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D2.7 Teacher's Guide

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Abstract

This deliverable provides an overview of helpful organisational, assessment, design and teaching approaches, examples of best practices, and practical tips for educators when employing a distance learning model while delivering the MSc in Industry 4.0 course. D2.7 covers four main issues:

1. Organise at strategic level,
2. Evaluate and Improve at a strategic level,
3. Use the Distance Learning model,
4. Manage the course via Quality Assurance.

The first part of the report presents the organisational aspects of the course that are primarily related to the capacity of the HEI (and the specific educational structure in particular) that delivers the course. Insights of the processes needed to design an action plan for efficiently delivering the course are provided (with efficiency being viewed strategically at an institutional and academic department level). The Action Plan is a blueprint that ensures the delivery of a quality course, aligned with institutional objectives and goals, and supported by an evaluation process for continuous improvement.

The second part describes the basic principles of the evaluation process, providing high-level guidelines for the assessment of teachers, learners, processes, methods and technology.

The third part focuses on the use of the educational material, as an enabler of didactic methods, for delivering the MSc course through a distance learning model. Several best practices or designing and using digital educational content are presented.

The fourth part presents a complete Quality Assurance framework for managing the course lifecycle from design to delivery and improvement.

1 Organisational aspects of the MSc course

1.1 Organisational purpose and objectives

This report aims to describe a specific methodology for the efficient implementation of the educational process for MSc Industry 4.0 and suitable educational practices based on international experience.

As a first step of the implementation process, each institution (that will provide the MSc course) must clarify its medium and long-term goals:

- How does the MSc in Industry 4.0 fits in the institution's strategic objectives, and which are the specific goals to be achieved?
- What needs to be done to achieve these goals?

The above questions can be made more specific at the School, Curriculum, Department, and Course level. First of all, having in mind the highly competitive environment that every institution operates (in terms of approaching new students and the professional development of graduates), an easy and logical answer to the first question is: "the goal is to increase the quality of studies". Indeed, quality studies are a competitive advantage for any HEI. This goal should be broken down into sub-goals in, at least, the main parameters that contribute to its achievement. The identification of these parameters and how they are managed should be achieved systematically (i.e. using a methodology), based on feedback and continuous improvement through evaluation.

To this end, some initial actions should take place:

1. the selection of priorities and the prioritization of the objectives that the institution considers realistic and necessary for the improvement of the quality of the educational work through the MSc in Industry 4.0 course,
2. the selection and formulation of action plans for the realization of the selected objectives and the strengthening or improvement of the quality of specific aspects of the educational model,
3. the identification of the essential elements of the action plans and the control of the parameters that contribute to the effective implementation of the course (schedules, implementation methodology- implementation strategies, resources, and means, organizational structures, planning procedures for monitoring and evaluating the action plan (s), success criteria, etc.).

It is therefore clear that the design and implementation of the MSc is multi-levelled (involving several educational structures: the Institution, Schools, Departments, courses) but also multi-dimensional, including the following axes:

- The educational process: how the teaching takes place and thus how Industry 4.0 topics are learned,
- The teaching staff
- The educational means
- The infrastructure

The educational structure responsible for implementing the MSc course is the sum of resources, tangible and intangible, that are involved in the delivery of the course (academic structure, academic staff, processes, equipment, internal and external stakeholders etc.).

1.2 Methodology

The methodology is based on the design of action plans, i.e., MSc improvement/efficiency delivery plans, based on good practices for the individual axes. The successful delivery of such a demanding and innovative program as the MSc in Industry 4.0, is not simple. The first step in designing an Action Plan, is the precise definition (boundaries) of the educational structure that will implement the course, an implementation that needs to serve the strategic goals of the HEI.

To this end, the educational structure responsible for delivering the course should identify fundamental weaknesses and strengths of the course implementation. Tools such as a SWOT analysis can help towards this end. This process is based on an assessment procedure, which ideally produces specific conclusions about the structure's strategic goals and what should be corrected or what is not working correctly. The evaluation, additionally to the members of the teaching staff, should also involve other members of the academic community (e.g., student representatives, administrators, external stakeholders) so that the actions that are planned have the acceptance of all stakeholders of academic life and at the same time strengthen their commitment for the successful implementation of the MSc course.

Typical strengths that can be explored include:

- Flexibility

- Convenience
- Quality of teaching staff
- Cutting Edge aspect of the Curriculum

Typical weaknesses that can be explored include:

- Lack of Industry 4.0 infrastructure
- Weak links with the industry
- The small number of practical assignments
- Not suitable learning material

Typical threats that can be explored include:

- Competition
- Weak assessment that prohibits improvement

Typical opportunities that can be explored include:

- Differentiation of the MSc course in terms of the application areas offered.

Participants should gather and record the priorities for action that emerged from the evaluation. This recording aims to study, prioritize, and finalize the activities that the structure will implement during the next academic years.

1.3 Analysis

The MSc Industry 4.0 Action Plan (AP) is a short and clear text outlining a set of activities by which the structure (e.g. at a department level) answers the critical question 'What should and how should it be done? do we provide a quality MSc Industry 4.0 training program? '.

The AP is a working document that guides the academic community members to systematically organize various initiatives and activities to improve specific areas of the course. Its purpose is to ensure the validity and effectiveness of the course in all phases of its implementation. In particular, it enables the educational managers to:

- focus on specific actions related to the improvement of the course,
- effectively organize the required activities,
- determine the resources (human and financial), as well as the support needed to implement the action,
- ensure continuous monitoring of progress and final evaluation of the course.

After prioritizing and making the appropriate decisions, the stakeholders are divided

into Working Groups and draw up detailed action plans, i.e., to draw up sets of instructions that will guide the actions of the Unit and answer the question "what and how should do it, to achieve the desired result".

Other members of the academic community may participate in each Working Group as mentioned above. In particular, during this phase, the participants, after taking into account the results of the internal evaluation, determine for each Action Plan:

- the objectives for the specific action. The goals should be specific, clearly define the desired outcome of the action plan, be realistic and achievable.
- the success criteria for each goal, based on which the structure will evaluate if the goal was achieved and to what extent. These may be qualitative or quantitative, depending on the nature of the objective to which they relate to. In each case, however, they need to be specific to facilitate the monitoring and evaluation of the degree of achievement of the objectives.
- the methodology of implementation, i.e., the specific methods and actions that will allow the effective implementation of each objective, the specific contribution of each factor, as well as the organizational structures (division of responsibilities, mechanisms of cooperation and coordination Action Plan) and the necessary formative interventions in the institution.
- the timetable in which the time required for the successful implementation of the Action Plan is designed. The design of the schedule must be realistic, i.e., consider the structure's specific capabilities and identified priorities.
- the resources and means required for the effective implementation of the course, which vary according to the nature of each action and include:
    - the human resources necessary to implement the course per year (working group meetings, training seminars, etc.),
    - the logistical equipment (consumables, supervisory means, rooms, technological equipment, etc.),
    - financial resources (cost of materials, visits, etc.),
    - action monitoring and evaluation tools (calendars, plans observation forms, recording forms, questionnaires, interview plans, etc.),
    - the sources that will be used for data collection.
- the monitoring and evaluation procedures, with a description of the evaluation

plan that the structure will use to assess the progress and results of the action.

- the person in charge of the Action Plan, i.e., the person who will be responsible for the whole organization and delivery of the MSc course, the coordination of the actions, the distribution of the activities, the monitoring, and the evaluation.

The 'formulation of priorities for action' and the 'formulation of the action plan are followed by transposing the techniques into practice, monitoring their implementation, and evaluating their effectiveness.

The Working Group that formed each plan is responsible for the implementation of the action plans. It has the primary responsibility for organizing, supporting, monitoring the course's progress, and evaluate its effectiveness.

Each Working Group determines a way of systematically recording the delivery of the course. During this stage, the team implements the plan in practice and carries out the activities designed for its effective implementation.

The practical implementation of each action plan requires continuous and systematic monitoring of its progress to examine:

- whether the course of the action plan is in line with the objectives set from the outset,
- whether and to what extent the intermediate or final results relate to the established success criteria,
- the degree of progress achieved,
- the quality of teamwork and the contribution of everyone involved in the implementation of the course,
- if the teachers' time, financial resources, and material, which were provided during the planning of the course, are sufficient for its effective implementation.

Such an examination may give rise to the need for some adjustments or changes in time, resources, implementation strategies, or evaluation procedures.

The implementation phase of each action plan is completed with the overall evaluation of its implementation by the Working Group. Using the group diary as a bases, as well as the sources and methods mentioned in the action plan, the Working Group attempts to answer the question 'what progress have we made?' by evaluating:

- the actions are taken,
- the results of the various actions to the objectives set (did they improve what they needed to improve?),
- the consequences of the actions to the general operation and the educational achievements of the structure or the HEI.

Each Working Group prepares a short text on the action and its effectiveness and informs the other groups about the course and results of its efforts. These texts are used in an Annual Internal Evaluation Report.

An essential element in educational planning is the planning and implementing a realistic and achievable number of actions (better results result from minor and focused efforts) and the involvement of as many academic actors as possible in their implementation. The following should also be taken into account when setting priorities for action:

a) between short-term (less than one year) and long-term priorities,

b)between planning new priorities for action and 'consolidating' the results of actions already implemented,

c) between fundamental (linked to "infrastructure" actions) and secondary priorities, as the former provides the basis for the latter's development.

1.4 Indicative Development Framework of the Action Plan

The following is an indicative framework for the development of the action plan. The framework aims to assist working groups in the effective planning and successful implementation of the various actions for implementing the MSc in Industry 4.0 course.

Each HEI can adapt the framework's elements to the specific objective of the course it intends to implement and its particularities. It should be noted that the design and effective implementation of action plans depends mainly on the "culture" and the particular circumstances prevailing at the HEI (e.g. based on institutional regulations or national policies and frameworks).

The primary purpose of the action plans included in this report is to support and enhance the creation of the necessary "infrastructure" through the active participation of all stakeholders. Also, given that some academic departments do not

have much experience in internal evaluation or educational planning, priority and emphasis should be given, among other things, to topics such as theory and workshop coordination, use of ICT in education, group projects, strengthening collaborative practices between trainers, connection to the labour market, etc.

