2.1.5 Module developmentM05 Work 4.0

Module Specification:

Work 4.0

Within the Erasmus+ KA2 Capacity Building Project (CBHE)

WORK4CE – Cross-domain competences for healthy and safe work in the 21st century

619034-EPP-1-2020-1-UA-EPPKA2-CBHE-JP

Product owner: Mykhailo Dombrovskyi (WUNU)

Team members: Mykhailo Dombrovskyi

Version 1.2 - from 26 April 2021

Actual version 1.8, 16.11.2022

1. Summary

The fourth industrial revolution as a synonym for digital transformation introduces new digital technology and leads to new ways of working. The aim of Work 4.0 module is to develop the holistic approach to describe and learning digitalized work forces and architecture. Industry 4.0 productive systems and processes engage humans across the lifecycle in designing, installing, maintaining, operating, and dismantling (at end of life) these systems. Attention to the demands and requirements for people, who will perform these tasks is the project design and competency requirement for Work 4.0 system. Students will possess evidence-based approach and uses foresight techniques to explore the future digitalized work activities. They will be capable to uses real time management in digital production systems based work 4.0. Students will develop in teams, and set up a digital transformation project for linking people, machines and products by forming together a new production system.

Overall Learning Outcome:

- Data Analytics competency as combination of big data competency as well as predictive methods.
- Development of IT strategies to support Supply chain Management (e.g. collaboration platforms on the cloud and Internet of Things);
- Real time management leveraging monitoring and tracking technologies in digital production systems based work 4.0.
- Entrepreneur competence to designing innovative ecosystems and introducing digital smart services using examples of the value chain from building investor to facility management.
- Interact dynamically with machines in the cyber- and physical- worlds by means of ‘intelligent’ human-machine interfaces, using human-computer interaction techniques designed to t the operators’ cognitive and physical needs, and improve human physical-, sensing- and cognitive-capabilities, by means of various enriched and enhanced technologies.
- Know computational and communication techniques, akin to adaptive control systems with the human-in-the-loop to efciently allocate labor (cognitive & physical) and distribute tasks between the automated part and the humans in the workstations of linking people, machines and products by forming together a new adaptive production system.

Target Group Analysis: Master degree students with bachelor in technology domains (IT, engineering), Lifelong learning student with bachelor /master in technology domains (IT, engineering) or equivalent experience

Competences & Learning Outcomes:

Upon completion of this module, the students will acquire the following learning outcomes, divided in three domains:

Knowledge

- explain the basics of the Work 4.0 in organizations
- explain the impacts of a digitalisation work project component on diverse stakeholders
- explain methods and models for human centered digital production system formation
- explain work 4.0 concept in interdisciplinary environments

Skills

- analyze and develop work transformation projects
- using digital literacy and to interact with digital technologies
- decide and initiate action communicating with people in digital environment

Competence – ability & attitude

- Students possess evidence-based approach and uses foresight techniques to explore the future digitalised work activities
- Uses Real time management in digital production systems based work 4.0
- Students work in teams and set up a digital transformation project for linking people, machines and products by forming together a new production system.

Selection of Content:

- Potentials effects of digital work change - new opportunities and challenges of workforce structures and workplace innovations for digitally enabled value creation
- Digitalization of Work Processes: A Framework for Human-Oriented Work Design. How to opens up innovative possibilities by digitalization for designing content, process, the organization of work and value network collaboration
- Holistic structured modelling approach to Work 4.0 production system developing based on Reference Architecture Model Industrie 4.0 (RAMI4.0)
- Preparing the workforce for the digital change and analyzing the competence requirements for Industry 4.0. Bearing in mind the design of work systems embedded healthy and safety measures
- Orchestrating human-centered design of interactive work digital platform based on cyber-physical systems model. Adaptation of production system in order to allow a dynamic and seamless transition of functions (tasks) allocation between humans and machines that optimally leverages human skills and competences
- Design thinking on user experience evaluation of Industry 4.0 concepts for employee's engagement
- Planning the digital transformation project scope based on Work 4.0 concept and digital business model canvas
- Acquiring and comprehensive evaluation of data from many different sources (production equipment and systems as well as enterprise- and customer-management systems) as standard support in real-time decision-making
- Industry 4.0 Developers concept: an entrepreneurial approach to designing innovation space for digital platforms projection
- Digital business entrepreneurship strategies as innovation driver for the digital ecosystem
- IoT for Work 4.0: Healthy and safely human operators in production systems and workplaces

