

WP 1 - Non-university Capacity Assessment

Outcome 1.2. Capacity Assessment Form

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REVISION SHEET

Version	Date	Author (Partner/Person)	The revision reason
1	2021/04/30	UMinho team (Rui Lima)	First draft of the capacity assessment form with items developed by the UMinho team and reviewed by the WP1 team.
2	2021/05/15	UMinho team (Rui Lima)	Second version of the capacity assessment form, after the think-aloud procedure.
3	2021/06/01	UMinho team (Rui Lima)	Third version of the capacity assessment form, after the test and re-test procedure.

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Executive Summary

The ReCap4.0 project aims to develop competences for the non-university sector in Thailand in the context of Industry 4.0 (I4.0) and innovative teaching and learning approaches. Consequently, the potential target institutions are the 40 Rajabhat Universities and the 9 Rajamangala Universities of Technology. Considering the scope of the project, the target teaching staff consists of mainly teachers from Industrial Engineering or similar departments and programs.

This document constitutes the outcome 1.2 - A capacity assessment form on non-university capacity, of the first work package, WP1 - Non-university capacity assessment. The assessment of the capacity of teaching staff from the non-university sector in Thailand is based on a self-perception questionnaire encompassing knowledge related to product, process and production in I4.0 Era, teaching skills enhancement and competence-based curriculum development.

The questionnaire was developed and validated during March, April and May 2021. The development and validation were based on: (i) think-aloud procedures with 6 teaching staff from Rajabhat and Rajamangala institutions, and (ii) test and retest statistics validation developed with approximately 30 teaching staff from the referred institutions. After this validation, the questionnaire will be applied, in June, aiming for more than 200 teaching staff.



Form - version 3, final version of the questionnaire

Part 0 – Introduction and participant characterization

The ERASMUS+ project ReCap4.0 aims to enhance the capacity and ability of Rajabhat Universities and Rajamangala Universities of Technology in Thailand, for the effective delivery of engineering and technology knowledge and skills related to Industry 4.0, to support Thailand sustainable smart industry and to strengthen a partnership among participating European and Thai universities. The main target group are teachers from Rajabhat Universities, followed by teachers of Rajamangala Universities of Technology. This project proposes the following modules for the enhancement of teachers' capacities and abilities:

Module 1.1: Industrial Management in Industry 4.0 Era

Module 1.2: Applications of Optimization, and Technology in Value Chain

Module 1.3: Digital Manufacturing

Module 1.4: Innovative Product Design and Development

Module 1.5: Data Analytic

Module 2.1: Communication and people skills development

Module 2.2: Innovative teaching and learning methods

Module 2.3: Problem and Project-Based Learning (PBL)

Module 2.4: Coaching and Mentoring Skills development

Module 2.5: Learning experience-focused course design and development

In order to be able to develop a training programme aligned with the needs of the teachers from the referred institutions, the first work package (WP1) of the ReCap4.0 project aims to apply a questionnaire to those teachers. This questionnaire should allow to develop a perspective of the required capacities and in this way give support for training development decisions. Thus, as an example of interpretation of the results, if the questionnaire shows a high level of capacity in some specific area, then in that area the training should be more complex. Additionally, the questionnaire should also support understanding what are the main interests of the participants regarding the training options. So, the training and the questionnaire will be focused in three main parts: Industry 4.0 parts (1.1 and 1.2), Educational part, and relative interest in different training modules.

Due to the challenging objectives of the ReCap 4.0 ERASMUS+ project, this questionnaire is somewhat long. We would much appreciate it if you patiently go through all questions.

Due to answer control reasons, we will ask for an email login, but only a small part of the team will access that information, and we will guarantee the privacy of the participants.

PARTICIPANT CHARACTERIZATION

Institution*: {Names;Other}

If not listed, please add your institution: {Text}

School and/or department: {Text}

Main area of actuation as teacher*: {Text}

Years of experience as teacher*: {1-5;6-10;11-20;21-30;>30}

Highest academic degree*: {Bachelor's / Master's / Doctorate}

Area of highest academic degree*: {Text}

English proficiency level*: {Elementary level; Low intermediate level; High intermediate level; Advanced level}

Age*: {Integer}

Gender: {Male;Female;Other}

Part 1 – Industry 4.0

Industry 4.0 Generic Items based on Acatech Elements

Cod	Items
A1	I am able to understand that companies have different Industry 4.0 maturity levels.
A2	I am able to evaluate the maturity level of a company in order to develop a project to evolve its Industry 4.0 stage.