The proposed framework of the action plan includes the following:

1. The necessity of the implementation of the action plan
2. The purpose and objectives of the action plan
3. The criteria for the success of the action
4. The methodology for the implementation of the action plan
5. The resources and the instruments of the action plan
6. The timetable for the performance of the action plan
7. The procedures for monitoring and evaluation of the action plan
8. The report of the results of the action plan.

2 The Educational Process

2.1 Effectiveness of the teaching staff

The effectiveness of the teaching staff should be evaluated on a semester basis by the students through questionnaires, based on the standard questionnaires of the respective national quality evaluation unit of the HEIs.

Teacher's evaluation process (by student).

The relevant questionnaire should:

1. be uniform for all courses and relate to the theoretical and laboratory part.
2. be anonymous.
3. The questionnaires should be distributed during the lesson between the 8th and 10th week of teaching for students to complete.

Application process.

The method of application of the procedure is considered very important. Therefore, the steps to be followed by the people who are involved in the course are the following:

1. The team members who have collected the questionnaires distribute the questionnaires together with folders where the course (theoretical or laboratory), the semester, the responsible teacher, and the date are written in advance.
2. They quickly explain the purpose of this action and the process, answer any clarifying questions and leave the room with the teacher.
3. They will enter after 15 minutes and collect the questionnaires.
4. The questionnaires are placed in an envelope, which is sealed.
5. After collecting the questionnaires from all the courses, the department takes care of entering the students' answers into a spreadsheet.
6. The data is processed below. The processing is limited to calculating the frequencies of the answers to each question for the whole section.

A well-structured questionnaire should include questions such as the following:

1. **Organization and presentation of the course material**

   The bibliography that the teacher gives and presents to the student should be studied in depth. Lectures should be well organized in academic units, and the presentation should be done with the most modern technological means, thus

causing more interest to the student. The use of e-class is also considered essential.

2. **Creating interest in the subject of the course**

The student's interest in the lesson must be continuous. For this reason, a great deal of effort is required from the teacher to stimulate the student's interest.

3. **Analysis and presentation of the concepts of the course simply and understandably. Use of examples.**

It is helpful to understand that difficult concepts and not only concepts are presented clearly. Modern audio-visual media can play an essential role in this. Multimedia applications, 3d animations.

4. **Encourage students to formulate questions and queries so that they can develop their judgment.**

   For the course to become attractive on the part of the teacher, he/she should also ask questions to the audience, thus obliging the student to be an active member during the lesson and ask questions. Students should be encouraged to ask questions.

5. **Consistency in the teacher's obligations (attendance at classes, timely correction of assignments or laboratory reports, hours of cooperation with students).**

   Although the trainer's workload, in addition to his teaching duties, such as administrative work, participation in committees, etc., is significant, he must be consistent in his obligations. Possible inability to meet the needs of students due to the minimal number of instructors that exist in the respective Departments.

6. **Level of Teacher / Learner relations.**

The relationship between faculty and students should be as strong as possible. No controversy should be observed. Any problems should always be resolved in the best consensual way, without extremes.

2.2 Quality and efficiency of the teaching process

2.2.1 Methods used

In the most significant percentage of courses, a mixed teaching model is followed, which promotes, as much as possible, the use of student-centered methods but also the utilization of the group practice, and includes:

- Synchronous, i.e., face-to-face teaching using the physical infrastructure of the department and application of teaching methods such as lectures, laboratory exercises, learning based on homework.
- Support of the educational process through the use of modern technology and the internet. Use of LMS, VLE, multimedia applications, projector.

2.2.2 Update the content of the courses and teaching methods

The teachers should update the range of the courses. The starting point for the above procedure is the reform of the Postgraduate Program by a Committee. Through their research activities and their collaboration with other institutions, teachers identify such a need.

At the course level, each teacher must modify the notes distributed or republish textbooks adapted to current data from time to time.

2.3 Organization and implementation of the teaching project

2.3.1 Announcement of the course material at the beginning of the semester

The detailed outline of each course is included in the MSc Industry 4.0 Study Guide, which is distributed to students upon their first enrollment. It is possible to extract the relevant information from the website of each Department. The first lesson focuses on getting to know the students and providing information about the lesson in the classroom. With the help of LMS / VLE, the teacher presents a plan of at least 13 lectures.

Especially for the Laboratory courses, at the beginning of each semester with the reception of the students in the laboratory, the teachers present in detail the content of their courses, share the rules of the laboratory, and answer the questions of the interested parties, to contribute to their correct orientation. With the help of the e-class, the teacher presents a plan of at least 13 laboratory exercises.

2.3.2 Description of learning objectives of the courses and expected results

Learning objectives and expected outcomes are an integral part of the course description. They are communicated to the students in the context of the above actions and in the courses' initial sessions. Therefore, the correct depiction of the educational process and the achievement of the expected learning objectives should be based on the following axes:

1. Clarity of course objectives
2. Organization and Response of the material to the objectives of the course
3. The necessity of prerequisite courses
4. Use of knowledge from / connection with other courses
5. Level of difficulty of courses depending on their year of study
6. The necessity of existence and evaluation of the quality of tuition
7. Transparency of grading criteria
8. Elaboration of assignments in the context of courses
9. Guidance on the preparation of the work and quality of the supervisor's comments - Possibility to improve the work
10. Result of a career in understanding the subject

2.3.3 Achieving learning objectives of the courses and expected results

Learning objectives and expected outcomes are an integral part of the course description. They are communicated to the students in the context of the above actions and in the courses' initial sessions. The "measurement" of the achievement of learning objectives can and should be done through:

- Activities organized by the teacher within the course
- Statistics such as those resulting from the completion of appropriate questionnaires by students

2.3.4 Keeping a schedule

The universal observance of the program schedule is an integral part of proper development and continuous improvement of the educational process.

The final, validated schedule is posted on the bulletin board and the Department's website. Teachers must comply fully with this throughout the academic semester.

2.3.5 Proper organization of the schedule

A well-structured curriculum should meet the following criteria:

- The teaching of theoretical lessons should be carried out in the morning zone
- The combination of laboratory and academic courses per day should depend on their severity and degree of difficulty to create as little student fatigue as possible.
- Laboratory classes should be conducted in both the morning and afternoon zones to serve working students
- The avoidance of significant teaching gaps in the daily program of each semester is also of great importance. This will result in as much continuous monitoring as possible and ensure a good percentage of free time for study and other activities.
- An essential criterion for the success of a well-structured timetable is the avoidance of overlap of the teaching hours of theoretical and laboratory courses of the same semester. For different semesters, this is not difficult enough to achieve due to the limited number of classrooms.

2.3.6 Correct matching of teaching staff and courses offered

Academic staff members participating in the Department's MSc Industry 4.0 (permanent and non-permanent) should teach courses that fall within their narrow or broader field of knowledge. If the research-scientific area they specialize in is relevant to the course being introduced, it is considered to belong to the narrow cognitive field of the teachers.

2.3.7 Organization and efficiency of the workshops

The following axes should guide the correct organization and efficiency of the workshops:

1. Adequacy of notes regarding laboratory exercises.
2. Explanation of the basic principles of the exercise.
3. Adequacy of laboratory equipment.
4. Level of difficulty of the laboratory for the year.

2.4 Educational aids

2.4.1 Types of aids offered

The educational process should be supported by several types of learning material, which should be distributed to students. Items such as:

- Books that will be selected as primary textbooks for each course and will be available from the institution.
- Teacher notes in printed form. It is considered particularly important for laboratory courses (e.g., laboratory guides).
- Electronic bibliography and links to international databases should be provided where students can find information about the study.
- For all courses, there should be a suggested bibliography available in the library of the institution.

The aids that will be distributed to the students, in their various forms, will cover the whole of the taught material.

2.4.2 How and when should the aids be available?

Aids should be available as soon as possible. It is best to have them available at the beginning of the educational process. Bureaucratic agents often prevent their immediate distribution. At the level of notes, things are more straightforward as the departments maintain warehouses with sufficient copies.

2.4.3 Bibliographic support in addition to the distributed books

The learner must be provided with bibliographic support in addition to this distribution of books. Bibliographic support is considered particularly important for the in-depth study of the subject of studies. The teaching staff should provide support through the institution's library. The continuous enrichment of the educational material of the library (purchase of new volumes, educational applications). Proper guidance of students for the acquisition of knowledge from libraries of other institutions with related subjects. It is also important to use free and public online resources by teachers and learners.

2.5 Utilization of new technologies in teaching

2.5.1 Use of new technologies in theoretical teaching

Classrooms should be equipped with computers and projectors. Thus, the teacher will have electronic equipment at his disposal to promote his subjects and take advantage of all the possibilities that modern technology provides. With the help of programs, educational videos have been created for several courses of the study program. Material that should be used for the best presentation of the taught material. Additional electronic aids available in the free trade or on the internet can complement the educational process. There should be an internet connection in the classrooms so that a topic can be studied in real-time in the presence of teachers and students. Creating a website in the VLE / LMS for the course can contribute to the educational process. The instructor can enrich the course website with educational material to meet any needs.

2.5.2 Use of new technologies in the conduct of laboratory teaching

Laboratories should be equipped with computers and presentation equipment (projectors). Thus, the teacher will have electronic equipment at his disposal to promote his subjects and take advantage of all the possibilities that modern technology provides. With the help of programs, educational DVDs have been created for several laboratory courses of the curriculum. Material that should be used for the best presentation of the taught material. Additional electronic aids available in the free trade or on the internet can complement the educational process. There should be an internet connection in the laboratory so that a topic can be studied in real-time in the presence of teachers and students.

2.6 Improving teaching

2.6.1 Approaches to improve educational activity

From the moment teachers are hired with the expectation of helping and supporting the educational activity, it is taken for granted that they must be given the necessary supplies to be able to achieve their goals.

Just as students deserve guidance, so do teachers need guidance in their teaching. No matter how good a teacher is in the amphitheater or the laboratory, there is always room for improvement. As effective as a teaching method is, it can be upgraded.

