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THE FOF-DESIGNER:
DIGITAL DESIGN SKILLS FOR FACTORIES OF THE FUTURE

Project Acronym:
DigiFoF

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Subject:
D3.2 Teaching and training materials for the design of the Factory of the Future

Dissemination Level:
RESTRICTED TO OTHER PROGRAMME PARTICIPANTS

Lead Organisation:
ULBS

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All Partners

Reviewers:
BOC

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1 Introduction

DigiFoF is a multidisciplinary project resulting from collaboration between academic and industrial partners to produce a collection of scientific-pragmatic outcomes.

The work package 3 is dedicated to learning materials, case studies, webinars and design tools. HEIs will be mainly responsible for this work package. In this task the academic partners will develop a problem-based learning path for the training in collaboration with economical partners. The principal idea is to have trainings directly with small groups who work creatively together using the digital library to solve open ended questions from real world cases. In addition, the partners will define the appropriate technological-support concepts and tools (e.g. wikis, multi-media, predictive learning paths etc.) necessary for this approach in the context of DigiFoF.

The objective of deliverable 3.2 is to provide a detailed course content for trainings. In this deliverable modular training units covering several scientific disciplines are presented. Strategy includes new business models, product-service-systems, and customer-orientation (“from the customer to the customer”), process orientation contains knowledge of business process management, management of the ICT enterprise architecture, and product-life-cycle management. Systems contain hard- and software and include cyber-physical systems (CPS) and topics like digital factory reference architecture, semantics (OWL, The FoF-Designer: Digital Design Skills for Factories of the Future / DigiFoF, RDF).

2 Training material development

The template that can be used to complete the information on each training materials is detailed in deliverable 3.1 "Problem-based learning path for students and professionals", section 4.1 (Table 1) . In this deliverable we complete the presented information with new information about the teacher that will present the training, and the competencies that can be obtained by students (Table 2). If the training has more modules, the following information (Table 3) needs to be specified for each module. Each course description has these 3 tables.

Table 1. The training specification details

Training specification	Explanation
Organizer	Name of the training institute, country
Training Topic	The training topics should deliver one or more competences related to FoF design. DigiFoF proposes three main categories of topics (proposed in section 2) to cover FoF design (strategy-, processes-, or systems-oriented topics). These topics and sub-topics proposed can be detailed according to the need of the training.
Training objectives	Describe what skills, competences, or knowledge participants will learn at the end of the training.
Method	Defines phases or steps of the training.
Target groups	Define the participants (e.g. professionals from the same company).
Recommended composition	A group could be homogeneous or heterogeneous (Mix of jobs, abilities, gender, work experience).
Recommended size of groups	Different categories as less than 10 persons, between 10 and 20, or more than 20.
Training duration	Based on the training needs and the project target (estimated 3x5 days in WP4).
Mode of tutoring	Based on Table 1 and defines the various instruments such as lecture, case, tutor role, and participants' role.
Mode of provision	Can be physical, virtual, or blended learning.
Tools and resources to be used (technological-support tools)	Either outside or from OMiLAB laboratories.
Recommended preparation	Defines the necessary information (e.g. having some information about the company, its strategy, and activities).
Modes of working in teams	Concerns the team animation and collaboration method (e.g. playing role, collaborative problem-solving, individual Q&A).
Communication and cooperation mode	E.g. Facebook, social bookmarking, photo or video sharing, wiki documents, word documents, instant messaging or texting, the group workspace, etc.
Necessary abilities to tackle the tasks of open problems	Core skills like research skills, critical analysis, problem solving, report writing, presentation skills, communication skills, organization skills, time management, and group working skills, presentation skills (i.e. soft and transferrable skills).
Knowledge prerequisites	Domain specific knowledge for entry level.

For each training need to be specified competencies and skills that are learned in the training. Present skills that are developed by getting specific training or learning.

Table 2 Training competence

Competence specification	Explanation
Knowledge and skills	Specific the knowledge and skills that are obtained at this training
Professional competence	Specific the competence acquired
General objective	The general objective of the training

If the training has more parts (module, is planned for more weeks) you can use Table 3 to describe each module. Before describing each training module please present all module names.

Table 3. Training Module specifications

Module specification	Explanation		
Teacher Name	The name for the teacher (more names if there are more teachers)		
Training Topic	The name for the training		
Training Code	The code for the training inside of DigiFoF project. Each code will contain the acronym for partner and the number of the training (_01, _02, _03, …)		
Module Name	The name of the part for the training		
Module duration	The duration for the module. Recommendations 2 hours.		
Module objective	• The general objectives that are met by the module •		
Mode of provision	Mode to organizing the module (classroom, online or homework)		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part

Each training needs to have a description in section 4 and a separate file as an archive with all files that contain the documentation for entire training. The archive will be named starting with the training code and after that the training name. The archive will contain the course material (document and course presentation) and materials that may be provided to students at classes. The archive with training content needs to be placed in same folder with the deliverable 3.2 and will be placed also in project site in the results section. In the section 4 "Description of course" at the end of description need to be presented the name of the archive that contain the entire training materials and a list with all files from the archive and what contain each file.

If in the creation of training material Word or PowerPoint documents are used, the templates defined in section WP6 must be used. For word document template at the “Subject” in the first page and in header needs to be specified the code and the name of the training. The “Contributors” and “Reviewers” can be modified with “Trainers”. The archive can also contain documentation material for students tacked from other sources that do not need to be in DigiFoF format but need to be specified the source.

3 List of trainings provided by DigiFoF competence network

In the project period DigiFoF Competence Network will develop and provide various trainings based on OMiLab laboratory that will develop at partners. These trainings are listed in table:

Table 4. Training description proposed by partners

Item	Training topic	Organizer	DigiFoF code
1	Customers needs' services deployment	EMSE-France	EMSE_01
2	Product-Service System design		EMSE_02
3	Transformation of Industrial Business Model through digitalization and servitization		EMSE_03
4	Introduction to the concept of PSS and to the dedicated PS3M modelling method		EMSE_04
5	Circular Economy and Product-Service System		EMSE_05
6	Deployment of Service-oriented Strategy		EMSE_06
7	Design Thinking for Product-Service System Design	EMSE/Clextral-France	EMSE_07
8	Workplace safety – Employees emotion recognition (Systems-oriented topics)	ULBS - Romania	ULBS_01
9	Sibiu – Smart city modelling (ADOxx) - Strategy-oriented topics		ULBS_02
10	Computer Vision for Manufacturing Industry Application (Systems-oriented topics)		ULBS_03
11	Computer Vision Applications – Parking Lot Availability Recognition (Systems-oriented topics)		ULBS_04
12	Modelling and simulation-based design and optimization of manufacturing systems and processes on the ADOxx platform (Process-oriented topics)		ULBS_05
13	Petri Nets based automation of manufacturing systems (Systems-oriented topics)		ULBS_06
14	Process-oriented topics: Service Operations Management	UNIBG-Italy	UNIBG_01
15	Process-oriented topics: Business Process Reengineering		UNIBG_02
16	Process-oriented topic: Product-service system engineering		UNIBG_03
17	Process-oriented topic: Process Simulation in manufacturing		UNIBG_04
18	Process-oriented topics: Fundamentals of Business Process Management (BPM)	UNIBIAL-Poland	UNIBIAL_01
19	Strategy-oriented topics: Product and service design with design thinking and business model canvas creation		UNIBIAL_02
20	Systems-oriented topics: Artificial intelligence tools and modelling virtualized resources for Industry 4.0 transformation		UNIBIAL_03

Item	Training topic	Organizer	DigiFoF code
21	Process-oriented topic: Robotics application in Virtual Laboratory	UNIOULU-Finland	UNIOULU_01
22	The OMILAB Ecosystem: Characteristics and Application Cases	OMiLAB	OMiLAB_01
23	Fundamental Conceptual Modelling Languages using Bee-Up		OMiLAB_02
24	Design Thinking using Scene2Model		OMiLAB_03
25	The Value of Conceptual Models		OMiLAB_04
26	Conceptual Modelling: Methods, Tools and Application		OMiLAB_05
27	Model-Driven Experimentation		OMiLAB_06
28	Scientific and Educational Exploitation		OMiLAB_07
29	intelligent assessment services using AWS cloud infrastructure for design artefacts		OMiLAB_08
30	Integration of the uses and design in the company business model	CIRIDD	CIRIDD_01
31	Cobots - installing and programming information needed for a rapid implementation of Cobots in industrial environment	CONTI	CONTI_01
32	AGV for modern Logistics in industrial companies		CONTI_02
33	Process-oriented topic: Process modelling using BPMN	BOC	BOC_01
34	Process-oriented topic: Process improvement using simulation		BOC_02
35	Process-oriented topic: Process performance monitoring		BOC_03

4 Description of the courses

4.1 Courses provided by EMSE

4.1.1 EMSE_01: Customers needs' services deployment

Table_1_EMSE_01. The training specification details

Training specification	Explanation
Organizer	EMSE France
Training Topic	Strategy-oriented topics: Customers needs' services deployment
Training objectives	The training allows the company's employees to create product-related service ideas and test them before implementing a deployment plan.
Method	Stage 1-Empathy: Understanding the human needs involved Stage 2-Definition: Reconstructing and defining problems in a human-centric manner Stage 3-Ideate: Making many creative ideas in the conception session
Target groups	Professionals of the same company
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	Less than 10
Training duration	3 hours to 6 hours on the same day or on 2 separate days
Mode of tutoring	Design thinking
Mode of provision	Workshop
Tools and resources to be used (technological-support tools)	Tools of Design Thinking
Recommended preparation	Having some information about the company, its strategy, its activity
Modes of working in teams	Playing roles, open mind for creativity
Communication and cooperation mode	Word documents; Empathy Map; Persona; Feasibility Roadmap

Training specification	Explanation
Necessary abilities to tackle the tasks of open problems	Group working skills, Presentation skills
Knowledge prerequisites	Product-Service System

For each training need to be specified competencies and skills that are learned in the training. Present skills that are developed by getting specific training or learning.

Table 2_ EMSE_01. Training competence

Competence specification	Explanation
Knowledge and skills	Design thinking uses
Professional competence	Customer focus
General objective	Change their point of view; adopt customers needs

If the training has more parts (module, is planned for more weeks) you can use Table 3 to describe each module. Before describing each training module please present all module names.

Table 3_ EMSE_01. Training Module specifications

Module specification	Explanation		
Teacher Name	N. Dubruc		
Training Topic	Strategy-oriented topics: Customers needs' services deployment		
Training Code	EMSE_01		
Module Name	Creativity session for industrial employees on PSS business model		
Module duration	3h		
Module objective	The training allows the company's employees to create product-related service ideas and test them before implementing a deployment plan		
Mode of provision	classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	Welcome 20’	T0 : Presentation of the day and its objectives	animators
		T1 : Introduction of the objectives for the company	manager
	15’	T2 : Explain the rules of the day (put yourself "out of routine")	animators
		T3 : Session "breaking ice" What keywords to define services in company?	animators

Module specification	Explanation		
		+ Recall keywords at the end	
	Customer expectations 1h15' 5'	T4 : Presentation, explications	animators
	5'	T5 : Distribution in 2 groups and distribution of personae cards	animators
	10'	T6 : Explanation of the support	animators
	10'	T7 : Individual work, ideas on colored post-it, in connection with the cards	animators
	45'	T8 : Filling the collective support	animators
	Restitution 45'	T9 : Joint return: exhibition and explanation of the two heads	animators
	15'	T10 : Closing debriefing	Manager + animators

The course content is available on the DigiFoF cloud in WP3 WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /EMSE/EMSE_01:Customers needs' services deployment

(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/EMSE/EMSE_01%3A%20Customers%20needs%27%20services%20deployment)

4.1.2 EMSE_02: Product-Service System design

Table 1_EMSE_02. The training specification details

Training specification	Explanation
Organizer	EMSE France
Training Topic	Strategy-oriented topics: Product-Service System Design
Training objectives	▪ Understand and apply a method for the design of product service Systems ▪ Acquire operational skills on the use of a PSS modelling toolkit (PS3M), dedicated to design support
Method	▪ Case study ▪ Practical work in team ▪ Model creation (PS3M modelling toolkit)
Target groups	▪ Vocational training : professional of system design ▪ Master students (Industrial engineering and management)

Training specification	Explanation
Recommended composition	Various industrial cultures (production, marketing, design)
Recommended size of groups	10 to 20
Training duration	12 hours
Mode of tutoring	Expert input + Practical case study animation
Mode of provision	Workshop
Tools and resources to be used (technological-support tools)	Computer Room with PS3M modelling toolkit
Recommended preparation	Read a case study
Modes of working in teams	Collective work with distributed role
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Creativity in system design, Coordination and communication abilities
Knowledge prerequisites	Introduction on PSS innovation and servitization

This training is expecting the following competence acquisition:

Table 2_EMSE_02. Training competence

Competence specification	Explanation
Knowledge and skills	- The concept of Product Service Systems and the industrial strategies associated - The design process, methodology and tools dedicated to product-service-systems - Operational skills on PS3M design tools, dedicated to support PSS Design
Professional competence	Acquire competencies on the key mind-sets and main processes required for PSS design together and , then, develop some concrete skills on a specific design tool (PS3M)
General objective	The general objective of the training is to make professional of system design aware of the complexity of PSS design and of the key aspects to manage when organising design methodologies in the industry.

The training is constituted by 4 training modules, further described below:

- Introduction to Product-Service-Systems (PSS) industrial strategies (1,5 hours);
- Discover several distinct PSS applicative fields (2 hours);

- Understand PSS design problematics and methodologies (1,5 hours) ;
- Experimentation of PSS design Case study (7)

Table 3_EMSE_02_Module 1 - Training Module specifications

Module specification	Explanation		
Teacher Name	X. Boucher		
Training Topic	Product-Service System design		
Training Code	EMSE_02		
Module Name	Introduction to Product-Service-Systems (PSS) industrial strategies		
Module duration	1,5 hours.		
Module objective	• General understanding on PSS industrial strategies • Understand key typologies and characteristics of PSS • Broad view on application fields • Understand key industrial impacts of PSS strategies		
Mode of provision	Lecture in classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	30 mn	PSS concepts and application fields	Teacher
	30 mn	PSS typologies and characteristics	Teacher
	30 mn	Servitization transformation, process	Teacher

Table 3_EMSE_02_Module 2 - Training Module specifications

Module specification	Explanation		
Teacher Name	X. Boucher		
Training Topic	Product-Service System design		
Training Code	EMSE_02		
Module Name	Discover several distinct PSS applicative fields		
Module duration	2 hours		
Module objective	Pragmatical creativity work to discover distinct applicative fields on PSS		
Mode of provision	Collaborative and collective work in classroom, with feedback from teacher		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	15 mn	Understand the objective of the work	Teacher
	75 mn	Creativity work : imagine, configure, and argument a PSS solution in a specific application field	Groups of students (3 to 5 person/group)
	30 mn	Debriefing with presentation of the collective work to the whole group, and feedback by teacher	Students and teacher

Table 3_EMSE_02_Module 3 - Training Module specifications

Module specification	Explanation		
Teacher Name	X. Boucher		
Training Topic	Product-Service System design		
Training Code	EMSE_02		
Module Name	Understand PSS design problematics and methodologies		
Module duration	1,5 hours.		
Module objective	• General understanding on PSS Design problematics • Provide a methodological background of PSS Design methodologies • Present PS3M modelling tool and the associated Design Method		
Mode of provision	Lecture in classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	30 mn	PSS Design problematics	Teacher
	30 mn	Methodologies for PSS design	Teacher
	30 mn	PS3M design approach and modelling toolkit	Teacher

Table 3_EMSE_02_Module 4 - Training Module specifications

Module specification	Explanation		
Teacher Name	X. Boucher		
Training Topic	Product-Service System design		
Training Code	EMSE_02		
Module Name	Experimentation of PSS design Case study		
Module duration	7 hours.		
Module objective	• Confront the students to a concrete and realistic situation of PSS design (BtoB industrial situation), with several steps of conceptual design. The design steps are supported by PS3M modelling tool, and a complementary objective is to develop concrete skills on the use of PS3M modelling toolkit. • The objective only covers a part of a full PSS design.		
Mode of provision	Interactive and collaborative sessions in Classroom + Homework		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	3 hours	Creativity Session to build and argument several alternative PSS offers, answering to an industrial BtoB situation	Students
	2 hours	Design PSS economic offers and contracts, with the support of PS3M toolkit.	Students

Module specification	Explanation		
	2 hours	Design and argument PSS delivery scenarios derived from the PSS solution resulting from creativity session. Model these scenarios with PS3M Toolkit	Students

The course content is available on the DigiFoF cloud in WP3 WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /EMSE/EMSE_02: Product-Service-System Design
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/EMSE/EMSE_02%3A%20Product-Service-System%20Design)

4.1.3 EMSE_03: Transformation of Industrial Business Model through digitalization and servitization

Table 1_EMSE_03. The training specification details

Training specification	Explanation
Organizer	EMSE France
Training Topic	Product-service systems & servitization : consequences on companies' business model and financial performance
Training objectives	Understand the consequences of PSS & servitization on companies' business model and financial performance
Method	Lecture and case study
Target groups	Students or professionals
Recommended composition	Only students or only professionals, from the same company or from different companies
Recommended size of groups	20 max
Training duration	1,5h (lecture) + 6h (case study)
Mode of tutoring	Lecture + Practical case study animation
Mode of provision	Lecture and case study
Tools and resources to be used (technological-support tools)	Traditional (PPT), videos Case study "Michelin Fleet Solutions: From selling tires to selling kilometres"; available on https://www.ccmp.fr/collection-hec-paris/cas-

Training specification	Explanation
	michelin-fleet-solutions-from-selling-tires-to-selling-kilometers
Recommended preparation	Not necessary
Modes of working in teams	The case study is realized in groups of 2-3 (students or professionals)
Communication and cooperation mode	Presentation, brain storming
Necessary abilities to tackle the tasks of open problems	Critical thinking
Knowledge prerequisites	None

Table 2_EMSE_03. Training competence

Competence specification	Explanation
Knowledge and skills	Understand: - what a "business model" is - how servitization/PSS impacts a firm BM - how servitization/PSS impacts the financial/economic model of a firm (revenues, costs, financing issues)
Professional competence	Use business model tools in order to shape a servitization strategy
General objective	Understand the consequences of PSS & servitization on companies' business model and financial performance

Table 3_EMSE_03.. Training Module specifications
Module 1: Lecture

Module specification	Explanation		
Teacher Name	S.Peillon		
Training Topic	Product-service systems & servitization : consequences on companies' business model and financial performance		
Training Code	EMSE_03		
Module Name	Lecture		
Module duration	1.5 hour		
Module objective	Understand: - what a "business model" is - how servitization/PSS impacts a firm BM - how servitization/PSS impacts the financial/economic model of a firm (revenues, costs, financing issues)		
Mode of provision	Classroom		
Laboratory	Time (min)	Objective	Performed by?