Competence Assessment:

competence assessment is composed of
- Individual assignment
- Team assignment
- Peer review
- Written exam

Curricula Integration: This module is targeted to be included in curriculum of Master in Project Management

Quality Evaluation: The module will undergo a pilot teaching and will be evaluated by students, professors and IT/media specialists to get feedback for improvement. This iteration continues during 3 years in different universities and publishable release will be produced in each iteration?

Table of Content

2. Introduction to the module

The fourth industrial revolution as a synonym for digital transformation, introduces new technology and leads to new ways of working. Work 4.0 brings together high technological level technologies and methods; represents new ways of working. Industry 4.0, based on increasingly progressive digitalization, is a global phenomenon that affects every part of work(s) in human society.

The aim of Work 4.0 module is to develop the holistic approach to describe and learning an essence of Industry 4.0 - Work 4.0 (as) productive system and processes. We argue, that all Industry 4.0 systems engage humans across the lifecycle in designing, installing, maintaining, operating, and dismantling (at end of life) these systems. Attention to the demands and requirements for people, who will perform these tasks is the project design requirement to Work 4.0 system.

The fourth industrial revolution marks a new quality leap in industrial production by linking people, machines and products by forming together a new production system, which enables faster and more targeted exchange of information. This change moves towards a future where people will collaborate with robots and will be supported by web technology and intelligent assistance systems in their work activities.

The growth of digitized processes creates a higher need for employees to understand the digital applications. Higher process complexity demands a broader and deeper process understanding, thinking and acting in networked and cross-cutting processes.

The design of the product and the work process improvement as well as the management of the production system development project itself will determine the production systems environment in digitalized future. These worker effects then will have consequences for human performance, which will determine the overall system performance.

Innovative working arrangements are key to a competitive manufacturing industry are important levers of the digital transformation of industry. They also pose new challenges to workers and enterprise structures witch will be embedded into digital ecosystems.

Platform Industry 4.0 based on the three central pillars of people, organization and technology, it aims at the sustainable design of work and learning. We are projecting a digitalized world of work that has people at its heart. We are committed to healthy, safe, fair and self-determined work and to a digital transformation.

Human-Centered Design (HCD) is an established methodology with a focus on the users of a prospective system. HCD intends to create interactive solutions that match the users' needs and expectations as well as to support their tasks towards their specific goals. The advantages are far-reaching and include increased productivity, improved quality of work, and increased user satisfaction.

Having a look at the digitization of human workflows within manufacturing industry it is difficult to choose the suitable degree between digital assistance and complete automation . Taking the example of order picking, the first kind of digitization is the "digital copy" of an actual workflow.

The digital architecture of Industry 4.0 is not an end in itself but could support people working in and with those structures to make production or service processes smarter and more efficient. Therefore, we focus on the relationship between the underlying digital architecture and the work assumed by the underlying digital architecture. From an organizational perspective, we describe the forms and types of organizing as a continuum, with its two poles of routinized and innovative work tasks.

Nowadays, we can perceive an evolution of the working environment due to the digitization of manual workows, work places or tools. Digitization within the context of manufacturing industry describes the transformation process from traditional handmade activities towards computer-supported activities, e.g. operate a robot or maintain a machine getting assistance through digital glasses. This ongoing change and its impacts on the employees is also known as a part of "Work 4.0".

3. Module Description

3.1 Overall Learning Outcomes

Upon completion of this module, the students will acquire the following learning outcomes:

Learners will know (Knowledge):

- analytical thinking and innovation; critical thinking and analysis; complex problem solving; leadership and social influence; emotional intelligence knowledge; brainstorm, ideation and problem solving and; system analysis and evaluation; to identify and frame a problem and come up with some solution, analyze the impacts of the project component on diverse stakeholders; workplace and environmental awareness for ergonomics; the work in interdisciplinary environments; adaptability and ability to change the mind-set; to develop the situational awareness that is relevant to agent's purpose; to design the action (plan) for achieving the goal; structuring and analyzing the large amounts of data and complex processes; active learning and learning strategies;

Learners will able (Skills):

- to use the digital literacy; to interact with digital technologies; to recognize the plan inadequacy and modify that, or change the goal; to negotiate with other agents for enhancing the perception; to develop the common orientation.