The question of what effective teaching is cannot be answered entirely. However, the basic materials for effective teaching are generally known. The main ones are:

1. the in-depth knowledge of the subject
2. the ability to communicate and motivate students
3. enthusiasm for the subject of teaching and learning
4. the purity of the presentation and the objectivity

The activities that should take place during the development of a well-trained teacher may include the following actions:

1. Programs to develop teachers' teaching skills to be effective for different students and various educational goals. Including skills for the proper use of other teaching methods, skills in the use of modern technology, and "discipline" in the teaching of specific principles and materials
2. Programs to build bridges between the teacher's knowledge and what the learner is trying to gain. Learners differ in experience, way of thinking, and motivation. For these reasons, only one educational method cannot be used. It takes skill for the teacher to be able to identify any peculiarities in a classroom and how to approach them
3. Specific capacity-building programs involve developing interpersonal relationships with students. It is essential for a student to feel that the teacher cares for him. Studies show that the most successful teachers are available to students both in and out of the classroom.
4. Teachers need to differentiate the way they teach depending on their teaching level—differentiation in teaching for introductory courses at the undergraduate and teaching courses in postgraduate programs.
5. Teachers need to improve by using the experience they gain as they teach.
6. The continuous encouragement of the teaching staff to support, evaluate, and assist in teaching others is also considered necessary. These can be achieved through collaboration on teaching based on making the educational activity as efficient as possible.

7. Procedures that will provide information to teachers about the ability to teach. This approach is critical. The data is usually done by the evaluation of the educational process by the students. Teaching ability can be improved by discussing with a more experienced colleague who can evaluate the results, encourage, and suggest teaching improvement strategies.

Teachers may need different types of help depending on the level at which they are (lecturers, deputies….). For example, new teachers may need help teaching, creating tests. Those in the middle of their academic career may need help to make the best possible use of new technologies in education. Those at the highest level could be the mentors for the younger colleagues.

2.6.2 Characteristics of a successful teaching program

For the implementation of MSc Industry 4.0 in host institutions to be successful, the following features of a successful curriculum must be present:

- The program follows the culture of the institution
- To be structured for different philosophies, to cover the peculiarities regarding personal preferences, schedules, and ways
- To be supported openly and clearly by the heads of departments
- Use teams of consultants to plan and run the program
- The program to "embrace" all types of teachers, not only ineffective but also effective
- To enable teachers to participate as equal members and to allow them to take the initiative to form a well-structured teaching capacity
- Involve as many staff members as possible in the design and operation of the program
- To promote the enthusiasm of the staff for knowledge production. To monitor any changes in the courses, any strategies, and methodologies that are developed and to publish them

- The program should be shaped through honest dialogue between the teachers. Any changes to be achieved with the most significant possible consent
- Recognize and reward excellence in teaching

2.7 Classification of teaching techniques

A pilot study was conducted at the Massachusetts Institute of Technology to classify (numerically) 10 teaching methods. The results are presented below, as they are helpful for the adoption of good practices that will be presented in section 4.

2.7.1 Classification of 10 methods by the students of the Departments of Economics and Engineering

Teaching method	School of Economics	School of Engineering
Well organized lectures	1 (74%)	1 (80%)
Preparing students for exams by organizing special lectures	2 (39%)	3 (39%)
Collection of information from students about what they have learned, what has confused them, etc.	3 (37%)	4 (38%)
Setting course objectives and plan from the beginning of the semester	4 (32%)	5 (37%)
Requesting and making changes to the course, based on student feedback	5 (30%)	6 (31%)
Quick correction of assignments, written exams	6 (29%)	2 (44%)
Providing examples of excellent exam answers, excellent work	7 (29%)	8 (28%)
Enabling students to correct their grade before final enrollment	8 (24%)	9 (24%)
Having a formal agenda for each lecture	9 (23%)	7 (29%)
Dialogue in groups in each lecture	10 (20%)	10 (16%)

2.7.2 Classification of 10 methods by the students of the Departments of Economics and Engineering based on the year

Teaching method	2nd Year	3rd Year	4th Year
Well organized lectures	1 (71%)	1 (78%)	1 (79%)
Preparing students for exams by organizing special lectures	2 (42%)	2 (48%)	4 (32%)
Collection of information from students about what they have learned, what has confused them, etc.	3 (38%)	3 (36%)	2 (35%)
Setting course objectives and plan from the beginning of the semester	6 (32%)	5 (31%)	3 (33%)
Requesting and making changes to the course, based on student feedback	7 (24%)	9 (22%)	6 (30%)
Quick correction of assignments, written exams	4 (36%)	4 (36%)	4 (32%)
Providing examples of excellent exam answers, excellent work	5 (33%)	7 (29%)	7 (24%)
Enabling students to correct their grade before final enrollment	8 (23%)	8 (28%)	9 (20%)
Having a formal agenda for each lecture	3 (22%)	6 (30%)	8 (22%)
Dialogue in groups in each lecture	10 (13%)	10 (15%)	10 (17%)

2.8 Advantages/disadvantages of VLEs

The main advantages of using the VLE (Virtual Learning Environment) to deliver the MSc course can be summarized as follows:

Advantages	
Extended access to learning	Learners around the world can access VLE at any time and as many times as they want.
Scalability	VLE can be easily distributed with minimal or no cost.
Support of educational material	They can efficiently function as supporting material for conventional forms of educational material (textbooks, lecture notes, etc.), enriching it significantly.
Reinforcement of educational material	They can enrich the conventional educational material with alternative forms of audiovisual material, thus making it more attractive and easier to learn.
Fast spread	They allow the rapid dissemination of information in contrast to the traditional peaks of printed material, thus increasing the effectiveness of the transmitted educational content.
Reduce costs for learners	In contrast to the traditional printed educational material, the supply of which in many cases is expensive, VLE reduces and even eliminates the cost of course materials for students.
Promoting innovation and talent	A broad audience can learn through the research interests and experience of an academic institution. In addition, prospective sponsors and students can be impressed, thus increasing the chances of enrolling in one of the offered departments or study programs.
Contact with graduates	Providing open access to an academic institution's VLE allows it to keep in touch with its students at a lifelong learning level.

Continuous improvement of resources	VLE can be improved faster, unlike traditional printed material, either by editing them by users or submitting comments to the institution that provides them. Instructors can also modify existing VLE parameters during teaching and make it readily available for use by other partners.

The main disadvantages of using the VLE can be summarized as follows:

Disadvantages	
Quality issues	Since many VLE repositories allow their users to create an account to post their material, many of the resources submitted may be irrelevant or even unsuitable for the intended use.
Lack of human interaction between teachers and learners	Many VLE are designed to be independent of the instructor's presence, based on self-directed learning. Therefore, a significant part of the teacher-learner interaction, necessary in some cases, is left out of this process.
Language and cultural barriers	Although efforts are being made to spread VLE, most of them are still available in English, making their widespread spread problematic. In addition, the cultural criteria of LMS intake play a critical role in their functionality and use/non-use.
Technological issues	Some VLEs may require high-speed internet, which learners may not have. Other VLEs may require special software that learners cannot obtain and use, either because of their high cost or their incompatibility with the operating system they use.
Intellectual property issues	To the extent that VLE s are intended for extended and open use, copyright issues that may significantly limit

	their widespread dissemination and use should be taken seriously.
Sustainability issues	To the extent that VLE creators do not receive any money for their work, there is a risk of a lack of incentive to upgrade LMS or ensure their availability on the internet.

Theoretically, at the educational/technological level, the advantages/disadvantages of using a VLE are summarized in the following points:

Advantages	
Accessibility	A VLE can be accessed from anywhere (WiFi, Internet, off-line). This feature in itself is not exceptional. But the simplicity of the software (and the educational services offered) makes a VLE accessible to any user,
Design ease	A VLE can be quickly produced using simple software (web camera, simple video editing, etc.) The design does not refer to the creation of the material from an educational point of view.
A mixture of formal and informal education	Usually, a VLE is designed with (many) formal learning principles, while the learning process itself (learning enaction) occurs as non-formal education.
Conditions for attendance	A VLE does not require registration, and virtually anyone can watch.
Lifelong education	It is considered a powerful tool of Lifelong Learning due to its open nature.

The disadvantages or challenges come mainly from the lack of experience to analyze how learning is achieved through a VLE. Several researchers with expertise in designing an LMS report that the relevant scientific field offers many exciting research problems of an educational and technological nature, capable of feeding generations of Ph.D. candidates in the coming years. On the other hand, skeptics and too much

publicity for the project (which they consider partly unscientific). They ask a series of questions that need to be answered to prove (theoretically and in practice) the educational and financial viability of VLEs. Of course, the open problems of this initiative do not necessarily constitute disadvantages once solved. The main ones are summarized in the following nature table:

Open Problems	
Design of educational material	Designing a VLE for teaching at post graduate is a complex process. At present, the structure of a typical University course is followed. A fact that offers validity to the study is a pole of attraction. At the same time, there is also relevant experience from teaching in a typical environment. It is generally expected that this configuration will be maintained for marketing reasons as well. However, the design of the training material, which admittedly should be careful and completed before the start of the course, is the most challenging phase of designing a VLE. Therefore, most of the open issues described below are directly or indirectly related to the educational material and the educational process in general. Today, it has not yet been determined how the training material of a VLE is designed because it is not precisely understood how a learner learns in a VLE.
Evaluation	It is not easy to design the evaluation, especially if the VLE goes to the next phase of its business model, where certification will be supported. In the current configuration, the assessment is unsupervised, so the trainee is responsible for adhering to the academic code of conduct. However, suppose certification (with the

	payment of a fee) is to be supported. In that case, it must be kept either in person (with examinations such as in classical institutions) or in some other way. Intermediate solutions are already in use (e.g., a specific period for completing an exercise once its solution has begun). In this case, there are several open issues regarding the design of the online evaluation, given that evaluation is unsupervised: • how it relates to educational goals, • what load it should have, • Or how the good ones are distinguished from the average students (e.g., in a multiple-choice exercise, this distinction is usually lost).
Learning rate	What is the pace of learning? The first VLE courses follow a slower pace of education than the corresponding University Courses. However, the main comment of the trainees after a lesson was the "suffocating" deadlines for the exercises. Therefore, a balance should be struck so that the trainees are not discouraged from the first weeks (and drop out), but also the pace is not too slow because the excellent trainees are discouraged (who will eventually complete it). In other words, it is crucial to maintain the value of the course due to the reputation of the Institution that offers it. An essential difference between the first VLE and the open courses is that the first ones are not offered throughout the year, and not every trainee can complete them whenever he wants and at any rate he desires. This is due to the following factors:

	▪ a VLE may be unsupervised in assessment and teaching, but it is supervised in support. Thus, instructors observe its evolution on the one hand to offer help (e.g., in the five most popular questions) and on the other hand to evaluate the educational performance of the course. ▪ A VLE is also offered as an aid to the University students who provide it. ▪ The evaluation material should be constantly updated as it is done in the classical Universities. However, this renewal is costly, and the point at which it will take place (e.g., each time the course is taught) must be specified. Furthermore, VLEs, which does not renew its material, reduces its credibility as an educational tool based on a renowned institution's reputation.
LMS Duration	What is the duration of a course provided through a VLE? The simple answer "as long as it takes to teach the material" raises new questions (concerning, for example, the definition of the material, the pace of learning, etc.). The first MOOCs (a popular form of VLEs) last about as long as a University course (7-13 weeks). The duration depends on the volume of material to be taught, the workload in total and per week, the availability of support staff. The first samples tend to emulate a VLE with a classical University course at least 50% -60% of the material, load, and duration.
Unsupervised training	Training in a VLE may be largely unsupervised due to a large number of trainees. The big problem is the lack of contact between the trainee and the trainer and how

	another mechanism will replace it. Education theorists argue that this absence is irreplaceable. Indirect ways to replace it so far are the following: ▪ Answer the most popular questions per unit by the teachers who supervise the course, ▪ Collaboration between learners who are encouraged to form workgroups (and supported by related software features), ▪ The meticulous design of the educational material to minimize the gaps that create questions (eg to be explanatory in difficult places, using references or examples, etc.) Research should offer other ways. In any case, individualized education cannot be provided even in classical Universities (ratio of teachers/students usually> 1/100).
Creating and managing communities	It has been observed that, learners usually form workgroups on their initiative using third-party services (the first virtual study support groups have already been created). Groups are formed based on geographical, social, or racial characteristics. The groups are not manageable by the teachers and probably should not be (and for workload reasons) from the first samples.
Creation of material by the trainees	Although it was proposed as a critical feature of open and personalized training, it does not apply to a VLE. The reasons are serious: ▪ The material over time would become bulky and the finding process stressful,

	▪ The validity of the material would be questionable, which would irreparably affect the credibility of the course, ▪ The material should be concise, concise, and educationally complete at a higher level than that used anywhere else, due to the profile of the trainees: anyone with basic computer skills, lacking time, seeking learning without expecting a tangible reward (e.g., .x. certification).
Maintaining the interest of learners	How to maintain the interest of learners who are not committed to complete the course while the reasons for dropout are many. A course supported by a VLE, to maintain an acceptable success rate (approximately 20% of the original subscribers), will have to "excel" in many areas: • in the quality of the material, • in the transmissibility of knowledge, • the interest of the taught object (and how it is transmitted to the learners), • the practicality of the introduced thing (usefulness) concerning the real needs of the trainees (e.g., connection with the needs of the market, lifelong learning needs of groups of the population, etc.)

3 Distance Learning Content – Best practices

3.1 The educational content as a didactic method enabler

The MSc in Industry 4.0 course uses the Distance Learning model which is highly dependent on the educational material (EM) used. The EM should be designed to incorporate the didactic approach, assessment, feedback, multiple learning paths, and guides to further reading. The following sections describe best practices for creating and using EM for distance learning, a model that is directly applicable to the Industry 4.0 curriculum.

The role of ICT. Information Technology in Education - ICT (from the internet and electronic texts to specialized e-learning systems) is a respectable percentage of teaching practices using corresponding traditional teaching practices and methods. Still, a rapid increase in their use is expected, as directly related to the Labor Market and its needs in this area.

The role of new technologies in education and their forms of influence have at least two dimensions:

- form a new learning object to acquire basic skills that then affect the way of teaching in general and the conditions of professional employment of the individual
- are a unique learning tool that differentiates access to knowledge and learning processes, forming new learning frameworks.

The role of the coding medium is considered equally important. The standard evaluation elements of the printed material and audiovisual media are related to the content and mainly to the scientific validity of the displayed knowledge. At the same time, this material is evaluated in terms of its relationship with the curriculum, its scope, and its suitability to the age of the trainees. In addition, however, special attention needs to be paid to its technical features, as electronic texts are read more slowly than traditional texts. Still, the high resolution of the image ensures efficient reading from the screen. Also, the possibilities of technology (split images, sudden color and lighting changes, artistic in and out) should attract the trainees' interest in the most critical points of the taught chapters.

3.2 The modern educational material

Having now adopted a digital form, educational material presents a complexity that should be analyzed before adopting its evaluation methods. Especially the electronic educational material cannot always be treated as simple information as it may contain embedded functionality (active content) or be inextricably linked to the media (as in wikis). Also, the need for even a simple shell to provide simple functionality (for example, an internet browser is required to access educational material in the form of web pages) can distract designers and creators from the actual quality goals.

The dissemination medium (seemingly not directly related to the educational material) significantly affects the critical dimension of Quality in Use, i.e., the user's reaction when using it. For example, reading digital books on different sized screens can range from satisfactory to unbearable. Therefore, the dissemination medium is evaluated together with the material, the system together with the data.

Essential questions to be answered are:

1. when a type of training material has built-in functionality
2. when a variety of educational material is so closely connected to the means of dissemination that they do not stand out in quality and
3. how easily we can distinguish the educational material and the educational software.
4.

3.3 Best practices for using educational material in distance learning

3.3.1 Structure and Content

3.3.1.1 Instruction 1: The EV should be clear

Description:	Education Material intended for distance learning should be written differently from that intended for classical education. The main difference lies in the absence of constant contact between trainers and trainees and explaining the material through lectures (physical presence). Although there are no instructions on how to write a good text for distance learning, it should be written in simple, explanatory words where needed

	and clear. As long as the text does not require pre-requisite knowledge, it should be understood mainly by the evaluator.
Implementation:	The evaluation should be done by sampling (it is not possible to check all the text sections. Some selection is selected). If a potential problem is identified, the evaluation is extended.
Remarks:	The process is influenced by the type of subject being evaluated (for example, Mathematics is more challenging to assess than a general text for Business Administration).

3.3.1.2 Instruction 2: The EM should be Short

Description:	A text should be short in the sense of non-repetition of information, adequately describing the object without unnecessary repetition and irrelevant information.
Implementation:	Like that described in the previous directive. The evaluator should identify possible quality failures such as: • the text is tedious to study (continuous text without examples, images, figures), • constant citation of definitions without standards, • the text arouses reduced interest (it is indifferent).
Remarks:	These factors are primarily subjective to this, and this component is difficult to assess.

3.3.1.3 Instruction 3: The EM should be up to date

Description:	A text should be relevant in the sense of describing the object according to modern literature.
Implementation:	Check the dates of the sources mentioned in the text or the bibliography. If the sources are repeatedly outdated (at least five years before the current date) by more than 75%, there may be a quality problem.

	It should be pointed out to the author.
Remarks:	The age of the springs is not necessarily problematic. But usually, there should be a variation that follows the normal distribution around a relatively recent date.

3.3.1.4 Instruction 4: The EM should be Complete

Description:	A text should be complete in the sense of educational completeness: it should contain all the necessary information so that the student can fully (or satisfactorily) study the subject.
Implementation:	**4.1 Listing of pre-required knowledge** If the study of the text requires pre-requisite knowledge, these should be reported in detail. Optionally, some repetitive exercises or activities may be included at the beginning of the chapter to remind students of basic pre-requisite concepts. **4.2 Listing of sources from the Internet** In addition to quoting books, quoting sources from the internet is also recommended. It has been proven in practice that students will hardly buy extra books from the trade (in the current economic situation). If books are available in the library, it would be good to mention this. If a source is quoted from the internet, its content, educational purpose, and time needed for its study should be noted. **4.3 Further Study Guide** The study guide includes additional resources (usually books) that can be used for in-depth study. For each source, complete bibliographic details should be given, the purpose for which the specific source is proposed, and the expected result from its use.
Example	**4.1 Example of repetitive activity**

The following text helps the student to remember knowledge taught in a previous Thematic Unit of the same Curriculum through an activity. The purpose (repetition, reminder), the medium (activity), and the educational goal (theory related to sound propagation) are described.

"But before proceeding to the presentation of all this new data, let us remember some basic knowledge through the elaboration of the following activities: Activity 2.1 This activity will help you to remember basic knowledge from the propagation of sound in the free space and is related to the prediction of ambient noise. First, calculate the absorption of a sound whose energy is distributed in the octave of 2kHz, when propagated in the air for 1000m, at a temperature of 20o C and humidity of 50%, according to the Sutherland formula, as described in Chapter 2 of volume "Introduction to Soundproofing and Sound Protection Methods."

4.2 Example of a source reference from the Internet

The following text helps the student to decide whether to visit the additional source on the internet. The site owner, the content (briefly), the time, the educational object, and an alternative study object is mentioned.

More information on project management can be found at the following internet resources:

- **Project Management Institute** The website of the internationally recognized PMI Institute. Contains articles, regulations, and standards for project management. If you have about 1 hour, you can study the standard 2011 Human Resource Management regulations that deepen the concepts in section 4.3. If you have more time, study the examples of suitable applications (success stories) that are of particular

	practical interest. Website Address: http://www.pmi.org/ **4.3 Example of a Further Study Guide** In the following example, the guide suggests two books for further study. For each one, the expected result/learning goal is briefly analyzed. **GUIDE FOR FURTHER STUDY** **1. Grammatikakis G.,** *The Autobiography of Light*, Heraklion 2009. A substantial deepening of this book will allow for multifaceted contact with aspects of culture related to light, freeing up mental processes and productive interactions. **2. Arnheim R.,** *Visual Thought*, University Studio Press, 2007. This book offers rich material on aesthetics in the field of art. The information you gather will reveal a kaleidoscopic view of light in the visual arts.
Remarks:	1. The use of 4.1 consists in the introductory chapters of the volumes, where the students are introduced to the subject under study.