Module specification	Explanation		
structure	45 min	Consequences of PSS & servitization on companies' business model	Teacher
	45 min	Consequences of PSS & servitization on companies' financial performance	Teacher

Table 3_EMSE_03. Training Module specifications
Module 2: Case Study

Module specification	**Explanation**		
Teacher Name	S.Peillon		
Training Topic	Case study "Michelin Fleet Solutions: From selling tires to selling kilometres"		
Training Code	EMSE_03		
Module Name	Michelin Fleet Solutions: From selling tires to selling kilometers		
Module duration	3 hours		
Module objective	This case investigates the difficulties that industrial groups face when they transition from selling products to providing service. It enables participants to better understand: The initial rationale for industrial groups to move towards solution businesses, the many operational and organizational challenges of such a move, the shift in the business model addressed.		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	30 min	Presentation and reading of the case study	Students/Teacher
	30 min	Understand the offerings: tires vs. Michelin Fleet Solution (MFS)	Students/Teacher
	30 min	Identify the factors driving Michelin to move towards offering solutions	Students/Teacher
	30 min	Identify the benefits of the MFS offer from the customer's point of view	Students/Teacher
	30 min	Understand the difficulties encountered by Michelin to roll out the MFS offer	Students/Teacher
	30 min	Should Michelin abandon or go on with MFS?	Students/Teacher

The course content is available on the DigiFoF cloud in WP3 WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /EMSE/EMSE_03: Product-Service Systems & servitization: consequences on companies' business model and financial performance

(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/EMSE/EMSE_03%3A%20Transformation%20of%20Industrial%20Business%20Model%20through%20digitalization%20and%20servitization)

4.1.4 EMSE_04: Introduction to the concept of PSS and to the dedicated PS3M modelling method

Table 1_EMSE_04. The training specification details

Training specification	Explanation
Organizer	EMSE France
Training Topic	Introduction to the concept of PSS and to the dedicated PS3M modelling method
Training objectives	Understand the concept of Product System Service, and how the usual product design method and practices have to change. Discover and experiment a PSS dedicated modelling tool (PS3M) and design method
Method	- Introductory lecture to provide all required conceptual notions on PSS - Introductory lecture to explain the conceptual and methodological structure of a PSS design method - Practical PSS design case study executed on the PS3M modelling tool
Target groups	PhD Students, (NEMO Summer School)
Recommended composition	If possible mix between PhD students from engineering and managerial sciences
Recommended size of groups	30 persons, by groups of 2 or for the practical case study
Training duration	3h
Mode of tutoring	1h : lecture 2h : Case study animation with PSS Design Tool (PS3M)
Mode of provision	Lecture can be on distance. Case study with physical teaching.

Training specification	Explanation
Tools and resources to be used (technological-support tools)	Computer room, with installation of PS3M software.
Recommended preparation	Installation of software Download of case study computer data and import of data within PS3M If possible anticipatory lecture of general paper on PSS.
Modes of working in teams	Collaborative problem-solving
Communication and cooperation mode	/
Necessary abilities to tackle the tasks of open problems	Problem analysis, Problem-solving abilities, Synthesis
Knowledge prerequisites	Modelling abilities.

This training is expecting the following competence acquisition:

Table 2_EMSE_04. Training competence

Competence specification	Explanation
Knowledge and skills	- Good understanding of the strategical and organisational problematics linked to the industrial transition towards Product-Service-Systems - Pragmatic skills on manipulation of a modelling toolkit dedicated to PSS design
Professional competence	Modelling logic and approach for PSS design
General objective	The general objective of the training is to give a good overview knowledge on both strategical and design issues and problematics concerning PSS design and deployment.

The training is constituted by 4 training modules, further described below:

- General introduction to PSS strategies and problematics.
- Discover a PSS modelling toolkit, used as support for PSS design methodology.

Table 3_EMSE_04_Module 1- Training Module specifications

Module specification	Explanation
Teacher Name	X. Boucher
Training Topic	Product-Service System design
Training Code	EMSE_04
Module Name	General introduction to PSS strategies and problematics
Module duration	1 hour.

Module specification	Explanation		
Module objective	• General understanding on PSS industrial strategies • Industrial impacts of the transition towards PSS • Introduction to PS3M, a PSS dedicated modelling toolkit • Introduction to PS3A a decision-making solution for PSS value chain assessment		
Mode of provision	Lecture in classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	15 mn	PSS concepts and application fields	Teacher
	15 mn	Servitization impacts and management	Teacher
	15 mn	PS3M modelling toolkit introduction	Teacher
	15 mn	PS3A decision-making solution presentation	Teacher

Table _EMSE_04_Module 2- Training Module specifications

Module specification	Explanation		
Teacher Name	X. Boucher		
Training Topic	Introduction to the concept of PSS and to the dedicated PS3M modelling method		
Training Code	EMSE_04		
Module Name	Discover a PSS modelling toolkit		
Module duration	2 hours.		
Module objective	Discover a PSS dedicated modelling toolkit, and develop some concrete skills on PSS design		
Mode of provision	Computer room, with work by pair of 2 persons		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	30 min	Understand the ergonomics and ways to use PS3M toolkit and discover the AUTOMATON case study	teacher
	90 min	Create and model a PSS delivery scenario	students

The course content is available on the DigiFoF cloud in WP3 WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /EMSE/EMSE_04: Introduction to the concept of PSS and to the dedicated PS3M modelling method (https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/EMSE/EMSE_04%3A%20Introduction%20to%20the%20concept%20of%20PSS%20and%20to%20the%20dedicated%20PS3M%20modelling%20method)

4.1.5 EMSE_05: Circular Economy and Product-Service System

Table 1_EMSE_05. The training specification details

Training specification	Explanation
Organizer	EMSE France
Training Topic	Circular Economy and Product-Service System
Training objectives	To make students familiar with sustainable solution providing
Method	• Theoretical background teaching • Case study
Target groups	Master Students
Recommended composition	Students from various engineering background
Recommended size of groups	10 to 30
Training duration	7 hours (50% lecture, 50% project)
Mode of tutoring	Literature review, industrial cases review, Practical case study animation
Mode of provision	Teaching and workshop
Tools and resources to be used (technological-support tools)	No need for a special technological support
Recommended preparation	Read industrial cases and think about a solution
Modes of working in teams	Collective work
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	System approach, teamwork
Knowledge prerequisites	No prerequisites required

Table 2_EMSE_05. Training competence

Competence specification	Explanation
Knowledge and skills	Specific the knowledge and skills that are obtained at this training
Professional competence	Specific the competence acquired

Competence specification	Explanation
General objective	The general objective of the training

Table 3_EMSE_05_Module 1. Training Module specifications

Module specification	Explanation		
Teacher Name	E. Maleki		
Training Topic	Circular Economy and Product-Service System		
Training Code	EMSE_05		
Module Name	Unsustainability & Circular Economy		
Module duration	1.5 hours		
Module objective	Understand what causes the unsustainability & how Circular Economy can help		
Mode of provision	Theoretical background teaching		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	10	Critical trends that characterize the unsustainability of the current global situation	Teacher+Students
	30	Seeing the Bigger Picture : From linear to circular economy	Teacher+Students
	20	What circular economy is	Teacher+Students
	20	Possible solutions for a Circular Economy	Teacher+Students
	10	A new perspective: Rethink everything	Teacher+Students

Table 3_EMSE_05_ Module 2 - Training Module specifications

Module specification	Explanation		
Teacher Name	E. Maleki		
Training Topic	Circular Economy and Product-Service System		
Training Code	EMSE_05		
Module Name	Strategies to reach sustainability		
Module duration	1.5 hours		
Module objective	Create a global view of strategies to reach sustainability		
Mode of provision	Theoretical background teaching		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	15	Strategies to operationalize the circular approach : Product, production and consumption side	Teacher+Students

Module specification	Explanation		
		of reaching sustainability	
	75	Strategies & examples for moving towards Circular Solution: Depending on your role in company, there are various practices to implement circular solution.	Teacher+Students

Table 3_EMSE_05_Module 3 - Training Module specifications

Module specification	Explanation		
Teacher Name	E. Maleki		
Training Topic	Circular Economy and Product-Service System		
Training Code	EMSE_05		
Module Name	Sustainable Product-Service System		
Module duration	4 hours		
Module objective	Understand what a sustainable Product-Service System is.		
Mode of provision	Case study & Project-Based learning		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	15	Sustainable Solution-based approach	Teacher
	45	Dematerialization And Service Economy	Teacher + Students
	45	Bike Sharing Case	Students
	75	Industrial Machinery Case: Gear grinding machine	Students

The course content is available on the DigiFoF cloud in WP3 WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /EMSE/EMSE_05: A Circular Economy and Product-Service System

(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/EMSE/EMSE_05%3A%20Circular%20Economy%20and%20Product-Service%20System)

4.1.6 EMSE_06: Deployment of Service-oriented Strategy

Table 1_EMSE_06. The training specification details

Training specification	Explanation
Organizer	EMSE France
Training Topic	Interactive training with small and medium size industrial companies, to initiate a service-oriented strategy.
Training objectives	The objective is to bring various complementary competencies of the company, to work collaboratively on both strategic diagnosis and perspective development, so as to identify key strategical factors and incentive/resistance for service development, and key opportunities for initiating the transition.
Method	A structured framework is proposed, for various diagnosis steps : - Service-oriented strategical context analysis; - Service opportunities analysis, through business sectors - Collective competence transformation anticipation - Proposal of service development trajectory
Target groups	Vocational training: each training is dedicated to only one company. SMI companies with, a first contact with service activities, and an ambition to further develop service-oriented strategies
Recommended composition	Each group should gather actors from the key functions involved in product-service innovation in the companies, like top management board, marketing, sales management, system design and development, production, after sale services, customer relationship management.
Recommended size	15 persons
Training duration	2 days (4 half-day courses during 2 month)
Mode of tutoring	The seminar is full interactive diagnosis process, applied to the internal data of the company. The 2 days of training include three half-days in direct interaction with the actors for interview and information capture + one half-day of final debriefing and interaction. Additionally, the animators have to work 'off-line' additionally to the 2 training days on information analysis, synthesis and diagnosis.
Mode of provision	Interactive academic/industrial diagnosis process
Tools and resources to be used (technological-support tools)	Structured diagnosis methodology, including audit and diagnosis tools at different steps.
Recommended preparation	Top management of the company should be involved and should act as sponsor of the training. A preliminary awareness-raising on product-Service innovation strategies should be delivered to company staff.
Modes of working in teams	Collective problem analysis and solving. Collective creativity
Communication and cooperation mode	Physical interaction

Training specification	Explanation
Necessary abilities to tackle the tasks of open problems	Creativity, Innovation, Context analysis, Design thinking, System thinking.
Knowledge prerequisites	A preliminary awareness-raising on product-Service innovation strategies should be delivered to company staff.

This training is expecting the following competence development

Table 2_EMSE_06. Training competence

Competence specification	Explanation
Knowledge and skills	Understand the alternative innovation strategies linked to Product-Service-Design. Understand the approach of design-thinking applied to PSS context
Professional competence	- Capacity to analyse design oriented usage, in the context of the company ; - Capacity to manage a service-oriented creativity session , in the context of the company ; - Capacity to analyse the organisational impacts of new service development.
General objective	The general objective of the training is to help a SME company (key actors concerned by innovation) to configure a service-oriented innovation strategy, concerning one of its business area.

This training is composed of 4 modules, further described below:

- Understand the strategic innovation context of the company;
- Apply a creativity design-thinking approach on an innovation project;
- Anticipate the organizational impacts of service innovation;
- Evaluate and discuss the applicability of innovation proposals.

Table 3_EMSE_06_Module 1- Training Module specifications

Module specification	Explanation		
Teacher Name	S. Peillon, N. Dubruc, X.Boucher		
Training Topic	Deployment of Service-oriented Strategy		
Training Code	EMSE_06		
Module Name	Understand the strategic innovation context of the company		
Module duration	4 hours		
Module objective	• Capture the key strategical factors to understand the innovation context of a company (SME)		
Mode of provision	Directly in industrial context (by a company)		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for	Objective that need to be obtained	Who perform in this

Module specification	Explanation		
	this part		part
	90 min	Capture strategical innovation situation and factors from the Top Management (SME Manager)	PSS Experts + Company Top Manager
	90 min	Capture strategical innovation situation and factors from the Marketing and R&D departments	PSS Experts + Managers of Marketing and R&D departments
	60 min	Capture strategical innovation situation and factors from the Production and Sales departments	PSS Experts + Managers of Production and Sales departments

Table 3_EMSE_06_Module 2- Training Module specifications

Module specification	Explanation		
Teacher Name	S. Peillon, N. Dubruc, X.Boucher		
Training Topic	Deployment of Service-oriented Strategy		
Training Code	EMSE_06		
Module Name	Apply a creativity design-thinking approach on an innovation project		
Module duration	3,5 hours		
Module objective	• Put the key innovation actors of a company in situation to create imaginative new service-oriented offers, linked to a potential innovation project (on their proper business)		
Mode of provision	Directly in industrial context (by a company)		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	15 min	Share the objectives and structure of the session with all actors	PSS experts
	30 min	Make explicit the open usage expectations from different categories of clients	PSS Experts + Company Innovation Actors
	15 min	Synthesize and share the results	PSS Experts + Company Innovation Actors
	60 min	Create innovative PSS offers, through a design thinking mode	PSS Experts + Company Innovation Actors
	45 min	Synthesize and share the results of creativity session	PSS Experts + Company Innovation Actors
	45 min	Make explicit prioritization criteria and strategies concerning the potential deployment of PSS offers	PSS Experts + Company Innovation Actors

Table 3_EMSE_06_Module 3- Training Module specifications

Module specification	Explanation
Teacher Name	S. Peillon, N. Dubruc, X.Boucher
Training Topic	Deployment of Service-oriented Strategy

Module specification	Explanation		
Training Code	EMSE_06		
Module Name	Anticipate the organizational impacts of service innovation;		
Module duration	3 hours		
Module objective	• Make explicit the organisational impacts of developing innovative PSS offers, both on internal and external collective competencies		
Mode of provision	Directly in industrial context (by a company)		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	60 min	Analyse the key organisational difficulties and obstacles induced by an innovative service catalogue	PSS Experts + Company Top Manager
	60 min	Analyse the new requirements of internal and external competencies all along the life cycle of the new PSS offer	PSS Experts + Managers of Marketing and R&D departments
	60 min	Discuss the priorities and progressive strategies, for organisational change management	PSS Experts + Managers of Production and Sales departments

Table 3_EMSE_06_Module 4- Training Module specifications

Module specification	Explanation		
Teacher Name	S. Peillon, N. Dubruc, X.Boucher		
Training Topic	Deployment of Service-oriented Strategy		
Training Code	EMSE_06		
Module Name	Understand the strategic innovation context of the company		
Module duration	4 hours		
Module objective	• Confront the innovation path proposed, to the experience of the company managers		
Mode of provision	Directly in industrial context (by a company)		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	30 min	Presentation of the service catalogue and PSS offers resulting from the previous steps	PSS Experts
	60 min	Open discussion	Company managers
	30 min	Presentation of the organisation transformation path proposed	PSS Experts
	60 min	Open discussion	Company managers

The course content is available on the DigiFoF cloud in WP3 WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /EMSE/EMSE_06: A Deployment of Service-oriented Strategy

(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/EMSE/EMSE_06%3A%20Deployment%20of%20Service-oriented%20Strategy)

4.1.7 EMSE_07: Design Thinking for Product-Service System Design

Table 1_EMSE_07. The training specification details

Training specification	Explanation
Organizer	EMSE France
Training Topic	Design Thinking for Product-Service System Design
Training objectives	Defining a sustainable Product-Sevice System (PSS) using Design Thinking method and tool (OMILAB) • Design Thinking (Basics) • Industrial PSS Case • Design Thinking for PSS (OMILAB)
Method	• Theoretical background teaching • Case study
Target groups	Master Students Professionals
Recommended composition	Students or professions from various engineering background
Recommended size of groups	10 to 12
Training duration	14 hours (30% lecture, 70% project)
Mode of tutoring	Literature review, industrial cases review, Practical case study animation
Mode of provision	Teaching and workshop
Tools and resources to be used (technological-support tools)	No need for a special technological support
Recommended preparation	Read industrial cases and think about a solution

Training specification	Explanation
Modes of working in teams	Collective work
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	System approach, teamwork
Knowledge prerequisites	No prerequisites required