Technical skills:

- to identify and solve the engineering/technology problems, to conduct the experiments/standard tests and analyze the results; to identify and use the technical literature; to design the algorithms and programming tools

Soft skills will include:

- creativity, originality and initiative; effective written and oral communication to think creatively and holistically as well as make critical judgements; to get good practices in interdisciplinary teams and the efficient teamwork; to engage in self-directed learning; to form the commitment to the continuous improvement; to address the professional and ethical responsibilities; to apply the knowledge and skills; to develop a high level of self-reection (both personal and professional); to bridge the gap between theory and practice; to work out the ability to initiate and manage change; be able to make the constructive the face-to-face and virtual communication;

Competences in Technical domain:

- Design and implementation of Big Data architectures and software platforms;
- Development of applications and tools for Big Data analytics (e.g. R, Python);
- Big Data management, use of cloud computing and data storage;
- Big Data analytics Info-graphics for intuitive and engaging interpretation of data analytics;
- Design of data and workflow models;
- User experience design and corporate social responsibility.
- Programming and use of collaborative robots.
- Selection and application of data communication protocols (IoT, cloud, cybersecurity, Big Data) and Industry 4.0-related standards.

Competences in Professional domain:

- Problem-solving in a non-reductionist manner for highly complex real-life problems.

- Analysis, modelling and simulation of production based on big data from sensors and devices.
- Use of digital devices (e.g. tablets, smartphones, smartwatches) for production monitoring and control.
- Operate with a Triple Bottom Line, incorporating nancial protability, environmental integrity
- Management of human resources, interconnected through digital devices.
- Design of predictive maintenance systems (sensors, data flows and analytics).
- Selection, specification and integration of embedded devices, cyber-physical systems and advanced Human-Computer-Interfaces.
- Implementation of IT networks enabling real-time connection of robot, machines, products and people.
- Use of modelling tools to generate digital twins of manufacturing systems and simulate ”what if scenarios”.
- Use of graphic modelling tools to specify, analyse, design and verification of complex systems, including hardware and software components.
- Design of structured strategies for and management of cybersecurity, data privacy and safety.

Competences in Global domain:

- Problem solving competence to deal intelligently and creatively with the challenges of the environment.
- To digitalize and intelligently manage the production process and to use efficient technologies and knowledge.
- Deciding and Initiating Action Communicating with People Environmental Awareness for Ergonomics.
- Creating Business Networks Maintaining Customer Relationships, capable of reviewing their own experience and knowledge continuously.
- Create a win-win system between these collaborations and this is only done with commitment and personnel engagement.
- Creativity to innovate their production process, mainly to achieve more innovative and sustainable solutions.
- Entrepreneurial thinking of employees will have greater strategic responsibilities in companies, and they should constantly seek new ideas of improvement, have initiative and seek opportunities to Growth.
- Formation of several leaders throughout the company, the focus is the leadership by influence and not by authority, and the influence better builds collaborative work.
- Motivation to learn in order to accompany the changes, the collaborators are obliged to accompany these changes and always have availability to learn. Constant learning keeps them inserted in the market and enables the creation of new products, technologies and processes.
- IT afnity empower and allows to be more productive and efcient in their task execution.

3.2 Target Group Analysis

Target group	Characteristics	Prerequisites	Needs	Competence Goals	Prospective Job Field
Master degree students	Student	Bachelor in technology domains (IT, Engineering)	gain knowledge in engineering design and project management about digitalized production processes		Master level position in digitalization and IT sectors.
Lifelong learning student	Professional who need of digital competence training	Bachelor/Master in technology domains (IT, Engineering) or equivalent experience	Flexible - daily and weekly - dedication to the learning process. External motivation to keep on learning (motivation to dedicate to the module may be hindered by other factors such as work deadlines, family tasks...).		update of knowledge and developing competence to be able to function in digital transformed organization

3.3 Competences & Learning Outcomes

The aimed Work 4.0 module C&L Outcomes (W4LO_ _):