3.3.1.5 Instruction 5: The EM should be Reliable

Description:	A text should be credible in terms of the validity of the information it provides. This component is evaluated mainly by the Critical Reader since it concerns the scientific content. The expert's contribution to the ACE is: • the ability of the text to enable the student to fulfill all the stated learning objectives/results, • the validity of external sources.
Implementation:	**5.1 Learning Outcome Satisfaction Test**

	It is implemented through two complementary actions: • A sampling of the text: selecting part of the stated learning objectives and their satisfaction check: There should be explicit nominal references within the text and the corresponding information for each learning objective. • Use a checklist (with the corresponding name, e.g., Study Effectiveness Evaluation or Expected Results Evaluation) at the end of each chapter. The list checks if the student reached the learning outcomes after studying the chapter. If it did not arrive (optional), necessary instructions are given. These results are based on what was mentioned at the beginning of the chapter but are analyzed in more detail since the student, after the study, has deepened the relevant concepts. **5.2 Examination of external sources** Check all hyperlinks in the text or the literature. Invalid links should be identified and reported.
Example:	**5.1 Sampling control of learning outcomes** The following example successfully tests one of the many stated learning objectives. Learning Outcomes By completing the study of this chapter, you will be able to: • name the seven quality control tools, • define the two main methods of continuous improvement in quality assurance • …. …. Section 5.1 Quality and continuous improvement The literature suggests continuous quality improvement in small steps through education and quality problem-solving.

	There are two main methods of constant improvement in quality assurance: • PDSA cycle and • Benchmarking The PDSA cycle is implemented through 4 basic steps and is iterative…. The learning objective is optionally stated as part of a unit or sub-unit to be easily identified. The goal is clearly stated in the text using the same expression as at the beginning of the chapter and the relevant information. **5.1 Checklist Example** The following example lists a checklist. The expected results are generally reported at the beginning of the chapter. **Expected Results** Once you have completed the study of this chapter, you will be able to: • name the seven quality control tools, • define the two main methods of continuous improvement in quality assurance, • draw Pareto diagrams • … **Knowledge Checklist** After completing the study in Chapter 4, please return to the expected results and check whether you can: • name the seven quality control tools and identify where and when each is used, • draw a Pareto diagram and combine it with the cause-effect method, • …
Remarks:	Complete control in 5.1 depends on the learning objectives.

3.3.1.6 Instruction 6: Resources should be Accessible

Description:	It has to do with the ease with which an average student can access the sources suggested in the literature or the study guide. Authors should be encouraged to include resources (books) available in the EAP library (access through the relevant digital service) or other institutions' libraries. When references in the literature include scientific papers or foreign language books, the DOI (Digital Object Identifier) or ISBN should be cited. An optional hyperlink may also be available if it links to a known publisher's website (to ensure its stability).
Implementation:	• Check all references (sources) for the existence of DOI or ISBN.
Examples:	The following example provides the full details for a scientific paper in the context of a chapter bibliography. **Bibliography** S. S. IOUTAS (2012). Managing Unmanaged Data in Cloud Services: a loglgologN hash algorithm. In Data and Internet of Things, 1 (1). DOI: 324.34.535. https://www.acm.org/DIT/1.1/undata.pdf

3.3.2 Presentation

3.3.2.1 Instruction 7: The EM should be Legible

Description:	Proper organization of the presentation of the text and the organization of the information is an essential factor in increasing the educational effectiveness of the material.
Implementation:	**7.1 Emphasis on concepts, definitions**

	It is essential to highlight the points that the student should emphasize through appropriate text formatting or context. The concepts mentioned in the list of keywords at the beginning of each chapter should be relatively easily identified within the text either by sub-section headings or by special markup. **7.2 Include shapes or images** The use of shapes or images is appropriate for explaining concepts and examples, increasing students' interest. The check is done at the following points: • The figures should be precise, adequately explained in the text, and include the appropriate caption with a brief description. • The sharpness of the shapes is essential. Therefore, the printing is done (except in rare cases) in shades of green and not in color. In case important information is lost, it should be noted, and special consultation should be made whether it is possible to print in color or not. • check if the shape or image is mentioned in the text and its meaning is adequately explained. For example, simple references such as "this method is shown in Figure 15" are often unacceptable. Instead, the shapes should be described. • the caption of the figure should be short (since its use is explained in the text). If it is an image, the source should be mentioned. • the language of the text in the figures should be Greek except in exceptional cases. • The shapes should be computer-designed and not handwritten.

<table>
<tr><td></td><td>7.3 Including Tables
The use of tables summarizing particularly dense information described earlier in a section is essential. Recommended in cases where:
• there is a categorization of concepts, bibliography, methods, etc.,
• explain information that is classified/grouped into two or three dimensions,
• measurements or numerical data are presented.
7.4 Use of uniform standards for bibliographic declaration
The literature should be declared with the APA standard.</td></tr>
<tr><td>Examples:</td><td>Emphasis on concepts
In the following example, a key concept (and keyword of the chapter) is highlighted with bold letters and center alignment:
Ο γενικός ορισμός του έργου είναι ο παρακάτω:
Έργο (project) είναι ένα προσωρινό εγχείρημα που στοχεύει στη δημιουργία ενός μοναδικού προϊόντος, υπηρεσίας ή αποτελέσματος.
Παραδείγματα έργων είναι
This way, it is easy to find by the student.
Summary of information with table
In the following example, a table summarizes the analysis of the methods presented earlier in the form of text:
The following table summarizes the analysis of quality analysis techniques and their key characteristics:
<table><tr><th></th><th>Technique</th><th>Result</th></tr><tr><td>1</td><td>Pareto diagram</td><td>Basic causes</td></tr><tr><td>2</td><td>Taguchi diagram</td><td>Causes</td></tr><tr><td>3</td><td>Flow chart</td><td>Recording of procedures</td></tr></table></td></tr>
</table>

3.3.2.2 Instruction 8: The EM should be structured so that it can be understood

Description:	The HOU Curricula use detailed study schedules at the day level. Therefore, the correct structure of the text in sections and sub-sections of the right size facilitates understanding the concepts, correctly categorizing the knowledge, and allowing the gradual evaluation.
Implementation:	Subsections (depth heading 2) should not be too large (e.g., 7-8 pages). This makes it difficult for students to consolidate knowledge. There should (where possible, and usually is) structured sub-sections of at most 3-4 pages with the corresponding exercises and activities.
Remarks:	

3.3.3 Educational Suitability

3.3.3.1 Instruction 9: The EM is Suitable

Description:	It refers to the suitability of the EM to fulfill the educational goals for which it was designed. These objectives do not refer to the content but to the methodology used. In particular, the following characteristics should be displayed: • encouraging critical thinking • learning through practice, • incitement to conduct research, • connection with actual events and circumstances, and more generally active learning characteristics. The correct use of the time the student spends on learning concepts or engaging in learning activities is also checked. Examples (solved exercises) are an essential tool for teaching and understanding the material. They complete the self-

	assessment exercises educationally. Writers should be encouraged to use them where needed. Finally, the existence of learning paths is checked. Their presence is limited to the incorporation of different difficulty self-assessment exercises or activities. The difficulty of any such action should be noted by the author if there is variation.
Implementation:	**9.1 Active Learning Features** The assessor should check if the EV contains activities where requested by the student: • the search for sources of information, • information synthesis and critical reading, • the composition of small studies (essays). At least one activity of one of the above three types (or mixed) is required in each module with a heading of depth 2. If the subject of the EM allows it, the practical exercises are highly encouraged. **9.2 Control of the time required for Active Learning activities** Each activity should explicitly state the approximate time needed to complete it. **9.3 Detection of learning paths** Each chapter should contain self-assessment exercises of different difficulty (at least medium and increased difficulty). The restriction does not apply to the Activities (which are generally considered relatively increased difficulty). Exercises should not be simplistic or very easy (trivial). **9.4 The EM should contain examples** If there are self-assessment exercises, there should be corresponding solved examples. The directive does not apply to self-assessment exercises of multiple-choice, combinations of concepts, theoretical questions, and those containing arithmetic calculations, technical applications, etc.

Examples:	**9.1 An activity that requires search and critical thinking** The next activity is internet search, information synthesis, and critical thinking. The approximate time required is given, and a tip is given (help -tip). **Activity 5.3** Look for additional resources on Quality Control and Quality Assurance techniques. Then write a 250-word text summarizing the differences between the two concepts regarding their practical value in modern public administration organizations. What differences would you find if the application was for private companies? This activity takes about 35 minutes to complete. We suggest using the Google search engine with the keywords the search terms. The next activity is not worded correctly. **Activity 1.1** Read the book "Quality Control Handbook" and identify the difficulties of implementing quality control. This activity asks students to read the whole book to answer. The time of completion of the action is not given. A more correct (and enriched with features of active learning) formulation of the activity is: **Activity 1.1** Read sections 1.3 and 2.8 of the Quality Control Handbook for the difficulties of implementing quality control. Compare the findings with those in Table 1.4 of your book. Express your opinion on the differences and similarities you notice. Where do you think they are due? This activity takes about 1 hour to complete. **9.3 Self-assessment exercises of different difficulty**

	The following two exercises concern the same unit, but they are of different difficulty (the first is medium, and the second is more complex). **Self-assessment exercise 2.1** A company will have to decide whether to change its essential equipment in 3, 6 or 9 years. Every year that waits, the price of new equipment increases by 8% compared to existing, the cost of using old equipment increases by 1%. Draw the decision tree and calculate the appropriate path. **Self-assessment exercise 2.2** What will happen in the case of exercise 2.1, if the decision to be taken by the company takes into account the reaction of the competition? In case the company buys new machines, the competition will reduce prices by 4% per year. How does the decision tree change? The following exercise is considered simplistic and should be avoided: **Self-assessment exercise 3.1** Is the following statement correct? "*External quality control costs are more expensive than internal ones.*" □ True □ False
Remarks:	**1.** Where the depth heading module is small (e.g., does not include sub-modules or critical concepts to be tested), the requirement of Directive 9.1 becomes optional. **2.** The degree of difficulty of a self-assessment exercise need not be stated in the pronunciation but as stated in the solution.