Table 2_EMSE_07. Training competence

Competence specification	Explanation
Knowledge and skills	Participants learn to collectively visualise a business scenario
Professional competence	Share and understand different viewpoints in system design
General objective	Facilitating collaborative design

Table 3_EMSE_07_Module 1. Training Module specifications

Module specification	Explanation		
Teacher Name	E. Maleki		
Training Topic	Design Thinking for Product-Service System Design		
Training Code	EMSE_07		
Module Name	Design Thinking (Basics)		
Module duration	3 hours		
Module objective	What Design Thinking is		
Mode of provision	Teaching		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	60	How to approach problems using Design Thinking	Teacher
	30	Design Thinking: 1. RESEARCH	Teacher+Students
	30	Design Thinking: 2. IDEATION	Teacher+Students
	30	Design Thinking: 3. PROTOTYPING	Teacher+Students
	30	Design Thinking & Systems Thinking	Teacher+Students

Table 3_EMSE_07_Module 2 - Training Module specifications

Module specification	Explanation
Teacher Name	E. Maleki

Module specification	Explanation		
Training Topic	Design Thinking for Product-Service System Design		
Training Code	EMSE_07		
Module Name	Industrial PSS Case		
Module duration	4 hours		
Module objective	Industrial PSS Case		
Mode of provision	Case study & Project-Based learning		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	45	High precision gear grinding process	Teacher+Students
	45	Damage of the metal sludge	Teacher
	30	Separation of grinding oil and metal	Teacher
	60	New “products-services” solution based on circular economy and used sales	Teacher+Students
	60	Possible scenario	Teacher+Students

Table 3_EMSE_07_Module 3 - Training Module specifications

Module specification	Explanation		
Teacher Name	E. Maleki		
Training Topic	Design Thinking for Product-Service System Design		
Training Code	EMSE_07		
Module Name	Design Thinking for PSS (OMILAB)		
Module duration	7 hours		
Module objective	Design Thinking for PSS (OMILAB)		
Mode of provision	Case study & Project-Based learning		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	30	Download and install Scene2Model	Teacher+Students
	45	OMILAB basics	Teacher+Students
	45	Possible scenario	Teacher+Students
	180	Group working	Teacher+Students
	120	Final presentations	Teacher+Students

The course content is available on the DigiFoF cloud in WP3 WP3_FoF_Designer:Innovative_Teaching_Methods_Tools

T3.2 -Teaching and training materials for the design /EMSE/EMSE_07: A Design Thinking for Product-Service System Design

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4.2 Courses provided by ULBS

4.2.1 ULBS_01: Workplace safety – Employees emotion recognition

Table 1_ULBS_01. The training specification details

Training specification	Explanation
Organizer	ULBS, Romania
Training Topic	Workplace safety – Employees emotion recognition
Training objectives	• Understand how emotions affect risk perception and behaviour • Understand, design and implement a method to recognize human emotions from live video sequences
Method	• Case study: losing control of your emotions means losing control of your safety • Work in teams
Target groups	• Master students (Computer Science) • Software engineers
Recommended composition	Individuals with basic programming knowledge
Recommended size of groups	10 to 15
Training duration	12 hours
Mode of tutoring	Expert input + practical case study
Mode of provision	Workshop / Classroom
Tools and resources to be used (technological-support tools)	Computer room with Java/Python or C# installed
Recommended preparation	Get familiar with OpenCV
Modes of working in teams	Collective work with distributed role
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Ability to work in team

Training specification	Explanation
Knowledge prerequisites	Basic programming knowledge

Table 2_ULBS_01. Training competence

Module specification	Explanation
Knowledge and skills	Understanding to working with some programming languages Improve the knowledge in machine learning domain
Professional competence	Capability to understand and develop applications that learn from experience
General objective	Improve the ability of programming computer Obtain knowledge in Imagine Processing

This training is structured in 4 different laboratories, each having two hours per week. The training period if four weeks. In following describes the organisation of each separate module.

1. Introduction to Python & OpenCV
2. Face detection
3. Supervised learning
4. Recognizing facial emotions

4.2.1.1 Introduction to Python & OpenCV

Table 3_ULBS_01_Modul1 1. Training Module specifications

Module specification	Explanation		
Teacher Name	eng. Valentin Fleaca		
Training Topic	Workplace safety – Employees emotion recognition		
Module Name	Introduction to Python & OpenCV		
Module duration	100 minutes		
Module objective	• getting familiar with Python • handling basic OpenCV API calls		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of this laboratory	Teacher
	5	Downloading and installing PyCharm	Teacher and students

Module specification	Explanation		
		& Python	
	10	Installing OpenCV, NumPy, SciPy	Teacher and students
	15	Python vs C++ vs Java	Teacher
	30	Python language exercises	Students
	35	OpenCV usage	Teacher and students

4.2.1.2 Face detection

Table 3_ULBS_01_Module_2. Training Module specifications

Module specification	Explanation		
Teacher Name	eng. Valentin Fleaca		
Training Topic	Workplace safety – Employees emotion recognition		
Module Name	Face detection – Implementing a face detection system		
Module duration	100 minutes		
Module objective	• Face detection in static images • Face detection in a video stream		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of this laboratory	Teacher
	25	Face detection: theory	Teacher
	20	Detecting faces in images	Teacher and students
	30	Detecting faces in video sequences	Students
	20	Project architecture setup	Teacher and students

4.2.1.3 Detecting facial landmarks

Table 3_ULBS_01_Module_3. Training Module specifications

Module specification	Explanation
Teacher Name	eng. Valentin Fleaca
Training Topic	Workplace safety – Employees emotion recognition

Module specification	Explanation		
Module Name	Understanding what facial landmarks are and how they can be detected.		
Module duration	100 minutes		
Module objective	• Understanding what facial landmarks are and how they can be detected. • Getting familiar with SciKit API calls		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of this laboratory	Teacher
	45	Detecting facial landmarks	Teacher
	50	OpenCV exercises	Students

4.2.1.4 Recognizing facial emotions

Table 3_ULBS_01_Module_4. Training Module specifications

Module specification	Explanation		
Teacher Name	eng. Valentin Fleaca		
Training Topic	Workplace safety – Employees emotion recognition		
Module Name	Recognition facial emotions		
Module duration	100 minutes		
Module objective	• Understanding facial emotions • Recognize human emotions from live video sequences		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of this laboratory	Teacher
	20	Facial expressions and emotions	Teacher
	25	Learning a classifier to recognize facial emotions from a dataset	Teacher and students
	30	Tuning the classifier parameters to increase accuracy	Students
	20	Live face emotion recognition	Students

Module specification	Explanation		
		system	

References	
Recommended Reading (Books and web pages)	https://opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_objdetect/py_face_detection/py_face_detection.html
	https://www.pyimagesearch.com/2016/02/08/opencv-shape-detection/
	https://www.pyimagesearch.com/2017/04/03/facial-landmarks-dlib-opencv-python/
More references (Books and web pages)	https://scikit-learn.org/stable/supervised_learning.html
	https://scikit-learn.org/stable/modules/svm.html

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /ULBS/ULBS_01: Workplace safety – Employees emotion recognition
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4.2.2 ULBS_02: Sibiu – Smart city modelling (ADOxx)

Table 1_ULBS_02. The training specification details

Training specification	Explanation
Organizer	ULBS, Romania
Training Topic	Sibiu – Smart City Modelling Smart city modelling becomes a necessity and represents an indirect effect of Industry 4.0 revolution. The industrial evolution has both benefits (increasing wellbeing) and

Training specification	Explanation
	drawbacks (city crowding). The level of welfare of many families can be measured by the number of owned cars; in many cases, the number more than one. But this means much more traffic which includes the public and heavy goods transport, creating congestion and, finally, air and noise pollution. Also, parking space and other infrastructure problems are the consequence of city crowding. For educational and demonstration purposes the OMiLAB Package contains three demonstration scenarios, in line with the architecture of the Evaluation Space. The third Demonstration Scenario links all three architectural layers - the Business Layer, the Conceptual Modelling Layer and the Proof of Concept Layer - together in a Smart City/Smart Parking teaching example. It employs the mBot on the CPS-Proof of Concept Layer and the SAP Scenes figures on the Business Layer as well as all modelling tools.
Training objectives	▪ Understand and apply a method for the design of smart city modelling ▪ Acquire operational skills on the use of ADOxx toolkits for Smart City modelling
Method	▪ Case study ▪ Practical work in team ▪ Model creation
Target groups	▪ Vocational training: professional of system design ▪ Master students
Recommended composition	Various industrial cultures (production, marketing, design)
Recommended size of groups	10 to 20
Training duration	8 hours
Mode of tutoring	Expert input + Practical case study animation
Mode of provision	Workshop
Tools and resources to be used (technological-support tools)	Computer Room with ADOxx modelling toolkit
Recommended preparation	Read a smart city case study

Training specification	Explanation
Modes of working in teams	Collective work with distributed role
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Creativity in system design, Coordination and communication abilities
Knowledge prerequisites	Smart City challenges

Training competence

Module specification	Explanation
Knowledge and skills	
Professional competence	
General objective	
Specific objective	

Table 3_ULBS_01_Module 1. Training Module specifications

Module specification	Explanation
Teacher Name	eng. Dobrila Petric
Training Topic	Smart city modeling
Module Name	• Modelling Tools presentation and theory about models and limitations and application area • How to create a new user? • Implementing fist model: Hello world • Smart City • Smart Parking
Module duration	8 hours
Module objective	• Understand and install a modelling tool • Implement a model • Method for the design of smart city modelling • Acquire operational skills on the use of ADOxx toolkits for Smart City modelling

Module specification	Explanation		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	20	Presentation of laboratory objectives	Teacher
	40	Installing ADOxx Development toolkit	Teacher and students
	40	Installing ADOxx Modelling toolkit	Teacher and students
	20	Creating ADOxx users	Teacher and students
	60	Introduction to ADOxx; Platform demonstration	Teacher
	60	Smart City modelling	Teacher and students
	30	Realize a static graphical visualization	Teacher and students
	30	Realize a dynamic graphical visualization	Teacher and students
	30	Realize a sensor for the common air quality index	Teacher and students
	30	Create a new relation case	Students
	60	ADOxx web simulation	Teacher and students
	60	Smart Parking	Students

The complete course content is detailed in DigiFoF cloud in WP3
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /ULBS/ULBS_02: Sibiu – Smart city modelling (ADOxx)

(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/ULBS/ULBS_02%3A%20Sibiu%E2%80%93Smart%20city%20modelling%20(ADOxx))

4.2.3 ULBS_03: Systems-oriented topics: Computer Vision for Manufacturing Industry Application

Table 1_ULBS_03. The training specification details

Training specification	Explanation
Organizer	ULBS, Romania
Training Topic	Computer Vision for Manufacturing Industry Application

Training specification	Explanation
Training objectives	• The main goal of the proposed method is the improvement of quality assurance techniques • The possibility of automated defect detection in the manufacturing process leading to improved productivity and high quality
Method	• Case study: investigations on various textures and images taken from production stages • Work in teams
Target groups	• Master students (Computer Science) • Software engineers
Recommended composition	Individuals with basic programming knowledge
Recommended size of groups	10 to 15
Training duration	8 hours
Mode of tutoring	Expert input + practical case study
Mode of provision	Workshop / Classroom
Tools and resources to be used (technological-support tools)	Computer room with Java/Python or C# installed
Recommended preparation	Get familiar with OpenCV
Modes of working in teams	Collective work with distributed role
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Ability to work in team
Knowledge prerequisites	Basic programming knowledge

Table 2_ULBS_03. Training competence

Module specification	Explanation
Knowledge and skills	Working with image processing libraries Improve the knowledge in image processing and computer vision domain

Professional competence	Capability to understand and develop applications The role of quality assurance and the benefits of assisted quality control
General objective	Improve the programming abilities Understanding Image Processing and Computer Vision

This training is structured in 4 lab sessions, two hours each. The total training time will last 4 weeks.

Table 3_ULBS_03_Module 1. Training Module specifications

Module specification	**Explanation**		
Teacher Name	Prof. dr. Remus Brad		
Training Topic	Computer Vision for Manufacturing Industry Application		
Module Name	Texture detection in quality control		
Module duration	8 hours (480 minutes)		
Module objective	• Introduction to Image processing and programming libraries • Texture Detection and Recognition • Feature Extraction and Applications • Quality Control and Computer Vision • Understanding image processing techniques • Implement a model • Method for the design of smart city modelling • Acquire operational skills on the use of ADOxx toolkits for Smart City modelling		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	20	Presentation of laboratory objectives	Teacher
	40	Installing and configuring Visual Studio Community. Installing OpenCV libraries	Teacher and students
	60	Introduction to OpenCV. First programs. Loading an image.	Teacher and students
	60	Working with images. Basic OpenCV Image Processing libraries.	Teacher
	60	Textures. Spectrum analysis. Fourier transform.	Teacher and students
	30	Gabor functions. Texture detection	Teacher and students
	30	Building an application for texture detection	Teacher and students
	30	Texture recognition. Defects in texture	Teacher and students
	30	Case studies cases with different	Students

Module specification	Explanation		
		textures, materials and defects	
	60	Industry applications of visual inspection	Teacher and students
	60	Case study presentation	Students

References	
Recommended Reading (Books and web pages)	https://opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_tutorials.html
	GONZALEZ Rafael C., WOODS Richard E., Digital Image Processing, London; Sydney, Pearson Prentice Hall
	https://www.pyimagesearch.com/2015/12/07/local-binary-patterns-with-python-opencv/
More references (Books and web pages)	FORSYTH David A., PONCE Jean, Computer Vision: A Modern Approach, Prentice Hall
	http://www.jezzamon.com/fourier/index.html
	https://www.mathworks.com/help/images/texture-analysis-1.html

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /ULBS/
(https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/ULBS/ULBS_03%20Systems-oriented%20topics%20Computer%20Vision%20for%20Manufacturing%20Industry%20Application.pdf)

4.2.4 ULBS_04: Systems-oriented topics: Computer Vision Applications – Parking Lot Availability Recognition

Table 1_ULBS_04. The training specification details

Training specification	Explanation
Organizer	ULBS, Romania
Training Topic	Computer Vision Applications – Parking Lot Availability Recognition

Training specification	Explanation
Training objectives	• The main goal is to gain an expertise in analysing, understanding, implementing and testing a Smart City solution using Computer Vision • The development of a computer vision system for the detection of parking spaces
Method	• Working with OpenCV library • Case studies on different benchmarks and image scenarios • Work in teams
Target groups	• Master students (Computer Science) • Software engineers
Recommended composition	Individuals with basic programming knowledge
Recommended size of groups	10 to 15
Training duration	8 hours
Mode of tutoring	Expert input + practical case study
Mode of provision	Workshop / Classroom
Tools and resources to be used (technological-support tools)	Computer room with Python or C# installed
Recommended preparation	Get familiar with OpenCV
Modes of working in teams	Collective work with distributed role
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Ability to work in team
Knowledge prerequisites	Basic programming knowledge

Table 2_ULBS_04. Training competence

Module specification	Explanation
Knowledge and skills	Working with image processing libraries Improve the knowledge in image processing and computer vision domain

Professional competence	Capability to understand and develop applications
General objective	Improve the programming abilities Understanding Image Processing and Computer Vision

This training is structured in 4 lab sessions, two hours each. The total training time will last 4 weeks.

Table 3_ULBS_04_Module 1. Training Module specifications

Module specification	**Explanation**		
Teacher Name	Prof. dr. Remus Brad		
Training Topic	Computer Vision Applications – Parking Lot Availability Recognition		
Module Name	Detecting parking spaces using feature recognition		
Module duration	8 hours (480 minutes)		
Module objective	• Introduction to Image processing and programming libraries • Smart city solutions • Feature detection, recognition and applications • Parking lot and Computer Vision • Implement a concept of smart city applications		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	20	Presentation of laboratory objectives	Teacher
	40	Installing Visual Studio Community and OpenCV library	Teacher and students
	60	Introduction to OpenCV. First application using OpenCV library. Loading an image file.	Teacher and students
	60	Image processing techniques and algorithms.	Teacher
	60	Feature extraction. Feature classification	Teacher and students
	60	Applications in object recognition	Teacher
	60	Case studies. Using different algorithms for feature detection in OpenCV	Teacher and students
	60	Applications in parking lot detection	Teacher and students
	60	Smart City solutions using Computer Vision	Students
	480		

Module specification	Explanation

References	
Recommended Reading (Books and web pages)	https://opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_tutorials.html
	GONZALEZ Rafael C., WOODS Richard E., Digital Image Processing, London; Sydney, Pearson Prentice Hall
	http://cnrpark.it/
More references (Books and web pages)	FORSYTH David A., PONCE Jean, Computer Vision: A Modern Approach, Prentice Hall
	Gou Koutaki, Takamochi Minamoto and Keiichi Uchimura - EXTRACTION OF PARKING LOT STRUCTURE FROM AERIAL IMAGE IN URBAN AREAS, Graduate School of Science and Technology, Kumamoto University, September 2015

The complete course content is available on the DigiFoF cloud in WP3: WP3_FoF_Designer:Innovative_Teaching_Methods_Tools (https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/ULBS/ULBS_04%20Image%20Processing%20for%20Parking%20Lot%20Availability%20Recognition.pdf)

4.2.5 ULBS_05: Process-oriented topics: Modelling and simulation-based design and optimization of manufacturing systems and processes on the ADOxx platform

Table 1_ULBS_05. The training specification details

Training specification	Explanation
Organizer	ULBS, Romania
Training Topic	Modelling and simulation-based design and optimization of manufacturing systems and processes on the ADOxx platform
Training objectives	▪ Understand and apply methods for the design of manufacturing systems and processes; ▪ Understand and apply methods for the optimisation of manufacturing systems operation; ▪ Acquire operational skills on the use of ADOxx toolkits for domain specific metamodeling;

	▪ Acquire operational skills on the use of ADOxx toolkits for manufacturing systems modelling and simulation.
Method	▪ Case studies; ▪ Metamodeling stage – the participants define together a Domain Specific Language optimally describing the domain of the studied cases. On its bases, they build the modelling and simulation tools; ▪ Modelling stage – grouped in team the participants compete in solving manufacturing systems design problem. They must design a system producing a given product assortment; ▪ Simulation stage – grouped in teams, the participants compete in solving manufacturing system optimisation problems. They must find the best schedule for a given product assortment.
Target groups	▪ Master students
Recommended composition	Various specialisation (IT, mechatronics, processes)
Recommended size of groups	12 to 20 (3 to 5 teams of 4 members)
Training duration	16 hours
Mode of tutoring	Guiding the discussion Design thinking Moderating the After-Action report
Mode of provision	Workshop
Tools and resources to be used (technological-support tools)	Computer room with ADOxx modelling toolkit
Recommended preparation	Forming the interdisciplinary teams Domain familiarizing lecture
Modes of working in teams	Competing teams
Communication and cooperation mode	Informal communication Team work
Necessary abilities to tackle the tasks of open problems	Creativity in system design; Coordination and communication abilities; Problem solving abilities
Knowledge prerequisites	Knowledge in Enterprise architecture; Cyber Physical Systems; Production equipment; Manufacturing systems and processes

Table 2_ULBS_05. Training competence

Module specification	Explanation
Knowledge and skills	Operational skills on the use of ADOxx for the design and optimisation of manufacturing systems Capability to understand and design flexible manufacturing systems

Professional competence	Ability to understand and apply methods for designing manufacturing systems
General objective	Improve the ability of modelling and simulating manufacturing systems Improve the ability of manufacturing systems optimisation

This training is structured in eight different units, each having two hours. The organisation of each separate module is described in the following section.