- (W4LO1) Big Data/Data Analytics competency a combination of big data competency with sensors and mobile technology as well as predictive maintenance and machine learning.
- (W4LO2) Analytical oriented competencies include IT and technology affinity, network administration, data security, cloud architectures, programming, in-memory DBs.
- (W4LO3) Design of smart products (integration of sensors, antennas, chips and other components); and the service model (functionalities, interactions) based on the product-service platform.
- (W4LO4) Analysis of big data (e.g. sentiment analysis) to predict market behaviour and other phenomena impacting the supply chain.
- (W4LO5) Development of IT strategies to support Supply chain Management (e.g. collaboration platforms on the cloud and Internet of Things);
- (W4LO6) Real time management leveraging monitoring and tracking technologies in digital production systems based work 4.0.
- (W4LO7) Evidence-based approach and uses foresight techniques to explore the future digitalised work activities.
- (W4LO8) Create intelligent data management should be promoted by the construction of communication and networking infrastructure based on Industrial Internet and cyber security for successful remote controlling and monitoring.
- (W4LO9) Entrepreneur competence to designing innovative ecosystems and introducing digital smart services using examples of the value chain from building investor to facility management.
- (W4LO10) Organizing IT needs to be able to design the “big picture” of all the new information and technology capabilities required to support digital business.
- (W4LO10) Developing the workforce and job profiles in digital environment to meet present and future needs postulates the identification of required competencies.
- (W4LO11) Interact dynamically with machines in the cyber- and physical- worlds by means of ‘intelligent’ human-machine interfaces, using human-computer interaction techniques designed to t the operators’ cognitive and physical needs, and improve human physical-, sensing- and cognitive-capabilities, by means of various enriched and enhanced technologies.
- (W4LO12) Know computational and communication techniques, akin to adaptive control systems with the human-in-the-loop to efciently allocate labour (cognitive & physical) and distribute tasks between the automated part and the humans in the workstations of an adaptive production system.
- (W4LO13) Linking people, machines and products by forming together a new production system, which enables a future where people will collaborate with robots and will be supported by IoT technology and intelligent assistance systems in their work activities.

3.4 Content

Define the (thematic) content covered by the module.

Core courses:

1. **Introduction. Re-imaging work systems with the ongoing Industry 4.0 digital transformation in the value adding production and logistic processes innovative development** (1 ECTS)
    - Building on the concept of Work 4.0. Taking a look at the working society of today, tomorrow and beyond in evolution: trends and scenarios regarding work organisation and digital technological innovations.
    - Digital technological developments fusion. Key dimensions of Industry 4.0 digital transformation and the innovative impact on work-related outcomes.
    - Work is proving to be a key locus of the digital transformation. The coexistence of humans and technology in the digitalised production environment from a human-cyber-physical systems (HCPS) perspective.
2. **Work 4.0 production system development based on Reference Architecture Model Industrie 4.0** (RAMI4.0) (1 ECTS)
    - State-of-art in development of the reference architectures and frameworks to accelerate the growth of the Work 4.0 projects.
    - Multidimensional technological architecture to guide structured development and promote work 4.0 interoperability, vision and scenarios.
    - Industry 4 projects design and implementation regarding work aspects. Socio-technical approach towards work system digital innovation and human-technology integration.
3. **Adaptive project management for the context of socio-technical digital transformation** (1 ECTS)
    - The methodology of adaptive project management.
    - Work organisational project management based on socio-technical system approach and technochange methods.
    - Digitalization initiatives, that opens up innovative possibilities for designing content, process, the organization of work 4.0 projects.
    - Industry 4.0 and Work 4.0 case studies.
4. **Operator 4.0 concept of the complex activities conducting data-driven decision-making processes and work situational awareness** (1 ECTS)
    - A vision for the Operator 4.0 is in the context of productive human cyber-physical systems and adaptive automation towards human-automation symbiosis work systems.
    - Typologies and enabling technologies to support work distributed decision making at the era of Big Data.
    - Managing projects, that augmenting the physical and cognitive capabilities of the operators and support human work in digitalised environment. Adaptation of production system in order to allow a dynamic and seamless transition of functions (tasks) allocation between humans and machines that optimally leverages human skills and competences.
5. **Work 4 ergonomics and human's well-being designing towards industry 4.0** (1 ECTS)
    - Human-centred components of the well-being at the digitalised workplace.
    - Framework for designing work systems in the transition to Industry 4.0 where human factor, ergonomics, work system modelling and designing strategiesare intrgrated.
    - Digitalization opens up innovative possibilities for designing content, process, the organization of productive work collaboration.
    - Rethinking work architecture, retraining people, and rearranging the organization to leverage technology to transform business by Putting humans in the loop to create value for customers and meaningful work for people.