- A3 I am able to recognize a company required tangible, physical resources, including a company's workforce (human resources), facilities, machinery and equipment, tools, materials and the final product for Industry 4.0.
- A4 I am able to discuss the required information systems for Industry 4.0, in which the information is provided by both people and "information and communication technology".
- A5 I am able to recognize the required Industry 4.0 organisational structure, referring to both a company's internal organisation (structure and operational processes) and its position within the value network (value stream).
- A6 I am able to discuss the required learning and agile corporate culture, including willing to change, innovate, and develop employees' skills, in the context of Industry 4.0.
- A7 I am able to understand the importance of digital capability for decentralized pre processing of automated data acquisition through sensors and actuators.
- A8 I am able to understand that Industry 4.0 includes efficient communication between people and between people and machines through task based interfaces.
- A9 I am able to understand the importance of data and self learning systems for delivering context dependent data.
- A10 I am able to understand that Industry 4.0 information systems must provide full integration between processes under governance policies and protected by data security systems.
- A11 I am able to understand that in the context of Industry 4.0 the organization is a system enabled by a collective intelligence and agile management, i.e. involving motivation to change (problem solving, improvement), proper use of people skills and decentralized decision making.
- A12 I am able to understand that Industry 4.0 is focused on the customer benefits enabled by networked collaboration inside the company (i.e. intra company) and between different companies (i.e. inter companies).
- A13 I am able to recognize that collaborative management is important in the context of Industry 4.0, i.e. including democratic leadership and transparent communication between people.
- A14 I am able to discuss that in the context of Industry 4.0, people recognize the value of mistakes, are open to innovation, search for continuous professional development and are driven by knowledge databases and decision making in a continuous process of change.

Industry 4.0 Specific Items based on training modules

This part of the questionnaire is based on the predefined training modules. Please take note that this is an agreement scale.

In all following items, consider that you are self assessing your own capacity in each of the assertions. If you do not understand some concept in the question, please select one of the disagreements part of the scale ("Strongly disagree" or "Somewhat disagree").

Module 1.1: Industrial management in Industry 4.0 Era

- B1 I am able to discuss the relevance of agile project management in the context of Industry 4.0.
- B2 I am able to define the Industry 4.0 level of maturity of a company.
- B3 I am able to apply agile project management approaches in the context of Industry 4.0.
- B4 I am able to apply the team development phases (Forming, Storming, Norming, Performing, Adjourning) to support teamwork.
- B5 I am able to work effectively in a distributed team.
- B6 I am able to develop projects for the transformation of a company in the context of Industry 4.0.
- B7 I am able to use a modelling tool (e.g. BPMN, VSM) to represent industrial processes considering smart production concepts.
- B8 I am able to use performance indicators of a company's operating efficiency in the context of Industry 4.0.
- B9 I am able to recognize the role of customer service in the context of Industry 4.0.
- B10 I am able to plan and control the company's operations considering smart production concepts.
- B11 I am able to design real time data analytics systems to support operations planning and control.



- B12 I am able to discuss the impact of Industry 4.0 on quality management.
- B13 I am able to identify performance indicators of quality management area in the context of Industry 4.0.
- B14 I am able to collect quality management data for Industry 4.0.
- B15 I am able to design a data visualization solution for quality management and productivity indicators.
- B16 I am able to design a quality management system for Industry 4.0.

Module 1.2: Applications of Optimization, and Technology in Value Chain

- C1 I am able to formulate mathematical optimization models for practical problems in industrial application.
- C2 I am able to select appropriate optimization techniques to solve practical problems in industrial applications.
- C3 I am able to use optimization software (e.g. MATLAB, LINGO, or MPL software) to solve practical problems in industrial applications.
- C4 I am able to conduct sensitivity analysis to examine solutions robustness.
- C5 I am able to develop real time optimization approaches for Industry 4.0.
- C6 I am able to describe Sustainable Supply Chain Management (SSCM) models.
- C7 I am able to manage a Sustainable Supply Chain Management (SSCM) network in the context of Industry 4.0.
- C8 I am able to redesign a supply chain considering sustainability and Industry 4.0 requirements.

Module 1.3: Digital Manufacturing

- D1 I am able to describe the concept of Digital Factory.
- D2 I am able to understand the functionalities and limitations of current digital technologies.
- D3 I am able to use simulation to analyse the performance of a production system.
- D4 I am able to specify a digital transformation model for an industrial case study.
- D5 I am able to describe the concept of Cyber Physical System (CPS).
- D6 I am able to implement concepts of Smart Production using Cyber Physical Systems (CPS).
- D7 I am able to use the Internet of Things (IoT) to collect real time data from sensors.
- D8 I am able to develop Cyber Physical System (CPS) projects to improve business performance.
- D9 I am able to describe principles of Additive Manufacturing.
- D10 I am able to apply Reverse Engineering concepts in the context of Additive Manufacturing.
- D11 I am able to choose process parameters for effective Additive Manufacturing.
- D12 I am able to choose Additive Manufacturing technologies.
- D13 I am able to develop products using the Design for Additive Manufacturing (DfAM) concept.

Module 1.4: Innovative Product design and development

- E1 I am able to recognize the benefits of implementing innovations.
- E2 I am able to analyze strategic elements of new product innovation.
- E3 I am able to identify ideas for innovative products in the context of Industry 4.0.
- E4 I am able to apply methods for innovation (e.g. design thinking).
- E5 I am able to propose marketing strategies for launching new products.