4.2.5.1 Introduction to Manufacturing Systems and ADOxx

Table 3_ULBS_05. Training Module 1 specifications

Module specification	Explanation		
Teacher Name	Associate Prof. PhD Eng. Ion Dan Mironescu		
Training Topic	Modelling and simulation-based design and optimization of manufacturing systems and processes on the ADOxx platform		
Module Name	Introduction to Manufacturing System (MS) and ADOxx		
Module duration	120 minutes		
Module objective	• Getting familiar with MS • Getting familiar with the ADOxx Tool		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of the unit	Teacher
	10	Remembering notions related to the manufacturing system	Teacher and students
	15	Remembering notions related to modelling and simulation	Teacher and students
	20	Introducing the concept of metamodeling	Teacher
	20	Presenting of the ADOxx platform	Teacher
	20	Practical exercise on the platform	Students
	25	Discussing the workflow metamodeling/modelling/simulation	Teacher and students
	5	Conclusions	Teacher and students

4.2.5.2 Metamodeling

Table 4_ULBS_05. Training Module 2 specifications

Module specification	Explanation		
Teacher Name	Associate Prof. PhD Eng. Ion Dan Mironescu		
Training Topic	Modelling and simulation-based design and optimization of manufacturing systems and processes on the ADOxx platform		
Module Name	Metamodeling		
Module duration	120 minutes		
Module objective	• getting familiar with the methodology of designing and implementing an Domain Specific Modelling Language (DSML) • learn to design a DSML for manufacturing system		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of the unit	Teacher
	30	Presenting the methodology for the definition and implementation of a domain specific language in ADOxx	Teacher
	30	Defining the elements of the metamodeling language	Teacher and students
	25	Defining the graphical representation of elements	Teacher and students
	25	Defining the behaviour of each element	Teacher and students
	5	Conclusions	Teacher and students

4.2.5.3 Model based design and analysis of manufacturing system

Table 5_ULBS_05. Training Module 3 specifications

Module specification	Explanation
Teacher Name	Associate Prof. PhD Eng. Ion Dan Mironescu
Training Topic	Modelling and simulation-based design and optimization of manufacturing systems and processes on the ADOxx platform
Module Name	Model based design and analysis of manufacturing system
Module duration	120 minutes
Module objective	• getting familiar with model based design methods • learning to analysis the models of design variant

Module specification	Explanation		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of the unit	Teacher
	10	Presenting the design problem	Teacher
	5	Organising the teams	Teacher and students
	40	Designing the solution in the modelling tool	Students
	10	Presenting the analysis tools and methods	Teacher
	30	Analyse the solution	Students
	15	Discuss the result	Teacher and students
	5	Conclusions	Teacher and students

4.2.5.4 Simulation based analysis of manufacturing system

Table 6_ULBS_05. Training Module 4 specifications

Module specification	Explanation		
Teacher Name	Associate Prof. PhD Eng. Ion Dan Mironescu		
Training Topic	Modelling and simulation-based design and optimization of manufacturing systems and processes on the ADOxx platform		
Module Name	Simulation based analysis of manufacturing system		
Module duration	120 minutes		
Module objective	• getting familiar with simulation tools • learning to perform an analysis of simulation results		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of the unit	Teacher
	20	Discussing the principle, the tools and expected simulation outcome	Teacher and students
	30	Performing simulation	Students in teams
	20	Discussing the principle and the tools for the analysis of the simulation results	Teacher and students
	30	Performing analysis	Students in teams
	10	Discussion of results	Teacher and students
	5	Conclusions	Teacher and students

Module specification	Explanation

4.2.5.5 Scheduling in manufacturing system

Table 7_ULBS_05. Training Module 5 specifications

Module specification	Explanation		
Teacher Name	Associate Prof. PhD Eng. Ion Dan Mironescu		
Training Topic	Modelling and simulation-based design and optimization of manufacturing systems and processes on the ADOxx platform		
Module Name	Scheduling in manufacturing system		
Module duration	120 minutes		
Module objective	• getting familiar with the key concept of scheduling • learn to elaborate an feasible schedule		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of the unit	Teacher
	15	Discussing the key concept of scheduling	Teacher and students
	5	Presenting a single machine process model	Teacher
	25	Elaborating a schedule for the proposed model	Teacher and students
	10	Presenting a multi-machine model	Teacher
	40	Elaborating a schedule for the proposed model	Students in teams
	15	Discussing the solutions	Teacher and students
	5	Conclusions	Teacher and students

4.2.5.6 Single objective optimisation of the schedule

Table 8_ULBS_05. Training Module 6 specifications

Module specification	Explanation
Teacher Name	Associate Prof. PhD Eng. Ion Dan Mironescu

Module specification	Explanation		
Training Topic	Modelling and simulation-based design and optimization of manufacturing systems and processes on the ADOxx platform		
Module Name	Single objective optimisation of a schedule		
Module duration	120 minutes		
Module objective	• getting familiar with the single objective optimisation methods • learning to optimise a schedule in respect to one objective		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of the unit	Teacher
	15	Discussing the optimisation of the schedule for one machine case	Teacher and students
	5	Presenting the problem	Teacher
	35	Solving the problem	Students in teams
	15	Discussing the optimisation of the schedule for multi machine case	Teacher and students
	5	Presenting the problem	Teacher
	35	Solving the problem	Students in teams
	5	Conclusions	Teacher and students

4.2.5.7 Multiple objective optimisation of the schedule

Table 9_ULBS_05. Training Module 7 specifications

Module specification	Explanation		
Teacher Name	Associate Prof. PhD Eng. Ion Dan Mironescu		
Training Topic	Modelling and simulation-based design and optimization of manufacturing systems and processes on the ADOxx platform		
Module Name	Multiple objective optimisation of schedule		
Module duration	120 minutes		
Module objective	• getting familiar with the multiple objective optimisation methods • learning to optimise in respect to one objective a schedule		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of	Teacher

Module specification	Explanation		
		the unit	
	30	Discussing the methods and algorithms for multiobjective optimisation of schedules	Teacher and students
	10	Presenting the multiobjective optimisation problem	Teacher
	15	Familiarising with Genetic Algorithm Optimisation (GAO) tools in Matlab	Teacher and students
	40	Solving the problem	Students in teams
	15	Discussing the results	Teacher and students
	5	Conclusions	Teacher and students

4.2.5.8 Final assessment

Table 10_ULBS_05. Training Module 8 specifications

Module specification	Explanation		
Teacher Name	Associate Prof. PhD Eng. Ion Dan Mironescu		
Training Topic	Modelling and simulation-based design and optimization of manufacturing systems and processes on the ADOxx platform		
Module Name	Final assessment		
Module duration	120 minutes		
Module objective	Test the acquired knowledge and skills		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of this laboratory	Teacher
	5	Organising the competing teams	Teacher and students
	5	Presenting the case	Teacher
	50	Constructing the solution for the case	Students in teams
	20	Presenting the solution	Students in teams
	20	Discussion of the solutions	Teacher and students
	15	Course conclusions	Teacher and students

The complete course content is available on the DigiFoF cloud in WP3 in ULBS folder

https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/ULBS/ULBS_05%20Sibiu%20-%20Modelling%20and%20simulation-based%20design%20and%20optimization%20of%20manufacturing%20systems%20and%20processes%20on%20the%20ADOxx%20platform.pdf

4.2.6 ULBS_06: Systems-oriented topics: Petri Nets based automation of manufacturing systems

Table 1_ULBS_06. Training specification details

Training specification	Explanation
Organizer	ULBS, Romania
Training Topic	Petri Nets based automation of manufacturing systems
Training objectives	▪ Understand and apply a method for designing robust and deadlock free control solution for manufacturing systems ▪ Acquire operational skills on the use of Petri Nets tools for automation
Method	▪ Stage 1 The students learn to model the plants and the automation system using the Petri net using a mix of think-pair-share and problem solving ▪ Stage 2 The students learn to express the automated system specification as Petri Net properties that must be satisfied using a mix of case studies and problem solving ▪ Stage 3 The students solve problems of a manufacturing system automation
Target groups	▪ Master students
Recommended composition	Interdisciplinary (IT specialists, Automatists, Cyber Physical Systems engineers, Process engineers)
Recommended size of groups	12 to 20 (3 to5 teams of 4)
Training duration	16 hours
Mode of tutoring	Case studies animation Active probing Problem presentation After Action Report animation
Mode of provision	Workshop

Tools and resources to be used (technological-support tools)	Computer Room with Petri Net tools (ADOxx)
Recommended preparation	Forming the interdisciplinary teams Domain familiarizing lecture
Modes of working in teams	Think-pair-share Competing teams
Communication and cooperation mode	Informal communication Problem solving abilities Team work
Necessary abilities to tackle the tasks of open problems	Coordination and communication abilities Problem solving
Knowledge prerequisites	Automatic control of processes Manufacturing processes

Table 2_ULBS_06. Training competence

Module specification	Explanation
Knowledge and skills	Operational skills on the use of Petri Nets tools for automation Capability to understand and design control system for flexible manufacturing systems
Professional competence	Be able to understand and apply methods for designing robust, deadlock free and performance oriented control solution for manufacturing systems
General objective	Improve the ability of modelling and simulating discrete events system Improve the ability of controlling discrete events system

This training is structured in 8 different units, each having two hours. In following is described the organisation of each separate module.

4.2.6.1 Introduction

Table 3_ULBS_06_Module_1 Training Module specifications

Module specification	Explanation
Teacher Name	Conf, dr ing Ion Mironescu
Training Topic	Petri Nets based automation of manufacturing systems
Module Name	Introduction to Flexible Manufacturing System and Petri net
Module duration	120 minutes
Module objective	• getting familiar with FMS • getting familiar with Petri net
Mode of provision	Classroom

Module specification	Explanation		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of the unit	Teacher
	10	Remembering notions related to the manufacturing system	Teacher and students
	15	Remembering notions related to the modelling and simulation	Teacher and students
	30	Presenting Petri nets	Teacher
	10	Analysing the philosopher's dinner	Students
	20	Introducing the Petri net tools	Teacher and students
	25	Constructing and analyising the philosopher/s dinner	Teacher and students
	5	Conclusions	Teacher and students

4.2.6.2 Modelling and simulation of manufacturing systems using Petri net

Table 3_ULBS_06_Module 2. Training Module specifications

Module specification	Explanation		
Teacher Name	Conf, dr ing Ion Mironescu		
Training Topic	Petri Nets based automation of manufacturing systems		
Module Name	Modelling and simulation of manufacturing systems using Petri net		
Module duration	120 minutes		
Module objective	• knowing the basic elements for the modelling of an FMS with Petri net		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of the unit	Teacher
	40	Exploring the possibilities of representing the FMS with elements of Petri net	Teacher and students
	5	Presenting an simple FMS example	Teacher
	30	Analysing the system	Teacher and students
	10	Constructing the net	Students
	25	Simulating and analysing the system	Teacher and students
	5	Conclusion	Teacher and students

Module specification	Explanation

4.2.6.3 The Automation System

Table 3_ULBS_06_Module_3. Training Module specifications

Module specification	Explanation		
Teacher Name	Conf, dr ing Ion Mironescu		
Training Topic	Petri Nets based automation of manufacturing systems		
Module Name	The Automation System		
Module duration	120 minutes		
Module objective	• learning to represent the control system as a Petri net		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of the unit	Teacher
	30	Exploring the possibilities of representing the control system with elements of Petri net	Teacher and students
	25	Presenting the theorem of controller synthesis and the general procedure	Teacher
	5	Assignment 1 presentation	Teacher
	20	Solving Assignment 1	Students
	5	Discussing solution to Assignment 1	Teacher and students
	5	Assignment 2 presentation	Teacher
	15	Solving Assignment 2	Students
	5	Discussing solution to Assignment 2	Teacher and students
	5	Conclusion	Teacher and students

4.2.6.4 Deadlock control

Table 3_ULBS_06_Module_4. Training Module specifications

Module specification	Explanation
Teacher Name	Conf, dr ing Ion Mironescu

Module specification	Explanation		
Training Topic	Petri Nets based automation of manufacturing systems		
Module Name	Deadlock control		
Module duration	120 minutes		
Module objective	▪ getting familiar with deadlocks in DES ▪ getting familiar with the possibilities of controlling deadlocks in FMS ▪ getting familiar with the possibilities of expressing constraints and enforcing them through supervisory control		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of this laboratory	Teacher
	10	Discovering the notions of deadlock and deadlock control	Teacher and students
	5	Assignment 1 presentation	Teacher
	10	Solving Assignment 1	Students
	5	Discussing solution to Assignment 1	Teacher and students
	5	Assignment 2 presentation	Teacher
	15	Solving Assignment 2	Students
	5	Discussing solution to Assignment 2	Teacher and students
	5	Assignment 3 presentation	Teacher
	20	Solving Assignment 3	Students
	5	Discussing solution to Assignment 3	Teacher and students
	5	Assignment 4 presentation	Teacher
	15	Solving Assignment 4	Students
	5	Discussing solution to Assignment 4	Teacher and students
	5	Conclusion	Teacher and students

4.2.6.5 Timed Petri Nets

Table 3_ULBS_06_Module_5. Training Module specifications

Module specification	Explanation
Teacher Name	Conf, dr ing Ion Mironescu
Training Topic	Petri Nets based automation of manufacturing systems
Module Name	Introduction to Flexible Manufacturing System and Petri net

Module specification	Explanation		
Module duration	120 minutes		
Module objective	• getting familiar with expressing constraints in Timed Petri net		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of this laboratory	Teacher
	25	Discussing the timed Petri Nets	Teacher and students
	5	Assignment 1 presentation	Teacher
	30	Solving Assignment 1	Students
	5	Discussing solution to Assignment 1	Teacher and students
	5	Assignment 2 presentation	Teacher
	30	Solving Assignment 2	Students
	5	Discussing solution to Assignment 2	Teacher and students
	5	Conclusion	Teacher and students

4.2.6.6 Supervisory control of FMS I

Table 3_ULBS_06_Module_6. Training Module specifications

Module specification	Explanation		
Teacher Name	Conf, dr ing Ion Mironescu		
Training Topic	Petri Nets based automation of manufacturing systems		
Module Name	Introduction to Flexible Manufacturing System and Petri net		
Module duration	120 minutes		
Module objective	• learn to design supervisory controllers for FMS using Petri net		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of this laboratory	Teacher
	5	Assignment 1 presentation	Teacher
	45	Solving Assignment 1	Students
	5	Discussing solution to Assignment 1	Teacher and students
	5	Assignment 2 presentation	Teacher
	45	Solving Assignment 2	Students
	5	Discussing solution to Assignment 2	Teacher and students

Module specification	Explanation		
	5	Conclusion	Teacher and students

4.2.6.7 Supervisory control of FMS II

Table 3_ULBS_06_Module_7. Training Module specifications

Module specification	Explanation		
Teacher Name	Conf, dr ing Ion Mironescu		
Training Topic	Petri Nets based automation of manufacturing systems		
Module Name	Supervisory control of FMS II		
Module duration	120 minutes		
Module objective	• learn to design supervisory controllers for FMS using Petri net		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
		Presenting the objectives and structure of this laboratory	Teacher
	5	Assignment 1 presentation	Teacher
	45	Solving Assignment 1	Students
	5	Discussing solution to Assignment 1	Teacher and students
	5	Assignment 2 presentation	Teacher
	45	Solving Assignment 2	Students
	5	Discussing solution to Assignment 2	Teacher and students
	5	Conclusion	Teacher and students

4.2.6.8 Final assessment

Table 3_ULBS_06_Module 8. Training Module specifications

Module specification	Explanation
Teacher Name	Conf, dr ing Ion Mironescu
Training Topic	Petri Nets based automation of manufacturing systems

Module specification	Explanation		
Module Name	Final assessment		
Module duration	120 minutes		
Module objective	Test the acquired knowledge and skills		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of this laboratory	Teacher
	5	Organising the competing Teams	Teacher and students
	5	Presenting the case	
	50	Constructing the solution for the case	Students in teams
	20	Presenting the solution	Students in teams
	20	Discussion of the solutions	Teacher and students
	15	Course conclusions	Teacher and students

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /ULBS/ULBS_06: Systems-oriented topics: Petri Nets based automation of manufacturing systems
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/ULBS/ULBS_06%3A%20Systems-oriented%20topics%3A%20Petri%20Nets%20based%20automation%20of%20manufacturing%20systems)

4.3 Courses provided by UNIBG

4.3.1 UNIBG_01: Process-oriented topic: Service Operations Management

Table 1_UNIBGS_01. The training specification details

Training specification	Explanation
Organizer	UNIBG Italy
Training Topic	Process-oriented topic: Service Operations Management
Training objectives	Process-oriented topic: The training allows the company's employees to understand the main concept of service, analyze in the associated processes and get to know the main techniques to classify and model them.
Method	• Case study • Team working • Business process modelling
Target groups	Engineering professionals or master students
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	Between 10 and 20
Training duration	6 hours
Mode of tutoring	Expert input + Practical case study animation
Mode of provision	Workshop
Tools and resources to be used (technological-support tools)	Tools and languages for process modeling
Recommended preparation	none
Modes of working in teams	Collective with distributed roles
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Creativity, Group working and collaborative skills

Training specification	Explanation
Knowledge prerequisites	None

Table 2_UNIBG_01. Training competence

Competence specification	Explanation
Knowledge and skills	The student acquires the necessary elements and concepts related to the service business both in pure service industry and in manufacturing. Through the utilization of theoretical and practical applications, focusing on both the strategic and operational aspects that characterize service management, operations and engineering, this course deals with service operations, organization, processes and performance measurement.
Professional competence	Manage the operations of a service company and of service department in a manufacturing company
General objective	Through the utilization of theoretical and practical applications, focusing on both the strategic and operational aspects that characterize service management, operations and engineering, this course deals with service operations, organization, processes and performance measurement.

