, name and description	E.9. IS Governance Defines, deploys and controls the management of information systems in line with business imperatives. Takes into account all internal and external parameters such as legislation and industry standard compliance to influence risk management and resource deployment to achieve balanced business benefit.	
3. Required proficiency level	L1	-
	L2	-
	L3	-
	L4	Provides leadership for IS governance strategy by communicating, propagating and controlling relevant processes across the entire ICT infrastructure.
	L5	Defines and aligns the IS governance strategy incorporating it into the organisation's corporate governance strategy. Adapts the IS governance strategy to take into account new significant events arising from legal, economic, political, business, technological or environmental issues.
4. Required knowledge and skills K: is aware of S: is able to	K1 the ICT infrastructure and the business organisation K2 the business strategy of the company K3 the business values K4 the legal requirements	
	S1 manage applicable governance models S2 analyse the business context of the company and its evolution S3 define and implement appropriate KPI's S4 communicate the value, risks and opportunities derived from the IS strategy	

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