3.3.4 Self-assessment, Feedback

3.3.4.1 Instruction 10: The EM contains Feedback

Description:	Self-assessment exercises and activities are among the main teaching aids in distance education. They should be designed very carefully to provide appropriate feedback due to the lack of physical contact between trainee and trainer. Evaluating the quality of input of EV is one of the main tasks of the specialist in ACE. Each exercise (and especially each activity) should contain feedback, i.e., point out to the student the points to focus on and their importance. Students who have failed to complete a problematic exercise successfully should be offered a way out. This is done with paranoid reasons and tips on how to get out of the knowledge impasse (e.g., additional resources on the internet, repetition of a specific section, etc.).
Implementation:	Checking the responses of each self-assessment exercise and each EM activity for: • Report on the educational goal, • analytical solution (in self-assessment exercises), • solution model or critical points of the solution (in the activities), • information on the level of difficulty, • tips for removing the cognitive impasse.

Examples:	The answer to the following exercise states at the beginning the educational goal, specifying. It offers a reward to the student who managed to solve the exercise stating its level of difficulty. It provides a way out of the cognitive impasse using the different study guides. The importance of the learning goal to which the exercise is linked is emphasized. **Self-Assessment Exercise Answer 2.1** This exercise aims to familiarize you with the design of control charts for quality control of services according to the ISO17000 standard and, in particular, the issue of feedback. The first step you need to take to solve the exercise is to …… … .. Suppose you managed to draw the diagram correctly, and in particular, you managed to identify the problematic point regarding the feedback of the process. In that case, it means that you are well acquainted with quality control. Well done! This exercise was a bit difficult. If you failed, do not worry, you probably need to invest a little more time developing your ability to analyze processes. You can repeat section 2.1.1 by emphasizing example 2.2. Seek additional information from the other study guide in the 2nd report, which contains several similar examples. It is essential to understand the basic principles of charting because they are considered critical elements of the audit process. Therefore, you will need them in the following chapters, which examine non-deterministic quality assurance techniques. The following activity response analyzes the critical points of the answer and provides feedback. **Activity Response 5.8**

	In this activity, you were asked to briefly analyze the view of light according to Plato, from source 1 of the Bibliography. Plato's work is of insurmountable importance since it is considered by many to be the forerunner/background of the whole…. …. Suppose your answer identified these four main points of Plato's view, then well done! You have precisely specified, in this sub-section, the activity request. If you have not found them all, it does not matter; it is worth re-reading, now in a different light, section 3.1 of the relevant source. After completing the activity, you may have been interested in reading Chapter 4 of source 1 to determine how Plato's vision laid the foundations for the Renaissance views of light. A critical view of the Platonic view and its variations over time (with particular emphasis on 20th-century culture) can be found in source 4 of the Further Study Guide.. The last paragraph enriches the activity by stimulating the interest of the students. The activities must challenge the students to further research and deepen an object, using the guide for further study.
Remarks:	1. It is essential to offer a natural way out of the cognitive impasse caused by the failure to solve an exercise, especially if it is linked to a meaningful learning goal. For example, the mere urge to repeat a section is usually not enough. The guide for further study or additional resources listed in the exercise solution is the appropriate route. 2. The solution should emphasize any difficult points by analyzing them in more detail. 3. From the examples, it is clear that the author should design a chapter so that all its components (learning objectives,

	material, assessment, feedback, further study) are closely linked. Their loose connection gives an ungrateful EM.

3.3.4.2 Instruction 11: Linking assessment to learning objectives

Description:	Self-assessment should be closely linked to all learning objectives. This is not self-evident to the writers. Evaluating the quality of this connection is the primary responsibility of the MEA specialist. Essential points of the evaluation are: – Learning objectives are stated at the beginning of each chapter or section. – The achievement of general learning objectives related to concepts can be tested through multi-question self-assessment exercises. – The consolidation of knowledge is achieved through practical exercises (problem-solving). – Building and expanding knowledge through activities.
Implementation:	**1.** Examine whether all learning objectives are assessed by at least one self-assessment exercise. **2.** Examine if at least one activity is used after the central unit (where many learning objectives are supposed to be cured). **3.** Examine if there is at least 1 exercise at the end of each primary unit, which combines multiple learning objectives simultaneously. Suppose there is no need to ask the author if this was impossible (e.g., because of the subject).

	4. Examine whether some simplistic exercises or exercises do not control stated learning objectives.
Examples:	In the following example, a self-assessment exercise simply controls a learning outcome: **Learning outcomes:** By completing this chapter, you will be able to: – name the seven quality assurance tools – etc ... – … .. **Self-assessment exercise 4.2** Which of the following tools belong to the list of 7 quality tools: A. Cause-Effect Diagrams B. Taguchi Charts C. Ax and knife. D. None of the above. In case more complex concepts need to be tested, self-assessment exercises can be used that repeat solved examples of the text or extend them by focusing on difficult points that require critical thinking to be translated. In the following example, the consolidation of a technique is checked thoroughly: **Self-assessment exercise 4.6** What will happen if, in example 2.4, the temperature value changes from -5C to + 5C? How will the torque be affected? The next self-assessment exercise combines two learning outcomes stated at the beginning of the chapter: **Learning outcomes:** By completing this chapter, you will be able to: – calculate the Present Value (TSA) based on the annual capital flow,

	– calculate the ROI of an investment, – … **Self-assessment exercise 3.3** A company will have to decide whether to invest in the purchase of a new information system. There are three alternatives…. …. Using the results of applying the TPA techniques of section 3.1.1 and ROI of section 3.1.2, what is the best solution of the three?
Remarks:	1. The types of exercises to be used vary depending on the learning objectives. Some favor the activities (Positive Sciences) while others do not so much. 2. It is unnecessary to have a self-assessment exercise after each sub-section (depth of heading 3) unless the author deems it necessary to test some important concept. 3. It is better to group the exercises close to the sections where the corresponding primary material is (and not, for example, at the end of a large area altogether). The study is done weekly, and there is a case of interference of a significant, educational period between the study of the material and exercise.

4 Quality Assessment of the Distance Learning methodology

4.1 Foundation

The quality assessment of the MSc in Industry 4.0 program is based on the ESG (Standards and guidelines for quality assurance in the European Higher Education Area)[1], the recent research made by the MOOQ project[2], and international ISO standard ISO/IEC 40180.

4.2 Methodology

The following tables present the F Quality Checklist with leading questions for all three dimensions: the phases and processes, the perspectives, and the roles. The Quality Checklist asks important questions and is intended for both novices and experts in a DL course design and development. Therefore, the Quality Checklist serves as a starting point and a reminder of each ESG standard's critical issues.

Some processes or some of their quality indicators are pre-specified and (partly or entirely) defined by pre-conditions and requirements (e.g., the available resources, budget, and staff).

The phases and processes are based on the adapted international ISO standard ISO/IEC 40180 (former ISO/IEC 19796-1).

The following symbols, where applicable, are used:

- For the phases: "A" is a phase, and "A-1" is a process
- For the perspectives: (P) = Pedagogical - (T) = Technological - (S) = Strategic/Business
- For the roles: R = Responsible - X = Involved

[1] https://enqa.eu/index.php/home/esg/

[2] Stracke, C. M., Tan, E., Texeira, A., Pinto, M., Vassiliadis, B., Kameas, A., Sgouropoulou, C., & Vidal, G. (2018). *Quality Reference Framework (QRF) for the Quality of Massive Open Online Courses (MOOCs)*. Online available at www.mooc-quality.eu

4.3 Policy for Distance Learning Quality Assurance

P1: *Institutions should have a policy for Distance Learning (DL) quality assurance made public and forms part of their strategic management. Internal stakeholders should develop and implement this policy through appropriate structures and processes while involving external stakeholders.*

The Analysis phase for a DL QA policy is as follows:

P1A	Analysis of DL Quality Assurance policies	Designer	Facilitator	Provider
P1A-1	Initiation • Who has to be involved to kick start the DL QA planning and development? (P) (T) (S) • Which QA policy examples from the past exist, if any? (P) (T) (S) • What is the envisaged timeframe? (P) (T) (S)			R
P1A-2	Stakeholder identification • Which different types of stakeholders are involved in the formation of the DL QA policy? (S) (e.g., learning designers, authors, experts, media designers, developers, technology providers, technical support, facilitators, evaluators, managers, board members, HR, marketing, public authorities, learners, customers, partners, others)			R
P1A-3	Definition of objectives • What are the general QA policy objectives? • What are our general economic objectives? (S) • What are our general strategic objectives? (S)			R
P1A-4	Needs and demand analysis • What are the needs and demands of the HEI for a DL QA policy? • What are the needs and demands of the market? (S)			R

	• What are the demands of other stakeholders? (S)			
P1A-5	Analysis of the external context • Which legal conditions or laws exist that affect the design, implementation, and realization of the QA policy? • Which evaluation, approval, certification, or accreditation is required? (S)			R
P1A-6	Analysis of the organizational context • Which internal departments and units of the HEI are involved? (S) • Which pedagogical principles exist? (P) (S) • Which spatial requirements exist? (P) (S) • Which technology requirements exist? (P) (T) (S) • Which economic specifications exist? (S) • Which strategic requirements exist? (S)	X		R
P1A-7	Time, resources, and budget planning for QA policies • What is the timeframe? (S) • Which staff categories are required? (S) • Which internal staff can be deployed? (S) • Which external staff has to be recruited or commissioned? (S) • Which budget is available? (S) • How is the budget allocated? (S) (e.g., staff, external contracts, technology, marketing) • Is a detailed financial plan including a return on investment calculation and cost-benefit analysis developed? (S)	X		R

The design phase is as follows:

P1D	Design of QA policies	Designer	Facilitator	Provider
P1D-1	Define Objectives of QA policy • What are the short-term, medium-term and long-term quality objectives? (P) (S) • How are they defined? (P) • How are they assessed? (P) (S)	R	X	X
P1D-2	Define organizational concept and roles • How does the policy timeline look like? (P) (T) (S) • Which roles are defined for each activity? (P) • Which types of activities require what kind of support? (P) (T) • How are all roles and staff coordinated? (P) (T) (S) • How is openness and free access guaranteed? (P)	R	X	X
P1D-3	Design concept and methods • What are the critical determinants that affect the decisions on QA concepts and methods? (P) • Which methodologies are used? (P) • How are the principle and methods communicated to the stakeholders? (P) • How is the policy supported by IT? (P) (T) • How are inclusion and equity guaranteed? (P) (T)	R	X	X
P1D-4	Define communication concept • Which communication concept will be followed? (P) (T) • Which support is required for the different types of communication? (P) (T)	R	X	
P1D-5	Define interaction concepts • Which types of interaction will be used with the stakeholders? (P) (T) • How will the interaction be designed? (P)	R	X	

	• Which support is required for the different types of interaction? (P) (T)			
P1D-6	Define feedback concepts • Which types of feedbacks will be given to which stakeholders? (P) (T) • How and when will the feedbacks be provided to which stakeholders? (P) • Which support is required for the different types of feedback? (P) (T)	R	X	

The influence of internal and external stakeholders is maximised during the initiation and design phases. Their influence is exponentially reduced as time passes and the policies are developed and delivered. Stakeholder influence increases again when policies are re-designed.