Table _UNIBG_01. Training Module specifications

Module specification	Explanation		
Teacher Name	Dr. Giuditta Pezzotta		
Training Topic	Service Operations Management		
Training Code	UNIBG_01		
Module Name	Service Operations Management		
Module duration	6 h		
Module objective	• Understating of the main service features • Understating of how to design, describe and improve a service process • Understating on how to measure a service process		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	120 min	Introduction: Definition of service; The main characteristics of services (intangibility, inseparability, perishability, variability); The driving forces behind the growth of services	Dr. Giuditta Pezzotta
	120 min	Service Engineering & Operations: Definitions; Service Process models; Service Engineering & Operations methods	Dr. Giuditta Pezzotta
	120 min	The Performance measurement of	Dr. Giuditta Pezzotta

Module specification	Explanation		
		Services: An integrated Performance Measurement System; Customer Satisfaction and Customer Loyalty; The determinants of Customer Satisfaction; The gap model; The SERVQUAL model	

The complete course content is detailed in a separate archive name "UNIBG_01_Service Operations Management". The archive contains pdf files with the course.
(https://cloud.digifof.ulbsibiu.ro/index.php/f/5802)

4.3.2 UNIBG_02: Process-oriented topic: Business Process Modeling and Reengineering

Table 1_UNIBGS_02. The training specification details

Training specification	Explanation
Organizer	UNIBG Italy
Training Topic	Process-oriented topic: Business Process Modeling and Reengineering. Understand how to represent and improve a business process
Training objectives	The training allows the company's employees to explore the main methods and tools to analyze and improve business processes. Trainings on simulation techniques to develop what ifs analysis will be also proposed.
Method	• Team working • Practical case study • Modelling exercise • Process improvement through "what-if analysis" and simulation
Target groups	Professionals or master students
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	Between 10 and 15
Training duration	12 hours
Mode of tutoring	Expert input + Practical case study to be analyzed through simulation
Mode of provision	Workshop

Training specification	Explanation
Tools and resources to be used (technological-support tools)	Modelling tools and simulation software
Recommended preparation	none
Modes of working in teams	Group working
Communication and cooperation mode	Informal communication and shared documents and models
Necessary abilities to tackle the tasks of open problems	Group working skills
Knowledge prerequisites	Basic features of business processes

Table 2_UNIBG_02. Training competence

Competence specification	Explanation
Knowledge and skills	The student acquires the necessary elements and concepts related to business process modeling and reengineering, in terms of methods and tools to analyze and improve business processes. The student will get known of two static modelling languages (ARIS and IDEF 0) and of the main principles of simulation. At the end of the course, the student will also have a basic knowledge of the AREMA discrete event simulation software.
Professional competence	Analyse and improve processes, both service and manufacturing processes
General objective	Through the utilization of theoretical and practical applications, this course deals with business process modeling and reengineering, in terms of methods and tools to analyze and improve business processes. Trainings on simulation techniques to develop what ifs analysis will be also proposed.

The complete course content is detailed in a separate archive name "UNIBG_2_Business Process Modeling and Reengineering". The archive contains pdf files with the course.

Table 3_UNIBG_02_Module 1. Training Module specifications

Module specification	Explanation
Teacher Name	Dr. Fabiana Pirola
Training Topic	Business Process Modeling and Reengineering
Training Code	UNIBG_02
Module Name	Business Process Modeling
Module duration	4 h
Module objective	• Understanding the meaning of a process modeling • Making an analysis of the possible modeling tools

Module specification	Explanation		
	• Getting to know and use ARIS and IDEF0 • Apply these tools to a case study		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	120	Methods and Tools for Business Process Modeling	Dr. Fabiana Pirola
	120	Exercises on Methods and Tools for Business Process Modeling	Dr. Fabiana Pirola

Table 3_UNIBG_02_Module 2.

Module specification	Explanation		
Teacher Name	Dr. Fabiana Pirola		
Training Topic	Business Process Modeling and Reengineering		
Training Code	UNIBG_02		
Module Name	Business Process simulation		
Module duration	8 h		
Module objective	• What is simulation • Which are the main phases of a simulation project • What is Discrete Event Simulation (DES) • How to simulate with Arena		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	120	Introduction to simulation	Dr. Fabiana Pirola
	180	Arena tutorial	Dr. Fabiana Pirola
	180	Case study	Dr. Fabiana Pirola

The complete course content is available on the DigiFoF cloud in WP3:
The complete course content is detailed in a separate archive name "UNIBG_2_Business Process Modeling and Reengineering". The archive contains pdf files with the course.

(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/UNIBG/UNIBG_02_Business%20Process%20Modeling%20and%20Reengineering)

4.3.3 UNIBG_03: Process-oriented topic: Product-service system engineering

Table 1_UNIBGS_03. The training specification details

Training specification	Explanation
Organizer	UNIBG Italy
Training Topic	Process-oriented topic: Product-service system engineering
Training objectives	Process-oriented topic: The training allows the company's employees to understand the main concept of product-service system, get to know the main methods to design and engineer them.
Method	• Case study • Team working • Business process modelling
Target groups	Engineering professionals or master students
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	Between 10 and 20
Training duration	6 hours
Mode of tutoring	Expert input + Practical case study animation
Mode of provision	Workshop
Tools and resources to be used (technological-support tools)	none
Recommended preparation	none
Modes of working in teams	Collective with distributed roles
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Creativity, Group working and collaborative skills
Knowledge prerequisites	None

Table 2_UNIBG_03. Training competence

Competence specification	Explanation
Knowledge and skills	The student acquires the necessary elements and concepts related to the product service system in manufacturing. Through the utilization of theoretical and practical applications, this course deals with methods and tools to design and engineer product service systems starting from the analysis of customer needs.
Professional competence	Design and engineering product-service system in manufacturing companies
General objective	Through the utilization of theoretical and practical applications, deals with methods and tools to design and engineer product service systems starting from the analysis of customer needs.

Table 3_UNIBG_03. Training Module specifications

Module specification	Explanation		
Teacher Name	Dr. Giuditta Pezzotta		
Training Topic	Product-service system engineering		
Training Code	UNIBG_03		
Module Name	Product-service system engineering		
Module duration	6 h		
Module objective	• Understanding of the main service features • Understanding of how to design, assess and prototype product-service		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	120 min	Introduction: Definition of product-service; the main characteristics of services (intangibility, inseparability, perishability, variability)	Dr. Giuditta Pezzotta
	120 min	Methods and tools for product-service design and engineering	Dr. Giuditta Pezzotta
	120 min	Application to a case study	Dr. Giuditta Pezzotta

The complete course content is detailed in a separate archive name “UNIBG_03_ Product-service system engineering”. The archive contains pdf files with the course. (https://cloud.digifof.ulbsibiu.ro/index.php/f/5803)

4.3.4 UNIBG_04: Process-oriented topic: Process Simulation in manufacturing

Table 1_UNIBGS_04. The training specification details

Training specification	Explanation
Organizer	UNIBG Italy
Training Topic	Process-oriented topic: Process Simulation in manufacturing
Training objectives	The training allows the company's employees to explore the main concept of simulation and, in particular, discrete event simulation applied to manufacturing process.
Method	• Team working • Practical case study • Simulation exercise
Target groups	Professionals or master students
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	Between 10 and 15
Training duration	8 hours
Mode of tutoring	Expert input + Practical case study to be analyzed through simulation
Mode of provision	Workshop
Tools and resources to be used (technological-support tools)	Simulation software
Recommended preparation	none
Modes of working in teams	Group working
Communication and cooperation mode	Informal communication and shared documents and models
Necessary abilities to tackle the tasks of open problems	Group working skills
Knowledge prerequisites	Basic features of business processes

Table 2_UNIBG_01. Training competence

Competence specification	Explanation
Knowledge and skills	The student acquires the necessary elements and concepts related to simulation, specifically applied to manufacturing processes. The student will get known of the Flexsim discrete event simulation software.
Professional competence	Analyse and improve processes making what if analysis, with a specific focus on manufacturing plant simulation
General objective	Through the utilization of theoretical and practical applications, this course deals with process simulation. Trainings on discrete event simulation techniques to develop what ifs analysis are proposed.

Table 3_UNIBG_03. Training Module specifications

Module specification	Explanation		
Teacher Name	Dr. Fabiana Pirola		
Training Topic	Process Simulation in manufacturing		
Training Code	UNIBG_04		
Module Name	Business Process simulation		
Module duration	8 h		
Module objective	• What is simulation • Which are the main phases of a simulation project • What is Discrete Event Simulation (DES) • How to simulate with Flexsim		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	120	Introduction to simulation	Dr. Fabiana Pirola
	180	Flexsim tutorial with a case study	Dr. Fabiana Pirola
	180	Advanced topics in Flexsim	Dr. Fabiana Pirola

The complete course content is detailed in a separate archive name “UNIBG_4_-Process Simulation in manufacturing”. The archive contains pdf files with the course. (https://cloud.digifof.ulbsibiu.ro/index.php/f/5798)

4.4 Courses provided by UNIBIAL

Bialystok University of Technology (UNIBAL) provides the following trainings.

4.4.1 UNIBIAL_01: Process-oriented topics: Fundamentals of Business Process Management

Table 1_UNIBIAL_01. The training specification details

Training specification	Explanation
Organizer	Bialystok University of Technology, Poland
Training Topic	**Fundamentals of Business Process Management (BPM)**
Training objectives	Understanding the key aspects of process management in the enterprise. Hands-on learning process understanding and knowledge of the principles of analysis, designing and documentation processes. Understanding of modern IT systems supporting the process management and digitalization. Developing creativity and contextual thinking.
Date	II-XI 2020
Location	Bialystok University of Technology, Faculty of Engineering Management, OMILAB, Poland
Certificate	Does not provide a certificate
Method	lecture - presentation of basic theoretical content – 4h working in groups, case study and discussion – 1 1/2h discussion and summary – 1/2h
Target groups	Professionals of the same or different companies
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	Less than 10 persons
Training duration	1 day (6 hours)
Mode of tutoring	Lecture, case method
Mode of provision	Face to face training
Tools and resources to be used (technological-support tools)	IT tools for BPM
Recommended preparation	Understanding of fundamentals business management and its internal and external factors for development
Modes of working in teams	Collaborative problem-solving, Team/individual Q&A
Communication and cooperation mode	Presentations, sharing documents, discussions
Necessary abilities to tackle the tasks of open problems	Critical analysis skills, Group working skills
Knowledge prerequisites	Fundamentals of organization/business unit management

References	
Recommended Reading (Books and web pages)	Hammer M. (2015). *What is Business Process Management?* In: J. Vom Brocke, M. Rosemann (Eds.), Handbook on business process management 1: introduction, methods and information systems, Berlin, Springer, pp.3–16.
	Jeston, J., Nelis, J. (2014). *Business process management: practical guidelines to successful implementations*. London; New York, Routledge/Taylor a. Francis Group.
	Jurczuk A. (2019). *Multi-aspect identification and typology of sources of inconsistencies in business processes*, Bialystok University of Technology, Bialystok, 2019 (in Polish).
	Business Process Management Journal, www.emerald.com

Table 2_UNIBIAL_01.

Module specification	Explanation
Knowledge and skills	Acquisition a knowledge about the idea of process-oriented approach to enterprise management and fundamentals of business processes management Improving a knowledge about key-success factors of BPM and main sources of business process inconsistencies Improving skills of identification, analysis of business processes
Professional competence	Developing competence in process thinking for business management purposes
General objective	Developing an ability to creative thinking and problem-based thinking for BPM implementation

The training consists of two modules:

- Fundamentals of Business Process Management (BPM) - Understanding the concept and fundamentals of process management
- Fundamentals of Business Process Management (BPM) - Business processes identification and analysis

Table 3_UNIBIAL_01_Module_1. Training Module specification

Module specification	Explanation		
Teacher Name	Arkadiusz Jurczuk, PhD		
Training Topic	Process-oriented topics		
Training Code	UNIBIAL_01		
Module Name	Fundamentals of Business Process Management (BPM), part 1		
Module duration	4 hours		
Module objective	Understanding the concept and fundamentals of process management		
Mode of provision	classroom		
Lecture structure	Time (min)	Objective	Performed by?
	15	Presentation of the lecture and conceptual layers of OMILAB approach to improving process –	Teacher

Module specification	Explanation		
		oriented competencies	
	45	Presentation of theoretical background of process-oriented approach to enterprise management	Teacher
	45	Definition and classification of business processes.	Teacher
	45	Presentation of BPM life-cycle	Teacher
	45	Presentation and discussion key-success factors of BPM implementations	Teacher and students
	30	Presentation and discussion the state of the art in the field of BPM implementations	Teacher and students
	15	Q&A session	Teacher and students

Table 3_UNIBIAL_01_Module_2. Training Module specification

Module specification	Explanation		
Teacher Name	Arkadiusz Jurczuk, PhD		
Training Topic	Process-oriented topics		
Training Code	UNIBIAL_01		
Module Name	Fundamentals of Business Process Management (BPM), part 2		
Module duration	2 hours		
Module objective	Improving the ability and skills of business processes identification and analysis		
Mode of provision	classroom		
Lecture structure	Time (min)	Objective	Performed by?
	15	Presentation the idea and an objective and expected outputs from a case study	Teacher
	90	Improving skills of identification, analysis of business processes	Students
	15	Discussion and summary of the outputs	Teacher and students

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /UNIBIAL
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files/?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/UNIBIAL&fileid=4221)

4.4.2 UNIBIAL_02: Strategy-oriented topics: Product and service design with design thinking and business model canvas creation

Table 1_UNIBIAL_02. The training specification details

Training specification	Explanation
Organizer	Bialystok University of Technology, Poland
Training Topic	**Strategy-oriented topics: Product and service design with design thinking and business model canvas creation**
Training objectives	Improving the ability to create and develop business models; improving skills of identifying weaknesses of current solutions, seeking opportunities for the development, planning, visualization; designing new products, creating innovative solutions, planning their implementation in practice; solving problems; basic analysis of selected elements of the organization's environment; improving the skills of teamwork, communication and presentation of prepared solutions.
Date	VII-XII 2020
Location	Bialystok University of Technology, Faculty of Engineering Management
Certificate	No
Method	presentation of basic theoretical content and example case study on business model canvas (BMC), 9 blocks of BMC: discussion of a given model element and its individual creation; presentation of basic theoretical content and implementation of the individual steps of the design thinking process; presentation and discussion of results
Target groups	Professionals of the same or different companies
Recommended composition	homogeneous or heterogeneous
Recommended size of groups	between 10 and 20
Training duration	1 day (6 hours)
Mode of tutoring	lecture, case study discussion, solving the problem under the guidance of the tutor
Mode of provision	Face to face workshop
Tools and resources to be used (technological-support tools)	from OMiLAB laboratories (access to computer workstations with Internet access and a basic business package, sheets of paper, post-it notes, creative space, magnetic board, materials to create a prototype)
Recommended preparation	none
Modes of working in teams	collaborative problem-solving
Communication and cooperation mode	word documents, the group workspace, messaging and texting
Necessary abilities to tackle the tasks of open problems	critical analysis, problem solving, presentation skills, communication skills, group working skills, presentation skills
Knowledge prerequisites	fundamentals of business management

References	
Recommended Reading (Books and web pages)	Shafer S. M., Smith H. J., & Linder J. C. (2005). *The power of business models*. Business Horizons 48(3), 199-207, doi:10.1016/j.bushor.2004.10.014.
	Osterwalder A. & Pigneur Y. (2010) *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*, John Wiley & Sons.
	Osterwalder A., Pigneur Y., Papadakos P., Bernarda G., Papadakos T., & Smith A. (2014). *Value Proposition Design: How to Create Products and Services Customers Want*, John Wiley & Sons.
	Liedtka J. & Ogilvie T. (2011). *Designing for Growth: A Design Thinking Tool Kit for Managers*, Columbia Business School Publishing.
	Lockwood T. (2010). *Design thinking : integrating innovation, customer experience and brand value*, Allworth Press: Design Management Institute, New York.
	Brown T. (2008). *Design Thinking*. Harvard Business Review 86(6), 84-92.