Elective courses: Integration of learning modules lead by Work 4.0 (1 - 2 ECTS each electives)

1. **IoT for Work 4.0: Healthy and safely human operators in production systems and workplaces (WUNU)**
    a. Intelligent Health and Safety approach to Work 4.0 based IoT.
    b. Sensors, actuators, controllers, protocols, smart things, Fogy/Cloud computing under industry 4.0
    c. Collect data from sensors and analysis the microclimate, emotional state of employees (heart rate, temperature parameters), equipment data collection: operating modes, data on failures and malfunctions energy consumption, air pollution, Integrity of premises, movement of people, violation of the perimeter, unauthorized access to equipment
    d. Control of microclimate (optimal rate, humidity, air conditioning, lighting), equipment (stop in case of failures, breakdowns, deterioration of working conditions, harmful emissions, physical condition of workers and other emergencies), security systems (reports of perimeter violations or access to equipment (police, management and other services), accidents (reports of medical services, police, management), premises (blocking / unlocking of premises, equipment, etc.)
2. **Skills of the future and changing the workplace under the influence of the industrial revolution (NU-ZP)**
    a. The main trends that determine the nature of work in the 21st century.
    b. Skills of the 21st century.
    c. Strengthening social security.
3. **Digital Technologies involved in Work 4.0. (ASCCA)**
    a. Cloud/edge computer.
    b. Embedded systems.
    c. Robotics.
    d. Block chain.
    e. Data/digital/Tele communication.
    f. Augmented/virtual reality.