4.4 Design and approval of DL courses

P2: *Institutions should have processes for the design and approval of their DL courses. The courses should be designed so that they meet the objectives set for them, including the intended learning outcomes. The qualification resulting from a course should be clearly specified and communicated and refer to the correct level of the national qualifications framework for higher education.*

The Design and approval phase for a DL course is as follows:

P2D	High level design of a DL course	Designer	Facilitator	Provider
P2D-1	Define the Learning objectives (P) (S) • Define learning objectives based on the desired learning outcomes (e.g., acquisition of specific knowledge and skills) (P) (S) • Define learning objectives (P) (S) • Define target-group driven learning objectives (e.g., entry level in relation to content, IT competency, prior experience in online and e-learning environment) (P) (S)	R	X	X

	• Define learning objective(s) by the week, topic, lesson, sub-module, skill, competences, activity, task etc. (if applicable) (P) • Involve external stakeholders in the process • Define workload (e.g. in ECTS)			
P2D-2	Define organizational concept and roles (P) (T) (S) • Set up a team of content experts (with pedagogical coordinators) and technical experts (P) (T) (S) • Define all roles required for the DL course (P) (T) (S) • Assign content experts to lead each theme, module, unit (if applicable) (P) (S) • Assign facilitator(s) and define facilitation tasks (P) (S)	R	X	X
P2D-3	Define an approval process • Form a committee including external stakeholders • Define metrics and standards to measure the course proposals	R	X	X

4.5 Student-centered learning, teaching and assessment of DL courses

P3: *Institutions should ensure that the DL courses are delivered in a way that encourages students to take an active role in creating the learning process, and that the assessment of students reflects this approach.*

According to this guideline, the courses should be carefully designed and delivered to the learners ensuring sufficient assessment procedures. Three main phases are identified: student centred design, course delivery and course assessment.

The student centred design phase of a DL course is as follows:

P3D	Student centered design of a DL course	Designer	Facilitator	Provider
P3D-1	Define didactical concept and methods (P) (T) Define critical determinants of didactical approaches: Content, learning objectives and target learners. (P) (T) Following are some of the didactical approaches used in DL (list is not exhaustive): • Combination of different design principles: 4CID, cognitive apprenticeship and network learning • Learner-centered • Network-based • Competence-based • Task-based • Active-learning oriented • Interactive-based approach • Experiential learning • Problem-based approach: case study • Lectured-based approach: direct instruction using video lectures • Specialised content (stimulations and problem solving) Define learning pace, personalisation and monitoring progress (P) (T)	R	X	X

P3D-2	Define concept for content (P) (T) (S) • Adopt a needs-driven approach (e.g., specific procedures to assess the market demand for a DL course and its content) (P) (S) • Consider target learners and groups, motivation and entry levels (content knowledge and IT competence) (P) (T) (S) • Align learning objectives with course content and course duration (duration of 6 to 8 weeks is recommended) (P) (S) • Structure content (based on entry levels and prior knowledge – beginners, intermediate or advanced; novices, experts; size – units, modules) (P) • Ensure instructional alignment of course: learning objectives, module objectives, activities and assessments (P) (T) • Identify possible certification for different levels of completion (if applicable) (P) (S)	R	X	X
P3D-3	Define concept for learning activities (P) • Provide the following (if relevant; based on chosen pedagogical approach and instructional design) (P) • Range of varied activities to engage and to motivate learners • Authenticity of tasks in real life setting • Activities that promote transfer of learning and application • Hands-on activities • Simulations to facilitate experiments • Educational games (e.g., can be linked to case studies) • Peer-review activities	R	X	X

	• Interviews and interaction with practitioners and field experts • Webinars • Interactive activities that promotes social learning • Activities that promotes participation in the learning environment • Activities that promotes interaction between learners • Activities that promotes interaction within small group • Activities that promotes collaboration • Additional and external resources for advanced learners • Incremental increase on the difficulty level and workload (easy-start is recommended)			
P3D-4	Design Technical concept (P) (T) (S) • Embed technological tools to foster interaction, collaboration and community building (P) (T) • Integrate technological tools (e.g., Chat, Google hangouts) to enhance social learning, interaction and community-building (P) (T) • Provide curated sources (e.g., blogs, infographics, websites, videos, articles) (P) (T)	X	X	R
P3D-5	Media Design (P) (T) Provide the following (if relevant; based on chosen pedagogical approach and instructional design) (P) (T) • Video-lectures • Digital text • Text with audio explanation • Text with video explanation • Hypertext • PPT Presentations with narration	R R	X X	X X

	• Animated PPT			
P3D-6	Define communication concept (P) (T) • Define communication via emails, broadcast alerts, chat, forum (P) (T) • Define communication with facilitator (P) (T) • Define communication with fellow course particpants learning peers (P) (T) • Define communication on a small group basis (P) (T)	R	X	
P3D-7	Define interaction concept (P) (T) • Design interaction with fellow participants (P) (T) • Design interaction with facilitators (P) (T) • Create opportunities for synchronous interaction with experts and practitioners (by topic, module, unit, weekly questions) (P) (T)) • Design interaction via Blogs, forums & social media platforms to foster social learning (P) (T) • Develop free mobile app to facilitate support network (P) (T) • Provide regular coaching sessions in small group (P) (T) • Create a community of learners (P) (T)	R	X	
P3D-8	Feedback concept (P) (T) • Design automated feedback (P) (T) • Design feedback by facilitator (P) (T) • Design peer/group feedback moments with guidelines and rubrics (P) (T)	R	X	

	• Design weekly feedback from program leaders via video (P) (T) • Provide prompt feedback for activities and tasks (P) (T)			
P3D-9	Concept for tests and assessment (P) (T) • Design tests (topic/ unit/ thematic) with automated feedback (P) (T) • Design weekly quizzes (to check for understanding of e.g., short sections of a topic/ unit) (P) (T) • Design case study analysis and application (P) (T) • Design assessment instruments to be aligned with content, weekly learning objectives and learner-profile (multiple choice does not do justice to advanced learners) (P) (T) • Design assessment instruments that are able to test and evaluate some specific desired learning outcomes (e.g., draw, design and formulate) (P) (T) • Embed gamification elements e.g. badges in assessment instruments (P) (T) • Provide practical self-assessment strategies and techniques (e.g., digital video, online forms, rubrics, chats and reflection tools) (P) (T) • Design peer assessment with guidelines and scoring rubrics (P) (T) • Design rubrics for peer-review (prior knowledge match to reduce gaps between pairs) (P) (T) • Design rubrics for evaluation of final product (P) (T) • Define mind mapping and concept mapping for deep learning	R	X	X

	• Design open assignment using scenario tools • Design collaborative assignments and provide scaffolds to support the collobaration process e.g., by means of intelligent teaching agents/tutors and/ or cognitive tools (P) (T) • Define formative assessment (e.g., provide open-answers to distinguish excellent from average learners) (P) (T) • Define final product and artefact (P) • Define written exams (P) (T) • Design provision of feedback and answers for optional activities (P) (T)			

The delivery phase consists of implementation and realisation sub-phases. During the implementation sub-phase, the design of the course is realised. During the realisation sub-phase, the course is taught. These sub-phases are analysed as follows:

I	Implementation	Designer	Facilitator	Provider
P3I-1	Content realization • How will the content be produced and delivered? (P) (T)	R	X	X
P3I-2	Design realization	R		X

	• How will the graphical design be realized? (P) (T)			
P3I-3	Media realization • How will the media be produced and provided? (P) (T)	R		X
P3I-4	Technical realization • How will the technical concept be realized? (T) • How will the technical requirements on scalability, accessibility, usability, infrastructure, security, privacy, services, support and documentation be realized? (T) • How will the maintenance be realized? (T)	X		R
P3I-5	Organization of use • How will the organizational concept of the DL course (pedagogical and technical aspects) be realized? (P) (T)	X	X	R
P3I-6	Testing and activation • How will the DL course and its learning resources be tested? (P) (T) • How will the DL course and its learning resources be adapted? (P) (T) • How will the DL course and its learning resources be activated? (P) (T)	R		X
P3R	**Realization**	**Designer**	**Facilitator**	**Provider**
P3R-1	Administration • How is the registration organized? (P) (T) • How is topic-related feedback for the learners during the DL course ensured? (P) (T) • How is pedagogical feedback for the learners during the DL course ensured? (P) (T)	X	X	R

	• How is technical support for the learners, moderators and facilitators during the DL course ensured? (P) (T)			
P3R-2	Learning activities and related support • How are the learners inducted into the course and the pedagogical approach including the learning objectives, the course content, activity and assessment types, communication, interaction and feedback channels? (P) (S) (e.g., introductory unit, orientiation week, instructional guide) • Which pedagogical approach is realized? (P) (S) • How is autonomous and self-regulated learning realized? (P) (T) (e.g., learning support for individual and reflective learning, learning support using personas, provide office-hours for students with questions/ challenges) • How is network learning realized, if any? (P) (T) (e.g., provide tools and related tasks and assignments) • How is group work realized, if any? (P) (T) (e.g., facilitate formation of small groups, provide small group support and related tasks and assignments) • How is the communication process facilitated? (P) (T) • How are forum and discussion platforms organized? (P) (T) • How are the interaction activities realised? (P) (T)	X	R	X

	• How is feedback provided? (P) (T) (e.g., automated, by peers, by facilitators, by community teaching assistants) • How are reviews by educators and experts realized? (P) (T) • How are peer reviews realized? (P) (T) (e.g., provide scoring-rubrics, provide exercises to train learners to give peer reviews)			
P3R-3	Review of competence levels • Which types of optional assessments are offered? (P) • Which types of mandatory examinations are offered? (P) • How is grading realized? (P) • Which certificates are provided and how are they assessed and achieved? (P) (S) • Which credits are provided and how are they assessed and achieved? (P) (S)	R	X	X