Table 2_UNIBIAL_02 - Training competence

Module specification	Explanation
Knowledge and skills	Knowledge: what is a business model, business model in Osterwalder's view, advantages and disadvantages of BMC, examples of implementation, characteristics of blocks of the business model scheme representing various aspects of the company's functioning; basics of the creative process, expected effects and stages of design thinking; explanation of the methods supporting the realization of particular stages. Skills: creation of business model canvas; realization of particular stages of design thinking; discussion and presentation of prepared solutions.
Professional competence	Create and develop business models in context of strategy creation. Designing new products and solutions using design thinking approach.
General objective	Improving the ability to collaborate, to think creatively, to stimulate own innovativeness while creating products and services.

The training consists of two modules:

- **business model canvas for FoF strategy creation,**
- **design thinking for product and service design.**

Table 3_UNIBIAL_02_Module_1. Training Module specification

Module specification	Explanation
Teacher Name	Alicja Gudanowska, PhD
Training Topic	Strategy-oriented topics: Product and service design with design thinking and business model canvas creation
Training Code	UNIBIAL_02
Module Name	Business model canvas for FoF strategy creation

Module specification	Explanation		
Module duration	2 hours		
Module objective	• improving the ability to create and develop business models; • improving skills of identifying weaknesses of current solutions, seeking opportunities for the development; • improving skills of planning, visualization; • improvement of skills of teamwork and presentation of prepared solutions.		
Mode of provision	classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of OMiLAB laboratory	Teacher
	20	Presentation of basic theoretical content and example case study	Teacher
	5	Division of teams, clarification of the subject matter of each team	Teacher and students
	75	9 blocks: discussion of a given model element and its individual creation	Teacher and students
	15	Summary and presentation	Students

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer: Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /UNIBIAL
https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/UNIBIAL/UNIBIAL_02_Business%20model%20canvas%20for%20FoF%20strategy%20creation.pdf

Table 3_UNIBIAL_02_Module_2. Training Module specification

Module specification	Explanation
Teacher Name	Alicja Gudanowska, PhD
Training Topic	Strategy-oriented topics: Product and service design with design thinking and business model canvas creation
Training Code	UNIBIAL_02
Module Name	Design thinking for product and service design
Module duration	4 hours
Module objective	• improving the skills of designing new products, creating innovative solutions, planning their implementation in practice, solving problems; • improving skills of analysis of selected elements of the organization's environment; • improving the skills of teamwork, communication and presentation of prepared solutions.
Mode of provision	classroom

Module specification	Explanation		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presentation of the objectives and structure of OMiLAB laboratory	Teacher
	20	Presentation of basic theoretical content	Teacher
	10	Division of teams, clarification of the design challenge	Teacher and students
	160	Implementation of the individual steps of the design thinking process	Students
	30	Presentation of results	Students
	15	Evaluation round and ideas for improvement	Teacher and students

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer: Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /UNIBIAL

https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/UNIBIAL/UNIBIAL_02_Design%20thinking%20for%20product%20and%20service%20design.pdf

4.4.3 UNIBIAL_03: Systems-oriented topics: Artificial intelligence tools and modelling virtualized resources for Industry 4.0 transformation

Table 3_UNIBIAL_03. The training specification details

Training specification	Explanation
Organizer	Bialystok University of Technology, Poland
Training Topic	**Artificial intelligence tools and modelling virtualized resources for Industry 4.0 transformation**
Training objectives	Acquainting participants with knowledge regarding fundamentals of Industry 4.0 technologies and trends and cloud manufacturing paradigm; shaping the ability of data sources identification and data acquisition; introducing the basics of artificial intelligence tools enabling industrial transformation; shaping the ability of modelling and simulations with the use of chosen artificial intelligence tools.
Date	VII-XII 2020
Location	Bialystok University of Technology, Faculty of Engineering Management
Certificate	No
Method	Presentation of the basic theoretical contents concerning Industry 4.0 technologies and cloud manufacturing paradigm, examples of data acquisition and data sources identifications, identifying data sources, data acquisition, identifying virtualizable resources and capabilities,

Training specification	Explanation
	presentation of the basic theoretical contents in the field of artificial intelligence methods, creating neural network models, discussion and summary.
Target groups	Professionals of the same or different companies
Recommended composition	homogeneous or heterogeneous
Recommended size of groups	between 10 and 20
Training duration	1 day (6 hours)
Mode of tutoring	lecture, case study discussions
Mode of provision	Face to face workshop
Tools and resources to be used (technological-support tools)	from OMiLAB laboratory (computer workstations with Internet access and a basic business package)
Recommended preparation	none
Modes of working in teams	Individual Q&A, collaborative problem-solving
Communication and cooperation mode	Excel documents, the group workspace, open source AI software
Necessary abilities to tackle the tasks of open problems	critical analysis, problem solving, presentation skills, communication skills
Knowledge prerequisites	fundamentals of business management

References	
Recommended Reading (Books and web pages)	Li W., Mehnen J. (eds.). (2013). *Cloud Manufacturing. Distributed Computing Technologies for Global and Sustainable Manufacturing*; Springer, 2013.
	Liu Y., & Xu X. (2016). *Industry 4.0 and cloud manufacturing: a comparative analysis*. Journal of Manufacturing Science and Engineering, 139(3), 1-8. doi: 10.1115/1.4034667
	Yuan M., Deng K., & Chaovalitwongse W. A. (2017). *Manufacturing Resource Modeling for Cloud Manufacturing*. International Journal of Intelligent Systems, 32(4), 414-436. doi: 10.1002/int.21867.
	Rutkowski L. (2008)., *Computational Intelligence: Methods and techniques*, Springer.
	Surma J. (2011). *Business Intelligence. Making Decisions Through Data Analytics*, Business Expert Press.
	Shanmuganathan S., Samarasinghe S. (eds.). (2016)., *Artificial Neural Network Modelling*, Springer.

Table 2_UNIBIAL_03 - *Training competence*

Module specification	Explanation
Knowledge and skills	Knowledge: review of cloud manufacturing paradigm; characteristics of key enabling technologies; service modelling; basics of service

	composition and management; resources and capabilities virtualization; fundamentals of Industry 4.0 and presentation of digital technologies and trends enabling industrial transformation Fundamentals of artificial intelligence, explanation of expert systems and artificial neural networks. Skills: fundamentals of data mining - gathering and analyzing data enabling efficient manufacturing processes; proposing ideas of expert systems supporting decision making process and problem solving. Modelling with the use of artificial neural networks.
Professional competence	Shaping the ability of data sources identification and data acquisition and the ability of modelling and simulating with the use of artificial neural networks; designing expert systems supporting decision processes.
General objective	Acquainting participants with knowledge regarding fundamentals of cloud manufacturing paradigm, Industry 4.0 technologies and trends; introducing the basics of artificial intelligence tools enabling industrial transformation.

The training consists of two modules:

- **Artificial intelligence tools for Industry 4.0 transformation,**
- **Cloud manufacturing for modelling virtualized resources.**

Table 3_UNIBIAL_03_Module_1. Training Module specification

Module specification	**Explanation**		
Teacher Name	Julia Siderska, PhD		
Training Topic	**System-oriented topics: Artificial intelligence tools and modelling virtualized resources for Industry 4.0 transformation**		
Training Code	UNIBIAL_03		
Module Name	Artificial intelligence tools for Industry 4.0 transformation		
Module duration	4 hours		
Module objective	• improving the ability of modelling with the use of artificial neural networks; • improving skills of supporting decision process with the use of expert systems; • improvement skills of teamwork and presentation of prepared solutions.		
Mode of provision	classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presenting the objectives and structure of OMiLAB laboratory	Teacher
	45	Presentation of basic theoretical content and examples of neural network models	Teacher
	5	Division of teams, clarification of the subject matter of each team	Teacher and students
	60	Explanation of the neural model assumptions and its individual creation	Teacher and students
	45	Presentation of basic theoretical	Teacher

Module specification	Explanation		
		content and examples of expert systems	
	60	Explanation of the expert system assumptions and its individual creation	Teacher and students
	20	Summary and presentation of results	Students

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer: Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /UNIBIAL

https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/UNIBIAL/UNIBIAL_03_%20Artificial%20intelligence%20tools%20for%20Industry%204.0%20transformation.pdf

Table 3_UNIBIAL_03_Module_2. Training Module specification

Module specification	Explanation		
Teacher Name	Julia Siderska, PhD		
Training Topic	**System-oriented topics: Artificial intelligence tools and modelling virtualized resources for Industry 4.0 transformation**		
Training Code	UNIBIAL_03		
Module Name	Cloud manufacturing for modelling virtualized resources		
Module duration	2 hours		
Module objective	• improving the skills of identifying virtualizable resources and capabilities; • shaping the ability of data sources identification and data acquisition; • acquainting with the knowledge concerning cloud manufacturing paradigm; and its' conceptual framework.		
Mode of provision	classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Presentation of the objectives and structure of OMiLAB laboratory	Teacher
	40	Presentation of basic theoretical content	Teacher
	40	Examples of data acquisition and data sources identifications, identifying data sources; data acquisition	Teacher and students
	20	Identifying virtualizable resources and capabilities	Students
	15	Discussion and summary	Teacher and students

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer: Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /UNIBIAL

https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/UNIBIAL/UNIBIAL_03_%20Cloud%20manufacturing%20for%20modelling%20virtualized%20resources.pdf

4.5 Courses provided by UNIOULU

4.5.1 UNIOULU_01: Process-oriented topic: Robotics application in Virtual Laboratory

Table 1_UNIOULU_01. Training specifications

Training specification	Explanation
Organizer	University of Oulu (UNIOULU) Finland
Training Topic	Process-oriented topic: Robotics application in Virtual Laboratory
Training objectives	Have knowledge of robotics process conceptual modelling based on ADOxx platform Be capable of implementing some hands-on tools (adopting Bee-up) to design the models Get the basic ideas how robots cooperate in the real settings Cultivate more sense of robotics
Method	Modelling practice case study
Target groups	Vocational training: professionals on automation Master students (Advanced Computing Systems)
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	Less than 10 people
Training duration	2 days
Mode of tutoring	Lecture, case study
Mode of provision	Workshop/laboratory-based training
Tools and resources to be used (technological-support tools)	Modelling tools
Recommended preparation	Basic knowledge about modelling and robotics
Modes of working in teams	Group discussion
Communication and cooperation mode	Informal communication Problem solving capacities
Necessary abilities to tackle the tasks of open problems	Problem solving
Knowledge prerequisites	Basic knowledge about robotics

Table 2_UNIOULUI_01. Training competence

Module specification	Explanation
Knowledge and skills	Understanding of ROS Understanding sensors in robotics Basic ability to program a robot Modelling skills
Professional competence	Ability to model and implement robotic applications
General objective	Learning robotics Obtain knowledge in modelling

This training is structured in 5 different laboratories. Four of the modules are two hour trainings and fifth is hands on lasting whole day. Modules are teach every other week so that the training period is 10 weeks. In following describes the organisation of each separate module.

1. ROS
2. Sensors
3. Robot
4. Modelling
5. Case study

4.5.1.1 ROS

Table 3_UNIOULUI_01_Module_1

Module specification	Explanation		
Teacher Name	--		
Training Topic	Robotics application in Virtual Laboratory		
Training Code	UNIOULU_01_ROS		
Module Name	Robotic operating system		
Module duration	100 min		
Module objective	• Introduction to robotic operating system • Installing ROS • Understanding of ROS Topics, Services and Parameters • Understanding of Simple Publisher and Subscriber • Understanding of Simple service and client		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	10	Introduction	Teacher
	15	Installation	Students
	25	First node	Teacher/ Students
	25	Topics	Teacher/ Students

Module specification	Explanation		
	20	Services	Teacher/ Students
	5	Finishing	Teacher

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /UNIOULU/ UNIOULU_01_Process-oriented_topic_Robotics_application_in_Virtual_Laboratory

https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/UNIOULU/UNIOULU_01_Process-oriented_topic_Robotics_application_in_Virtual_Laboratory/UNIOULU_01_ROS.pdf

4.5.1.2 Sensors

Table 3_UNIOULUI_01_Module_2

Module specification	Explanation		
Teacher Name	--		
Training Topic	Robotics application in Virtual Laboratory		
Training Code	UNIOULU_01_sensors in robotics		
Module Name	Sensors in robotics		
Module duration	100 minutes		
Module objective	• Introduction to sensors in robotics • Distance and depth sensors • Getting (and presenting) data from sensor • Interacting with sensor • Data processing		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Introduction	Teacher
	35	Sensor interaction	Teacher
	60	Exercise with forward sensor	Students

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools

T3.2 -Teaching and training materials for the design /UNIOULU/ UNIOULU_01_Process-oriented_topic_Robotics_application_in_Virtual_Laboratory
https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/UNIOULU/UNIOULU_01_Process-oriented_topic_Robotics_application_in_Virtual_Laboratory/UNIOULU_02_SENSORS.pdf

4.5.1.3 Kinematics

Table 3_UNIOULUI_01_Module_3

Module specification	**Explanation**		
Teacher Name			
Training Topic	Robotics application in Virtual Laboratory		
Training Code	UNIOULU_01 Kinematics		
Module Name	Kinematics		
Module duration	100 minutes		
Module objective	•Setup •Controlling robot via ROS •Kinematics •Sensor interaction		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	5	Introduction	Teacher
	35	Kinematics and sensor interaction	Teacher
	60	Exercise with forward kinematics	Students

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /UNIOULU/ UNIOULU_01_Process-oriented_topic_Robotics_application_in_Virtual_Laboratory
https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/UNIOULU/UNIOULU_01_Process-oriented_topic_Robotics_application_in_Virtual_Laboratory/UNIOULU_03_KINEMATICS.pdf

4.5.1.4 Modelling robotics

Table 3_UNIOULUI_01_Module_4

Module specification	Explanation		
Teacher Name			
Training Topic	Robotics application in Virtual Laboratory		
Training Code	UNIOULU_01		
Module Name	Modelling robotics		
Module duration	100 minutes		
Module objective	• Install modelling tools • Understand basics of modelling • Model of simple real-life case		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	10	Introduction	Teacher
	15	Modelling language implemented in BeeUp	Teacher
	10	Installing BeeUp	Students
	20	Using BeeUp	Teacher and Students
	15	Simple models	Students
	25	Warehouse example	Students
	5	Finishing	

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /UNIOULU/ UNIOULU_01_Process-oriented_topic_Robotics_application_in_Virtual_Laboratory
https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/UNIOULU/UNIOULU_01_Process-oriented_topic_Robotics_application_in_Virtual_Laboratory/UNIOULU_04_modelling_robots.pdf

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer: Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design/UNIOULU/UNIOULU_01_Process-oriented_topic_Robotics_application_in_Virtual_Laboratory
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/UNIOULU/UNIOULU_01_Process-oriented_topic_Robotics_application_in_Virtual_Laboratory)

4.6 Courses provided by OMiLAB

4.6.1 OMiLAB_01: The OMILAB Ecosystem: Characteristics and Application Cases

Table 1_OMiLAB_01. The training specification details

Training specification	Explanation
Organizer	OMILAB NPO (Germany)
Training Topic	The OMILAB Ecosystem: Characteristics and Application Cases
Training objectives	The training introduces OMILAB, its characteristics and application cases using a scenario-based approach. The training objective is to provide the foundation to other modules using OMILAB infrastructure and cases as an innovative training facility.
Method	• OMILAB Introduction: • Elements and building blocks of the physical and virtual OMILAB • The Smart Supermarket Case: a case for innovative service design, modelling and feasibility evaluation.
Target groups	Any interested party
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	10
Training duration	1 hours
Mode of tutoring	Presentation and Demonstration
Mode of provision	Interactive Demonstration
Tools and resources to be used (technological-support tools)	Physical OMILAB Space
Recommended preparation	None
Modes of working in teams	N/A
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Creativity, Group working and collaborative skills

Training specification	Explanation
Knowledge prerequisites	None

Table 2_OMiLAB_01.Training competence

Competence specification	Explanation
Knowledge and skills	The students acquire the idea of smart models within the OMILAB ecosystem
Professional competence	Innovation processes are externalized and supported
General objective	Experience on the practical aspect of the OMILAB towards innovation

Table 3_OMiLAB_01.Training Module specifications

Module specification	Explanation		
Teacher Name	OMILAB Team Member		
Training Topic	The OMILAB Ecosystem: Characteristics and Application Cases		
Training Code	OMILAB_01		
Module Name	The OMILAB Ecosystem: Characteristics and Application Cases		
Module duration	1 h		
Module objective	• Understand the OMILAB Setup and Environment • Understand the collaborative nature (physical and virtual) • Understand the purpose of modelling		
Mode of provision	OMILAB Laboratory (Creative Space		
Laboratory structure	Time (min)	Objective	Performed by?
	30 min	Introduction to the OMILAB	OMILAB Team
	30 min	Demonstration of a end-to-end case: Smart Supermarket	OMILAB Team

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /OMILAB/Module1_OMiLAB-Ecosystem_OMiLAB
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/OMILAB/Module1_OMiLAB-Ecosystem_OMiLAB).