- E6 I am able to valorize, capitalize and protect (e.g. using patents) the original solutions obtained from the creative activity.

Module 1.5: Data Analytic

- F1 I am able to describe the concept of Intelligent Decision Support System (IDSS).
- F2 I am able to apply techniques of Intelligent Decision Support Systems (e.g. artificial neural networks, machine learning or rule-based systems) to solve industrial problems.
- F3 I am able to describe a framework of Intelligent Decision Support System (IDSS).
- F4 I am able to design an Intelligent Decision Support System (IDSS) to support a smart production system.
- F5 I am able to identify data analytics principles.
- F6 I am able to apply data visualization techniques in dealing with big data sets.
- F7 I am able to apply key data mining techniques (e.g. classification analysis, clustering analysis, regression analysis) in dealing with big data sets.
- F8 I am able to develop data analytics algorithms for big data sets.
- F9 I am able to develop data analytics projects in the context of Industry 4.0.

Part 2 – Educational Part

This part of the questionnaire is based on the predefined training modules for teacher educational development. Please take note that this is an agreement scale.

In all following items, consider that you are self assessing your own capacity in each of the assertions. If you do not understand some concept in the question, please select one of the disagreements part of the scale ("Strongly disagree" or "Somewhat disagree").

Module 2.1: Communication and people skills development

- G1 I am able to make effective presentations to the students.
- G2 I am able to explain ideas effectively in a way that students understand.
- G3 I am able to understand the concept of emotional intelligence in different contexts of the teaching practice.
- G4 I am able to apply emotional intelligence concepts in different contexts of the teaching practice.
- G5 I am able to work in teams, collaborating with other teachers from the department or university.
- G6 I am able to lead, persuade, motivate and inspire students to achieve goals

Module 2.2: Innovative teaching and learning methods

- H1 I am able to enhance teaching using different technology solutions (e.g. mentimeter, kahoot, miro, amongst others).
- H2 I am able to provide opportunities for students to collaborate.
- H3 I am able to use online learning management systems (e.g. Moodle, Blackboard).
- H4 I am able to record videos for use by students later.
- H5 I am able to plan and teach a class either on a synchronous or asynchronous mode.
- H6 I am able to increase student engagement using a flipped classroom approach.
- H7 I am able to incorporate the use of self-directed learning approaches.

Module 2.3: Problem and Project-Based Learning (PBL)



- I1 I am able to understand Project- Based Learning (PBL) principles.
- I2 I am able to recognize different Project- Based Learning (PBL) typologies, i.e. different ways to put PBL in practice
- I3 I am able to identify problems or themes to be implemented in PBL context.
- I4 I am able to identify the main requirements for PBL organization (e.g. resources, teams, assessment).
- I5 I am able to create a PBL proposal for your teaching context.

Module 2.4: Coaching and Mentoring Skills development

- J1 I am able to understand the differences between coaching and mentoring.
- J2 I am able to provide additional explanations and communicate expectations for student achievement.
- J3 I am able to motivate students so that they can produce high- quality work.
- J4 I am able to provide formative feedback to students on their work indicating how they can improve.
- J5 I am able to plan appropriate interventions or additional support for students based on their identified needs.
- J6 I am able to support students in ensuring their work meets the appropriate standard including academic integrity (ethics)

Module 2.5: Learning experience-focused course design and development

- K1 I consider myself highly experienced in curriculum (programme) development and/or revision.
- K2 I consider myself highly experienced in developing courses.
- K3 I consider myself highly experienced in revising course structure, including the syllabus, study and teaching materials, learning outcomes, class plan and assessment plan.
- K4 I consider myself an expert on Bloom’s Taxonomy.
- K5 I consider myself an expert on Kolb’s Learning Cycle.
- K6 I am able to discuss the differences between forward and backward curriculum design.
- K7 I am able to develop a curriculum coherently integrating the following elements for both the courses and the whole program: objectives, learning outcomes, outline, resources, teaching and learning methods, time distribution and study load, evaluation and grading criteria.

Part 3 – Interest in Training Modules

This part of the questionnaire aims at collecting the participants’ main preferences in different training modules for the development of professional competences. In all following items, consider that you are reflecting upon your preference related to the different training modules for the development of your professional competences.

Select two of the following Industry 4.0 training modules according to your preference:

Module 1.1: Industrial Management in Industry 4.0 Era

Module 1.2: Applications of Optimization, and Technology in Value Chain

Module 1.3: Digital Manufacturing

Module 1.4: Innovative Product Design and Development

Module 1.5: Data Analytic



Select two of the following educational training modules according to your preference:

Module 2.1: Communication and people skills development

Module 2.2: Innovative teaching and learning methods

Module 2.3: Problem and Project-Based Learning (PBL)

Module 2.4: Coaching and Mentoring Skills development

Module 2.5: Learning experience-focused course design and development