The final phase is the assessment (evaluation) phase which is analysed as follows:

E	Evaluation	Designer	Facilitator	Provider
P3E-1	Evaluation planning • Which evaluation objectives are defined? (S) (e.g., failure reduction, quality assurance, quality management, continuous improvement cycle) • Which phases are covered by the evaluation? (S) • How is the evaluation planning organized? (P) (S) (e.g., weekly, periodic, thematic, module-based) • How is the evaluation designed? (P) (S) (e.g., evaluation categories, focus such as	X	X	R

	satisfaction, engagement, motivation, learning outcomes, impact, pedagogy, technology, organization, and constructs)			
P3E-2	Evaluation realization • How is the evaluation realized and assessed? (P) (T) (S) (e.g., surveys, questionnaires, learning analytic tools, log data, observations, forums, interviews)	X	X	R
P3E-3	Evaluation review • How are the evaluation data reviewed, analysed and discussed? (P) (S) • How are recommendations developed from the evaluation results? (P) (S)	R	X	X
P3E-4	Improvements and optimization • How are the evaluation recommendations used for improvements and optimization of the DL course and its re-usage? (P) (S) • How are the evaluation recommendations used for improvements and optimization of the evaluation design and realization? (P) (S)	X	X	R

4.6 Student admission, progression, recognition and certification

P4: *Institutions should consistently apply pre-defined and published regulations covering all phases of the student "life cycle", e.g. student admission, progression, recognition and certification.*

		Designer	Facilitator	Provider
P4A-1	Student admission • Design policies that guarantee open access to admission information (e.g. requirements, pre-requisites, workload) and processes to all kinds of potential students • Organise the aadmission process of students based on well-established standards and processes (P) (T) • Establish procedures that ensure fit for purpose admission and transparency • Establish procedures that recognizes prior learning	X	X	R
P4A-2	Student Progression • Define processes and IT tools that ensure monitoring of learner progression • Define processes and metrics that measure student success/failure/drop out • Define metrics and processes	X	X	R
P4A-3	Student recognition • Establish procedures and metrics for qualification, periods of study • Establish continuous involvement of QA agencies	X	X	R
P4A-4	Student certification • Establish procedures that align qualification gained with learning objectives met, level of studies and context. • Align course certification with National and International standards	X	X	R

4.7 Teaching staff

P5: *Institutions should assure themselves of the competence of their DL course teachers. They should apply fair and transparent processes for the recruitment and development of the staff.*

		Designer	Facilitator	Provider
P5A	Analysis: Tutor competences requirements • Design fit for purpose criteria and tests for necessary tutor competences			R
P5D	Design: Tutors' recruitment • Design policies that guarantee open access to admission information and processes to all kinds of potential tutors • Organise the aadmission process of tutors based on well-established standards and processes • Establish procedures that ensure fit for purpose admission and transparency of tutors • Ensure appropriate initial staffing • Ensure that staff development activities take place through drawing up of a staff development plan signed off by management			R
P5E	Evaluation: Tutors' Assessment • Define processes and IT tools that ensure monitoring of tutor efficiency • Define procedures that lead to improvement of tutor competences			R

4.8 Learning resources and student support

P6: *Institutions should have appropriate funding for learning and teaching activities and ensure that adequate and readily accessible learning resources and student support are provided for DL courses.*

		Designer	Facilitator	Provider
P6A	Analysis: IT infrastructure needs • Design processes that guarantee that all relevant stakeholders participate in the definition of learning resources and student support needs • Establish procedures that ensure transparency in needs definition • Organise the analysis processes so that the needs of a diverse student population are taken into account • Analyse the training needs of the support and administrative staff that will be involved in delivering the support • Design policies that guarantee open access to admission information and processes to all kinds of support personnel (facilitators, counsellors, advisors) • Estimate the cost of production of learning materials, resources and manpower needed for the support services • Estimate the cost of (IT) resources, hidden costs, and manpower to run the student support services. • Prioritize funding for resources and support	X	X	R
P6D	Infrastructure and services design and development • Use open software platforms where necessary (e.g., OpenEdX or Moodle) that can integrate all the tools useful for learners (T) (S) • Integrate third-party tools for formative assessment (web-based IDE, game-based learning	X	X	R

	tools for programming) (T) (S) • Set-up and sustain infrastructure, data security, documentation, support (T) • Set-up and sustain infrastructure, data security, documentation, support (T) • Ensure content maintenance (P) (T) • Re-use and adapt existing learning resources where appropriate in terms of content and learning objectives (P) (T) • Ensure new learning resources created for DL with licences are copyrighted by contributing authors and licensed under Creative Commons (P) (T) • Provide a set of concrete guidelines and instructions on learning resources and learning objectives, content presentation, activities and assessment plan and procedure (P) (T) • Provide detailed guidelines and instructions for facilitators and students (P) (T) • Ensure sustained interaction amongst IT platforms' administrators, designers and facilitators to report bugs and propose operational improvements (P) (T) • Set-up expert teams for coordinating different IT platforms, facilitation process and to control and to test usage (P) (T)			
P6E	Evaluation: Support services evaluation • Set-up an evaluation consultation team to oversee the implementation of recommendations (resulting from the evaluation review process) (P) (T) (S) • Use forum contributions and discussions for	X	X	R

	evaluating resources and support services • Provide regular interaction and collaboration with platform administrators and designers to report bugs and propose operational improvements (P) (T) (S)			

4.9 Information management

P7: *Institutions should ensure that they collect, analyse and use relevant information for the effective management of their DL courses and other activities.*

		Designer	Facilitator	Provider
P7A	Needs analysis for information management • Ensure that students and staff are involved in providing and analysing information and planning follow-up activities. • Identify evaluation objectives: ▪ reduce drop-outs ▪ increase engagement and motivation ▪ effective use of technological affordances to support learning • Specify the evaluation process and its frequency (e.g., regular intervals, periodic, theme-, module-, unit-based evaluation, etc.) (P) (S) • Provide an evaluation focus (e.g., on learners: engagement, motivation, interaction, collaboration, technological affordances that support learning, learning outcomes) (P) (T) (S)	X	X	R
P7D	Design and implement information management • Design metrics that record key information and performance indicators:	X	X	R

	▪ profile of the student population ▪ student progression, success and drop-out rates ▪ students' satisfaction with their programmes ▪ learning resources and student support available ▪ career paths of graduates • Use surveys, questionnaires, interviews, etc. (P) • Embed learning analytics tools to provide feedback on all learner activities (P) (T) • Use forum contributions and discussions as possible evaluation of learners' and groups' learning progress (P)			
P7E	• Adopt an after-action-review protocol involving all core stakeholders who are represented in the DL course design team (P) (S) • Provide documentation of findings, reviews and analysis from learning analytics, other forms of data obtained in the course of the DL course (P) (T) (S) • Identify specific area and provide recommendations for improvement (e.g., curriculum design and delivery requires differentiated course content and learning activities for two levels of learners) (P) (S)	X	X	R

4.10 Public information

P8: Institutions should publish information about their activities, including DL courses, which is clear, accurate, objective, up-to date and readily accessible.

		Designer	Facilitator	Provider
P8A	Needs analysis for publicizing information • Identify target groups of information publication			R

	and analyse their needs • Specify the policies for information publication • Assess the needs for specialized staff that will support the publication of information • Define the sources of information, how and when they provide the information • Define methodologies for validating the information to be made public			
P8D	Design and Implementation ▪ Ensure that crucial information about the DL course is available including: ▪ DL courses offers ▪ selection criteria ▪ intended learning outcomes ▪ qualifications they award ▪ teaching, learning and assessment procedures used ▪ pass rates and ▪ the learning opportunities available to their students as well as graduate • Use various means of information delivery (web site, social media, stakeholder dissemination channels etc.) • Ensure that information is accessible by special groups (disabled students, international students etc.)	X		R
P8E	Evaluation ▪ Assess the accuracy, accessibility and completeness of information published by various target groups.	X	X	R

4.11 On-going monitoring and periodic review of DL courses

P9: Institutions should monitor and periodically review their DL courses to ensure that they achieve the objectives set for them and respond to the needs of students and society. These reviews should lead to continuous improvement of the DL course. Any action planned or taken as a result should be communicated to all those concerned.

		Designer	Facilitator	Provider
P9A	Evaluation planning • Identify the evaluation objectives and how to measure them, including: ▪ the content of the DL course the light of the latest research in the given discipline thus ensuring that the course is up to date ▪ the changing needs of society ▪ the students' workload, progression and completion ▪ the effectiveness of procedures for assessment of students ▪ The student expectations, needs and satisfaction in relation to the course ▪ the learning environment and support services and their fitness for purpose for the course • Identify which stakeholders need to be included in the monitoring process	X	X	R
P9D	▪ Design processes that enable continuous monitoring and revision of DL courses ▪ Design metrics for measuring the evaluation objectives ▪ Publicize monitoring results and improvements introduced to DL courses	X	X	R

P9E	• Assess the impact of improvements introduced to DL courses	X	X	R

4.12 Cyclical external quality assurance

P10: DL courses should undergo external quality assurance as part of the external quality assurance of the institution.

External Quality Assurance processes are usually defined at an Institutional level. At a DL course level, processes are designed so as to contribute, where appropriate, to the institutional External QA policies.

		Designer	Facilitator	Provider
P10A	External quality assurance planning • Specify stakeholders that will contribute to Institutional External QA policy • Define DL course specific objectives for External QA			R
P10D	External quality assurance design and implementation • Provide processes to facilitate external QA • Provide a process that uses external QA recommendations to introduce improvements to the DL course			R
P10E	External quality assurance evaluation • Measure the impact of improvements introduced based on external QA recommendations			R

5 References

ESG Guidelines. https://enqa.eu/index.php/home/esg/

Stracke, C. M., Tan, E., Texeira, A., Pinto, M., Vassiliadis, B., Kameas, A., Sgouropoulou, C., & Vidal, G. (2018). *Quality Reference Framework (QRF) for the Quality of Massive Open Online Courses (MOOCs)*. Online available at www.mooc-quality.eu