4.6.2 OMiLAB_02: Fundamental Conceptual Modelling Languages using Bee-Up

Table 1_OMiLAB_02.The training specification details

Training specification	Explanation
Organizer	OMILAB NPO (Germany)
Training Topic	Fundamental Conceptual Modelling Languages using Bee-Up
Training objectives	The training introduces fundamental conceptual modelling languages and the aspect of model value. The modelling languages are introduced and exemplified.
Method	• Theoretical Foundation: Modelling Languages • Demonstration: Bee-Up: a hybrid implementation of modelling languages • Case: Modelling Case (Guided example) with model processing and interrelation to CPS
Target groups	Engineering students and domain experts
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	10
Training duration	3 hours
Mode of tutoring	Expert input + Practical case study + Group work
Mode of provision	Demonstration and Workshop
Tools and resources to be used (technological-support tools)	Bee-Up Modelling Toolkit, Laboratory Infrastructure
Recommended preparation	Background in domain-specific modelling, conceptual modelling
Modes of working in teams	Collective with distributed roles
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Creativity, Group working and collaborative skills
Knowledge prerequisites	None

Table 2_OMiLAB_02.Training competence

Competence specification	Explanation
Knowledge and skills	The students acquire the skills of conceptual modelling and languages provided in the form of domain-specific modelling languages and understand the term “model value”. The case provides practical skills in the modelling and analysis tasks.
Professional competence	Teamwork, collaboration
General objective	Provide practical experience with conceptual modelling and stimulate further discussion and thematic background for the participants.

Table 3_OMiLAB_02.Training Module specifications

<table>
<tr><th>Module specification</th><th colspan="3">Explanation</th></tr>
<tr><td>Teacher Name</td><td colspan="3">OMILAB Team Member</td></tr>
<tr><td>Training Topic</td><td colspan="3">Fundamental Conceptual Modelling Languages using Bee-Up</td></tr>
<tr><td>Training Code</td><td colspan="3">OMILAB_02</td></tr>
<tr><td>Module Name</td><td colspan="3">Fundamental Conceptual Modelling Languages using Bee-Up</td></tr>
<tr><td>Module duration</td><td colspan="3">3 h</td></tr>
<tr><td>Module objective</td><td colspan="3">• Understand the purpose of conceptual modelling
• Understand the aspect of domain-specific modelling (industrial, application domain)
• Relate the theoretical background to knowledge management aspects
• Practical experience with the approach</td></tr>
<tr><td>Mode of provision</td><td colspan="3">OMILAB Laboratory (Creative Space)</td></tr>
<tr><td rowspan="4">Laboratory structure</td><td>Time (min)</td><td>Objective</td><td>Performed by?</td></tr>
<tr><td>60 min</td><td>Introduction: Theoretical Foundation, Bee-Up</td><td>OMILAB Team</td></tr>
<tr><td>60 min</td><td>Examples: Model Value in practice</td><td>OMILAB Team</td></tr>
<tr><td>60 min</td><td>Individual exercises and case work</td><td>Participants in teams/groups</td></tr>
</table>

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /OMILAB/ Module2_Bee-Up_OMiLAB.
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/OMILAB/Module2_Bee-Up_OMiLAB).

4.6.3 OMiLAB_03: Design Thinking using Scene2Model

Table 1_OMiLAB_03. The training specification details

Training specification	Explanation
Organizer	OMILAB NPO (Germany)
Training Topic	Design Thinking using Scene2Model
Training objectives	The training introduces the selected design thinking method "SAP Scenes" as a storytelling approach for digital innovation and tool support using Scene2Model
Method	• Theoretical Foundation • Tool and Laboratory Infrastructure Support • Group Work: Design your own innovative solution
Target groups	Multidisciplinary teams within research and academia, industrial domain experts from different fields
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	10
Training duration	3 hours
Mode of tutoring	Expert input + Practical case study + Group work
Mode of provision	Workshop
Tools and resources to be used (technological-support tools)	Scene2Model Toolkit and Infrastructure (Camera, QR Detection, Paper figures)
Recommended preparation	none
Modes of working in teams	Collective with distributed roles
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Creativity, Group working and collaborative skills
Knowledge prerequisites	None

Table 2_OMiLAB_03.Training competence

Competence specification	Explanation
Knowledge and skills	The students acquire the skill how a design thinking approach is run in practice, within a collaborative setting and modelling tool support enhances knowledge externalization and communication.
Professional competence	Teamwork, collaboration
General objective	Provide practical experience with design thinking and stimulate further discussion and thematic background for the participants.

Table 3_OMiLAB_03.Training Module specifications

Module specification	Explanation		
Teacher Name	OMILAB Team Member		
Training Topic	Design Thinking using Scene2Model		
Training Code	OMILAB_03		
Module Name	Design Thinking using Scene2Model		
Module duration	3 h		
Module objective	• Understand of design thinking approach: storytelling • Relate the theoretical background to innovation process • Practical experience with the approach		
Mode of provision	OMILAB Laboratory (Creative Space		
Laboratory structure	Time (min)	Objective	Performed by?
	60 min	Introduction: Theoretical Foundation, Scene2Model Tool and Infrastructure	OMILAB Team
	30 min	Design Thinking Challenge: Formulate and present a design challenge in teams/groups of multidisciplinary nature	Participants in teams/groups
	60 min	Group work: Design Challenge Develop alternatives and solution space for the innovative idea	Participants in teams/groups
	30 min	Result presentation and peer feedback	Teams and OMILAB Team

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /OMILAB/ Module3_S2M_OMiLAB
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/OMILAB/Module3_S2M_OMiLAB).

4.6.4 OMiLAB_04: The Value of Conceptual Models

Table 1_OMiLAB_04. The training specification details

Training specification	Explanation
Organizer	OMILAB NPO (Germany)
Training Topic	The Value of Conceptual Models
Training objectives	Introduce the value of conceptual modelling and purpose in an academic/research as well industrial context
Method	• Conceptual Modelling Aspects • Benefits of Modelling in Research/Academia: Observations • Benefits of Modelling in Industry: Observations
Target groups	Any interested party
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	10
Training duration	1 hours
Mode of tutoring	Presentation
Mode of provision	Presentation
Tools and resources to be used (technological-support tools)	Classroom
Recommended preparation	None
Modes of working in teams	N/A
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Creativity, Group working and collaborative skills
Knowledge prerequisites	None

Table 2_OMiLAB_04.Training competence

Competence specification	Explanation
Knowledge and skills	The students acquire and understand the concept and purpose of conceptual modelling

Competence specification	Explanation
Professional competence	Knowledge management and engineering as a SOTA aspect in conceptual modelling
General objective	Guide the development and formulate the vision of model-based domain-specific approaches

Table 3_OMiLAB_04.Training Module specifications

Module specification	Explanation		
Teacher Name	OMILAB Team Member		
Training Topic	The Value of Conceptual Models		
Training Code	OMILAB_04		
Module Name	The Value of Conceptual Models		
Module duration	1 h		
Module objective	• Understand Conceptual Modelling and its Purpose • Discuss examples from academia/research and industrial application		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	30 min	Introduction to the Conceptual Modelling	OMILAB Team
	30min	Observation in Academia and Research/Industry and Outlook/Research challenges	OMILAB Team

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /OMILAB/
Module4_ValueOfConceptualModels_OMiLAB
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/OMILAB/Module4_ValueOfConceptualModels_OMiLAB).

4.6.5 OMiLAB_05: Conceptual Modelling: Methods, Tools and Application

Table 1_OMiLAB_05. The training specification details

Training specification	Explanation
Organizer	OMILAB NPO (Germany)

Training specification	Explanation
Training Topic	Conceptual Modeling: Methods, Tools and Application
Training objectives	Introduction to the foundation of conceptual modelling and metamodeling as a realization paradigm
Method	• Modeling Tools • Model Interoperability • Modeling Tool Implementation and Customization
Target groups	Any interested party
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	10
Training duration	3 hours
Mode of tutoring	Presentation and Demonstration
Mode of provision	Presentation and Demonstration
Tools and resources to be used (technological-support tools)	Classroom
Recommended preparation	None
Modes of working in teams	N/A
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Creativity, Group working and collaborative skills
Knowledge prerequisites	None

Table 2_OMiLAB_05.Training competence

Competence specification	Explanation
Knowledge and skills	The students acquire and understand the concept and purpose of conceptual modelling methods, tools and the capabilities of metamodeling as a realization approach for domain-specific tools
Professional competence	Knowledge management and engineering as a SOTA aspect in conceptual modelling
General objective	Guide the development and formulate the vision of model-based domain-specific approaches

Table 3_OMiLAB_05.Training Module specifications

Module specification	Explanation		
Teacher Name	OMILAB Team Member		
Training Topic	Conceptual Modeling: Methods, Tools and Application		
Training Code	OMILAB_05		
Module Name	Conceptual Modeling: Methods, Tools and Application		
Module duration	1 h		
Module objective	• Modeling Tools • Model Interoperability • Modeling Tool Implementation and Customization		
Mode of provision	Classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	60 min	Explain and showcase how modelers are support with open modeling tools, selection of the tool is based on background and field of classroom	OMILAB Team
	60 min	Interoperability: discussion on the interoperable nature of modelling, explanation on how different systems can be connected and harmonized (e.g HTTP requests, RDF Export, Social Media)	OMILAB Team
	60 min	Modeling Tool Implementation and Customization aspects are covered in the form of an introductory session on metamodeling and metamodel design – development and deploymdent	OMILAB Team

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /OMILAB/
Module5_MethodsToolsApplication_OMiLAB
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/OMILAB/Module5_MethodsToolsApplication_OMiLAB).

4.6.6 OMiLAB_06: Model-Driven Experimentation

Table 1_OMiLAB_06. The training specification details

Training specification	Explanation

Training specification	Explanation
Organizer	OMILAB NPO (Germany)
Training Topic	Model-Driven Experimentation: from Design to Modelling to Evaluation
Training objectives	Introduction to the foundation of conceptual modelling and metamodeling as a realization paradigm
Method	• Explanation of Smart Model Concept • Guided Case: From Design to Modelling to Evaluation in CPS • Concept of Abstraction and Decomposition
Target groups	Any interested stakeholder
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	10
Training duration	1 hours
Mode of tutoring	Presentation and Demonstration
Mode of provision	Presentation and Demonstration
Tools and resources to be used (technological-support tools)	OMILAB Physical Laboratory
Recommended preparation	None
Modes of working in teams	N/A
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Creativity, Group working and collaborative skills
Knowledge prerequisites	None

Table 2_OMiLAB_06.Training competence

Competence specification	Explanation
Knowledge and skills	The students acquire and understand the concept of smart models that connect design thinking with conceptual modelling and evaluation/feasibility assessment
Professional competence	Knowledge management and engineering as a SOTA aspect in conceptual modelling
General objective	Experience the digital innovation process in practice

Table 3_OMiLAB_06.Training Module specifications

Module specification	Explanation		
Teacher Name	OMILAB Team Member		
Training Topic	Model-Driven Experimentation: from Design to Modelling to Evaluation		
Training Code	OMILAB_06		
Module Name	Model-Driven Experimentation: from Design to Modelling to Evaluation		
Module duration	1 h		
Module objective	• Identify innovation idea and design methods • Conceptual modelling (with domain-specific language) • Decomposition and IOT Adaptors		
Mode of provision	OMILAB Physical Laboratory		
Laboratory structure	Time (min)	Objective	Performed by?
	30 min	Explain the concept of smart models	OMILAB Team
	30 min	Demonstration of a case that spans all layers of the laboratory	OMILAB Team

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /OMILAB/
Module6_ModelDrivenExperimentation_OMiLAB
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/OMILAB/Module6_ModelDrivenExperimentation_OMiLAB).

4.6.7 OMiLAB_07: Scientific and Educational Exploitation

Table 1_OMiLAB_07. The training specification details

Training specification	Explanation
Organizer	OMILAB NPO (Germany)
Training Topic	Scientific and Educational Exploitation
Training objectives	Introduction to the scientific and educational exploitation possibilities offered by the OMiLAB.

Training specification	Explanation
Method	• Explain the importance of OMiLAB topics for Higher Education Institutions • Provide guidance in how to incorporate the OMiLAB in teaching • Discuss possibilities of positioning research activities within the Digital Product framework of the OMiLAB
Target groups	Researchers, Master/PhD students
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	10
Training duration	1 hours
Mode of tutoring	Presentation
Mode of provision	Presentation
Tools and resources to be used (technological-support tools)	Classroom
Recommended preparation	None
Modes of working in teams	N/A
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	N/A
Knowledge prerequisites	N/A

Table 2_OMiLAB_07. Training competence

Competence specification	Explanation
Knowledge and skills	The participants acquire the knowledge about the scientific and educational exploitation possibilities offered by the OMiLAB
Professional competence	Support in thesis preparation, pointers and references to conferences of relevance
General objective	Show how the OMiLAB can facilitate teaching and research at HEI.

Table 3_OMiLAB_07.Training Module specifications

Module specification	Explanation		
Teacher Name	OMILAB Team Member		
Training Topic	Scientific and Educational Exploitation		
Training Code	OMILAB_07		
Module Name	Scientific and Educational Exploitation		
Module duration	1 h		
Module objective	• Explain the importance of OMiLAB topics for Higher Education Institutions • Provide guidance in how to incorporate the OMiLAB in teaching • Discuss possibilities of positioning research activities within the Digital Product framework of the OMiLAB		
Mode of provision	OMILAB Physical Laboratory		
Laboratory structure	Time (min)	Objective	Performed by?
	10 min	Fitting of OMiLAB topics to HEI guidelines and curricular recommendations	OMILAB Team
	25 min	Presentation of multiple OMiLAB courses and how they benefit form OMiLAB knowledge and artefacts.	OMILAB Team
	20 min	Possibilities of positioning research within the Digital Product framework of the OMiLAB	OMILAB Team
	5 min	Exploitation possibilities for community outreach and scientific outreach.	OMILAB Team

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /OMILAB/
Module7_ScientificAndEducationalExploitation_OMiLAB
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/OMILAB/Module7_ScientificAndEducationalExploitation_OMiLAB).

4.6.8 OMiLAB_08: Intelligent assessment services using AWS cloud infrastructure for design artefacts

Table 1_OMiLAB_08. The training specification details

Training specification	Explanation
Organizer	OMILAB NPO (Germany)

Training specification	Explanation
Training Topic	AI-Based Domain-Specific Assessment Service
Training objectives	An introduction to the use of cloud-based services for the assessment of collective-intelligence data through the OMiLAB Assessment Service project (https://www.omilab.org/assessmentservice/). Also, the application of conceptual models with AI for creation of new insights from the assessment.
Method	• Theory on assessment using (web-)services • Deployment and configuration of AWS-services in the cloud • Realization of an example questionnaire
Target groups	Any interested party
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	10
Training duration	1h
Mode of tutoring	Practical example
Mode of provision	Presentation and demonstration
Tools and resources to be used (technological-support tools)	Git, VisualStudio Code, PowerShell, AWS account, AWS CLI.
Recommended preparation	None
Modes of working in teams	N/A
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Creativity, group working and collaborative skills
Knowledge prerequisites	Services in general, some technical knowledge

Table 2_OMiLAB_08. Training competence

Competence specification	Explanation
Knowledge and skills	Participants acquire knowledge about the deployment and use of cloud services in AWS, and the analysis of results using simple techniques, conceptual models and AI.
Professional competence	Use of cloud-based services. Evaluate approaches for domain specific design artifacts.

Competence specification	Explanation
General objective	The use of AWS cloud services to realize assessments.

Table 3_OMiLAB_08.Training Module specifications

Module specification	Explanation		
Teacher Name	OMILAB Team Member		
Training Topic	AI-Based Domain-Specific Assessment Service		
Training Code	OMILAB_08		
Module Name	AI-Based Domain-Specific Assessment Service		
Module duration	1 h		
Module objective	• Deployment and use of cloud-based services for gathering collective-intelligence data and its assessment. • Application of conceptual models with AI for the creation of new insights.		
Mode of provision	Online meeting / classroom		
Laboratory structure	Time (min)	Objective	Performed by?
	30 min	Introduction. Presentation of example. Relaying of relevant topics for realizing the example (concepts of Assessment Service project, AWS, architecture, …)	OMILAB Team
	30 min	Deployment of AWS services and their use to realize the previously shown example.	OMILAB Team, Participants, Self-study

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /OMILAB/
Module8_AssessmentService_OMILAB
(https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/OMILAB/Module8_AssessmentService_OMILAB/Module8%20-%20AI-Based%20Domain-Specific%20Assessment%20Service.pdf).

4.7 Courses provided by CIRIDD

4.7.1 CIRIDD_01: Integration of the uses and design in the company business model

Table 1_CIRIDD_01. The training specification details

Training specification	Explanation
Organizer	CIRIDD, France
Training Topic	Integration of the uses and design in the company business model
Training objectives	• The objective is to bring companies to integrate the uses of the customer and the design in the company business model
Method	The training followed different stages: • Presentation of La cite du Design and its main fields of action • Workshop in groups on the integration of the uses • Concrete examples of companies which integrated uses and design in their business model
Target groups	• The training targeted all kind of companies, regardless of the size or the sector
Recommended composition	It is important that companies are represented by a decision maker. Someone who is able to implement this solution.
Recommended size of groups	20 persons
Training duration	4 hours
Mode of tutoring	The seminar is a two time process: A presentation by a professional for the target group to gather information and then an interactive process where they are put into a situation where they have to integrate the uses.
Mode of provision	Interactive industrial process
Tools and resources to be used (technological-support tools)	Fictive situations
Recommended preparation	Top management of the company should be involved and should act as sponsor of the training.
Modes of working in teams	Collective problem analysis and solving. Collective creativity
Communication and cooperation mode	Physical interaction
Necessary abilities to tackle the tasks of open	Creativity, Innovation, Design thinking, customer thinking.

Training specification	Explanation
problems	
Knowledge prerequisites	none.

Table 2_CIRIDD_01. Training competence

Module specification	Explanation
Knowledge and skills	Design thinking uses
Professional competence	User focus
General objective	integrate the uses of the customer and the design in the company business model

Table 3_CIRIDD_01.Training Module specifications

Module specification	Explanation		
Teacher Name	James Pédron, Laurent Vacheresse, Alexandre Peutin		
Training Topic	Functional economy		
Training Code			
Module Name	Integration of the uses and design in the company business model		
Module duration	3 hours		
Module objective	• The objective is to bring companies to integrate the uses of the customer and the design in the company business model		
Mode of provision	Interactive industrial process		
Laboratory structure	Time (min)	Objective	Performed by?
	Needed time for this part	Objective that need to be obtained	Who perform in this part
	10mn	RELIEF's support: Presentation of RELIEF	James Pedron (CIRIDD)
	30mn	Presentation of La Cité du design	Laurent Vacheresse, Alexandre Peutin (La Cité du Design)
	1h45	Workshop: taking into account the uses	Laurent Vacheresse (La Cité du Design)
	30mn	Concrete examples from companies	Laurent Vacheresse (La Cité du Design)

Module specification	Explanation		
	10mn	Conclusion	James Pedron (CIRIDD)

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /CIRIDD/CIRIDD_01: Integration of the uses and design in the company business model.
(https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/CIRIDD/CIRIDD_01-Integration%20of%20the%20uses%20and%20design%20in%20the%20company%20business%20model.pptx)

4.8 Courses provided by CONTI

4.8.1 CONTI_01: Cobots - installing and programming information needed for a rapid implementation of Cobots in industrial environment

Table 1_CONTI_01. The training specification details

Training specification	Explanation
Organizer	CONTI, Romania
Training Topic	Cobots - installing and programming information needed for a rapid implementation of Cobots in industrial environment
Training objectives	• Understand what cobot is and how the cobot interact with humans • Learn to select the proper cobot and griper • Understand mechanical and electrical installation of a cobot • Learn how to program a cobot
Method	• Theoretical presentation • Case study and lab activities: programming basic moves of a cobot
Target groups	• License and Master students (Engineering University)
Recommended composition	Individuals with engineering background
Recommended size of groups	10 to 15
Training duration	6 hours
Mode of tutoring	Expert input + practical case study
Mode of provision	Classroom or Online training/Workshop
Tools and resources to be used (technological-support tools)	Cobot
Recommended preparation	none
Modes of working in teams	Collective work with distributed role
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open	Ability to work in team

Training specification	Explanation
problems	
Knowledge prerequisites	Computer basic knowledge

Table 2_CONTI_01. Training competence

Module specification	Explanation
Knowledge and skills	Understanding to working with cobot programming languages Improve the knowledge in installation of cobots on production lines
Professional competence	Capability to implement cobots on production lines
General objective	Create the ability of programming cobots Obtain knowledge on cobots installation

Table 3_CONTI_01.Module_02_Training Module specifications

Module specification	Explanation
Teacher Name	eng. Cristian Mihuțoiu
Training Topic	Cobots - installing and programming information needed for a rapid implementation of Cobots in industrial environment
Training Code	
Module Name	Cobot selection
Module duration	20 min
Module objective	• Select the proper cobot for the application desired
Mode of provision	Classroom or Virtual training
Laboratory structure	none

Table 3_CONTI_01.Module_03_Training Module specifications

Module specification	Explanation
Teacher Name	eng. Cristian Mihuțoiu
Training Topic	Cobots - installing and programming information needed for a rapid implementation of Cobots in industrial environment
Training Code	
Module Name	Mechanical Installation
Module duration	20 min
Module objective	• Understand requirements for cobot installation on production lines

Module specification	Explanation
Mode of provision	Classroom or Virtual training
Laboratory structure	Observe cobot from Lab.

Table 3_CONTI_01.Module_04_Training Module specifications

Module specification	Explanation
Teacher Name	eng. Cristian Mihuțoiu
Training Topic	Cobots - installing and programming information needed for a rapid implementation of Cobots in industrial environment
Training Code	
Module Name	Griper Development
Module duration	20 min
Module objective	• Understand griper concept and requirements
Mode of provision	Classroom or Virtual training
Laboratory structure	Observe gripers used in Conti production lines, from videos.

Table 3_CONTI_01.Module_05_Training Module specifications

Module specification	Explanation
Teacher Name	eng. Cristian Mihuțoiu
Training Topic	Cobots - installing and programming information needed for a rapid implementation of Cobots in industrial environment
Training Code	
Module Name	Electrical Installation
Module duration	20 min
Module objective	•
Mode of provision	Classroom or Virtual training
Laboratory structure	Cobot electrical connections requirements.

Table 3_CONTI_01.Module_06_Training Module specifications

Module specification	Explanation
Teacher Name	eng. Cristian Mihuțoiu
Training Topic	Cobots - installing and programming information needed for a rapid implementation of Cobots in industrial environment

Module specification	Explanation
Training Code	
Module Name	Software of cobot
Module duration	20 min
Module objective	•
Mode of provision	Classroom or Virtual training
Laboratory structure	Understand cobot software possibilities.

Table 3_CONTI_01.Module_07_Training Module specifications

Module specification	Explanation
Teacher Name	eng. Cristian Mihuțoiu
Training Topic	Cobots - installing and programming information needed for a rapid implementation of Cobots in industrial environment
Training Code	
Module Name	Design of Cobot Program
Module duration	240 min
Module objective	•
Mode of provision	Classroom or Virtual training
Laboratory structure	Program simple movement of a cobot: free movement, linear movement and process movement

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /CONTI/
/CONTI_01: Cobots – Rapid implementation of Cobots in industrial environment

(https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/CONTI/CONTI_01%3A%20Cobots%20-%20Rapid%20implementation%20of%20Cobots%20in%20industrial%20environment/CONTI_01%20-%20Cobots%20-%20Rapid%20implementation%20of%20Cobots%20in%20industrial%20environment.pdf)

4.8.2 CONTI_02: AGV for modern Logistics in industrial companies

Table 1_CONTI_01. The training specification details

Training specification	Explanation
Organizer	CONTI, Romania
Training Topic	AGV for modern Logistics in industrial companies
Training objectives	• Understand what AGV is • Learn to select the proper AGV • Understand mechanical and electrical installation of an AGV
Method	• Theoretical presentation • Case study and lab activities: programming basics an AGV
Target groups	• License and Master students (Engineering University)
Recommended composition	Individuals with engineering background
Recommended size of groups	10 to 15
Training duration	4 hours
Mode of tutoring	Expert input + practical case study
Mode of provision	Classroom or Online training/Workshop
Tools and resources to be used (technological-support tools)	Cobot
Recommended preparation	none
Modes of working in teams	Collective work with distributed role
Communication and cooperation mode	Informal communication
Necessary abilities to tackle the tasks of open problems	Ability to work in team
Knowledge prerequisites	Computer basic knowledge

Table 2_CONTI_02. Training competence

Module specification	Explanation
Knowledge and skills	Understanding to working with AGV Improve the knowledge of AGV implementation
Professional competence	Capability to implement AGVs deliveries on production lines
General objective	Create the ability of programming AGVs Obtain knowledge on AGV implementation

Table 3_CONTI_02.Module_01_Training Module specifications

Module specification	Explanation
Teacher Name	eng. Cristian Mihuțoiu
Training Topic	AGV for modern Logistics in industrial companies
Training Code	
Module Name	General Considerations
Module duration	
Module objective	• Understand AGV • Understand AGV usage possibilities • Understand main safety measures and restrictions in using AGVs
Mode of provision	Classroom or Online training/Workshop
Laboratory structure	• Definitions, • General safety measures for AGVs usage • AGV selection

Table 3_CONTI_02.Module_02_Training Module specifications

Module specification	Explanation
Teacher Name	eng. Cristian Mihuțoiu
Training Topic	AGV for modern Logistics in industrial companies
Training Code	
Module Name	AGV Description
Module duration	
Module objective	• Understand components of an AGV • Learn about how to operate an AGV • Learn which are the main maintenance operations for an AGV
Mode of provision	Classroom or Online training/Workshop

Module specification	Explanation
Laboratory structure	• AGV description, component parts, technical data • Operation and use • Maintenance

Table 3_CONTI_02.Module_03_Training Module specifications

Module specification	Explanation
Teacher Name	eng. Cristian Mihuțoiu
Training Topic	AGV for modern Logistics in industrial companies
Training Code	
Module Name	Mechanical Installation (AGV on the Shopfloor)
Module duration	
Module objective	• Understand which are the main requirements and restrictions in using AGVs fleet
Mode of provision	Classroom or Online training/Workshop
Laboratory structure	• Standard AGV • Standard rack for loading/unloading • Standard alley size • Floor marking for the an AGV's

Table 3_CONTI_02.Module_04_Training Module specifications

Module specification	Explanation
Teacher Name	eng. Cristian Mihuțoiu
Training Topic	AGV for modern Logistics in industrial companies
Training Code	
Module Name	Advanced Robotics Command Language
Module duration	
Module objective	• Learn how to program an AGV to deliver load between two fixed positions
Mode of provision	Classroom or Online training/Workshop
Laboratory structure	• Introduction to ARCL • Understanding the Configuration Parameters • Outgoing ARCL Connection Setup Parameters • Connect to ARCL Using a Telnet Client

Table 3_CONTI_02.Module_05_Training Module specifications

Module specification	Explanation
Teacher Name	eng. Cristian Mihuțoiu
Training Topic	AGV for modern Logistics in industrial companies
Training Code	
Module Name	Fleet Management
Module duration	
Module objective	• Understand usage of an AGVs fleet and learn how to manage the AGVs fleet in an optimal way.
Mode of provision	Classroom or Online training/Workshop
Laboratory structure	• Fleet Management description • Network Connections • Traffic Management • Charge Management • Fleet Docking • Motion Sensors

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /CONTI/ CONTI_02: AGV for modern Logistics in industrial companies
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/CONTI/CONTI_02%3A%20AGV%20for%20modern%20Logistics%20in%20industrial%20companies)

4.9 Courses provided by BOC

4.9.1 BOC_01: Process-oriented topic: Process modelling using BPMN

Table 1_BOC_01. The training specification details

Training specification	Explanation
Organizer	BOC Poland
Training Topic	Process-oriented topic: Process modelling using BPMN
Training objectives	Understanding key concepts of BPMN. Modelling levels: descriptive, analytic, executable. Practical usage of BPMN for documenting product/service-related processes and extending those diagrams for automation purposes.
Method	History of BPMN Purposes of BPMN diagrams Descriptive modelling Analytic modelling Advanced BPMN and automation based on BPMN diagrams
Target groups	Professionals of the same or different companies
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	Less than 10 persons
Training duration	2 hours to 8 hours on the same day or on 2 separately days – depending on a local needs
Mode of tutoring	Lecture, Case method
Mode of provision	Workshop/laboratory-based training
Tools and resources to be used (technological-support tools)	ADOxx
Recommended preparation	Fundamentals of Business Process Management (BPM) training to understand the basic concepts of BPM
Modes of working in teams	Collaborative problem-solving, Team/individual Q&A
Communication and cooperation mode	Process maps and models, Reports, Collaboration tools
Necessary abilities to tackle the tasks of open problems	Critical analysis, Group working skills
Knowledge prerequisites	Fundamentals of organization/business unit management

Table 2_BOC_01. Training competence

Module specification	Explanation
Knowledge and skills	Knowledge of BPMN elements an skill to use it in practical process modelling
Professional competence	Capability to document processes using BPMN notation

General objective	Improve the understanding of key concepts of BPMN. Modelling levels: descriptive, analytic, executable. Learn practical usage of BPMN for documenting product/service-related processes and extending those diagrams for automation purposes.

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /BOCPL
(https://cloud.digifof.ulbsibiu.ro/index.php/apps/files/?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/BOCPL&fileid=5247)

4.9.2 BOC_02: Process-oriented topic: Process improvement using simulation

Table 1_BOC_02. The training specification details

Training specification	Explanation
Organizer	BOC Poland
Training Topic	Process-oriented topic: Process improvement using simulation
Training objectives	Understanding difference between AS-IS and TO-BE processes. Being able to apply process improvement techniques such as simulation to a process. Knowledge of information gathering methods for the purpose of a simulation.
Method	Extending BPMN diagrams with information about costs and times. Process frequencies, probabilities, variables. Using simulation to compare AS IS and TO BE processes and recommend changes Change management and process improvement Methods of process improvement
Target groups	Professionals of the same or different companies
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	Less than 10 persons
Training duration	2 hours to 8 hours on the same day or on 2 separately days – depending on a local needs
Mode of tutoring	Lecture, Case method
Mode of provision	Workshop/laboratory-based training
Tools and resources to be used (technological-support tools)	ADOxx
Recommended preparation	Fundamentals of Business Process Management (BPM) training to understand the basic concepts of BPM Process modelling using BPMN
Modes of working in teams	Collaborative problem-solving, Team/individual Q&A
Communication and cooperation mode	Process maps and models, Reports, Collaboration tools
Necessary abilities to	Critical analysis, Group working skills

Training specification	Explanation
tackle the tasks of open problems	
Knowledge prerequisites	Fundamentals of organization/business unit management

Table 2_BOC_02. Training competence

Module specification	Explanation
Knowledge and skills	Knowledge of simulation algorithms and ability to interpret simulation results
Professional competence	Capability improve processes and calculate/document results of process improvement
General objective	Understand difference between AS-IS and TO-BE processes. Gain ability to apply process improvement techniques such as simulation to a process. Knowledge of information gathering methods for the purpose of a simulation.

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /BOCPL
(https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/BOCPL/WP3%20T3.2%20-%20Process-oriented%20topic%20-%20Process%20simulation%20-%20BOC-PL.pdf)

4.9.3 BOC_03: Process-oriented topic: Process performance monitoring

Table 1_BOC_03. The training specification details

Training specification	Explanation
Organizer	BOC Poland
Training Topic	Process-oriented topic: Process performance monitoring
Training objectives	Being able to define goals for a process on a basis of a strategy and stakeholder analysis. Defining KPIs on a basis of goals or using the APQC PCF. Designing a process performance monitoring system, defining roles and responsibilities. Planning changes.
Method	Process goals and KPIs Benchmarking and KPI libraries Process performance monitoring system along with the processes (gathering data, reviews, planning initiatives), roles and responsibilities.
Target groups	Professionals of the same or different companies
Recommended composition	Mix of jobs, abilities, gender, work experience
Recommended size of groups	Less than 10 persons

Training specification	Explanation
Training duration	2 hours to 8 hours on the same day or on 2 separately days – depending on a local needs
Mode of tutoring	Lecture, Case method
Mode of provision	Workshop/laboratory-based training
Tools and resources to be used (technological-support tools)	ADOxx
Recommended preparation	Fundamentals of Business Process Management (BPM) training to understand the basic concepts of BPM
Modes of working in teams	Collaborative problem-solving, Team/individual Q&A
Communication and cooperation mode	Process maps and models, Reports, Collaboration tools
Necessary abilities to tackle the tasks of open problems	Critical analysis, Group working skills
Knowledge prerequisites	Fundamentals of organization/business unit management

Table 2_BOC_03. Training competence

Module specification	Explanation
Knowledge and skills	Knowledge of process metrics and calculation algorithms and management cockpits
Professional competence	Skills to report process performance
General objective	Improve ability to define goals for a process on a basis of a strategy and stakeholder analysis, designing a process performance monitoring system, defining roles and responsibilities, planning changes.

The complete course content is available on the DigiFoF cloud in WP3:
WP3_FoF_Designer:Innovative_Teaching_Methods_Tools
T3.2 -Teaching and training materials for the design /BOCPL
(https://cloud.digifof.ulbsibiu.ro/remote.php/webdav/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.2%20-%20Teaching%20and%20training%20materials%20for%20the%20design/BOCPL/WP3%20T3.2%20-%20Process-oriented%20topic%20-%20Process%20performance%20monitoring%20-%20BOC-PL.pdf)

5 Conclusions

In the WP3 package in deliverable "D.3.1. Problem-based learning path for students and professionals" the HEI partners and industry partners from DigiFoF project proposed a series of training materials developed around topics of OMiLAB laboratory. These are elaborated as support for academic and / or vocational trainings that will be done for master students and / or employees of the companies. In that deliverable, based on discussions and needs of companies, following 35 sets of materials were proposed (with 5 more than target).

The deadline for propose those materials was 30.06.2020. This deliverable contains the description of training materials and links for all materials and uploaded in the DigiFoF cloud in folder WP3_FoF_Designer: Innovative_Teaching_Methods_Tools/ T3.2 - Teaching and training materials for the design. This deliverable (D3.2) respect the topics proposed in D3.1 deliverable. All 35 training materials are completed and uploaded in the DigiFoF cloud.

Due to description of work this training materials was proposed in the first half of the project and was updated in PM22 until PM33. In that follow we present a centralised table with proposed materials, materials that already was described and materials that already was finished and the documents was published in the cloud.

Partner	Proposed	Described in deliverable	Finished documentation and uploaded in cloud
EMSE	7	7	7
ULBS	6	6	6
UNIBG	4	4	4
UNIBIAL	3	3	3
UNIOULU	1	1	1
OMiLAB	8	8	8
CIRIDD	1	1	1
CONTI	2	2	2
BOC	3	3	3
TOTAL	35	35	35
Fulfilment degree	116.67%	100.00%	100.00%