3.5 Teaching & Learning Activity Plan

1. **A) Select Teaching/learning methods per competence**

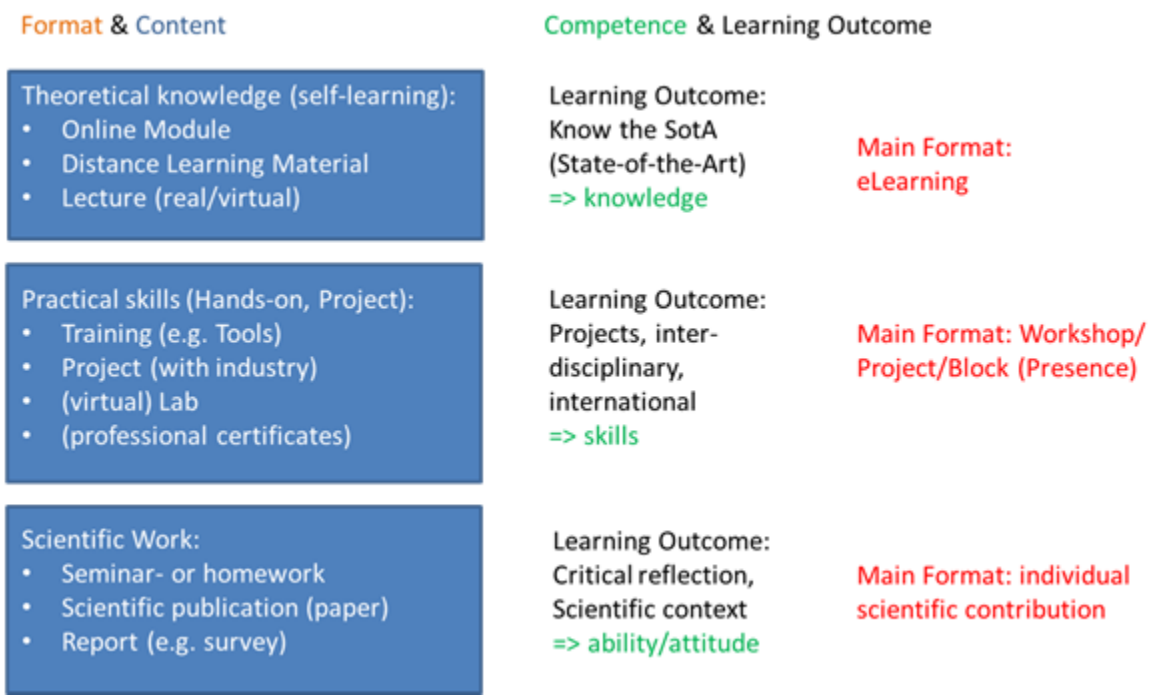

Figure 2: Mapping of Didactic Formats to Competence Areas [own source]

1. **B) Define didactic concept: e.g. choose from:**

   The core learning activity is mostly knowledge acquirement: this is achieved via online lecture, ebook, distance access educational resources, complemented with own reading in suggested reference literature.
   For the skills part labsessions will be used to train hands-on. Labs can be either physical labs, either virtual or remote labs, depending on the learning demand. Most of the labsessions for the technical course use a problem-based approach.
   For the formation of competencies provided upon completion of the module students will perform project simulation (case study) in teams.

1. **C) Define an Activity Plan, e.g. semester schedule**

   Activity 1: ore learning activity knowledge acquierement classes (15 x 2 h = 30 h)
   This classes are complemented with online lectures and distance access educational resources.

   Activity 2: Laboratory works (15x 2 h = 30 h)
   The laboratory works in computer (virtual) laboratory are complemented with online tutorials and reading materials (course book).

   Activity 3: Project simulation in teams (e.g. 3-5 students) or with module case study (20 h).

   Activity 4: Homework and self-study (100 h).

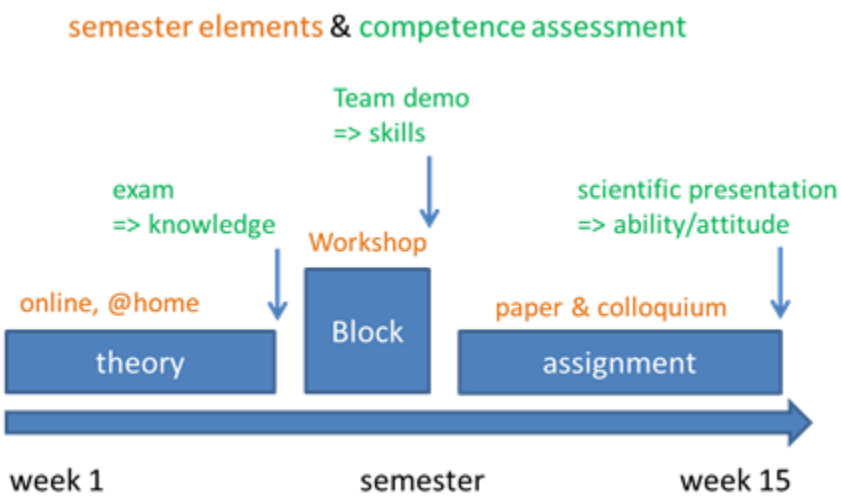

Figure 3: Scheduling Example of Didactic Formats during Semester [own source]

Describe predefined “student journeys” through the module, link it to learning trajectories and competence development paths.

3.6 Teaching & Learning Resources

List all required Literature/Media/Technical Requirements/Lab Equipment

Define Learning Management System (LMS, mandatory: moodle) and other required IT tools

3.7 Tailoring & Educational Tracks

Educational Tracks:

- Practical:
- Entrepreneurial:
- Scientific:

List the main tailoring options foreseen in the module design, e.g. range of ECTS (4-8), tailoring for target groups (students, professionals, …) and possible educational tracks.

3.8 Assessment Methods

FORM	**%**	**REMARK**
Written exam	40	Based on Activity 1,4
Evaluation of lab activities	30	permanent evaluation
Team presentation for results discussion	10	Project end presentation
Team presentation 1 for project simulation (activity 3)	20	Project end presentation

3.9 Curricula Integration

This module is targeted to be included in curriculum of Master in Project Management.

3.10 Quality Assurance - Evaluation

The module will undergo a pilot teaching and will be evaluated by students, professors and IT/media specialists to get feedback for improvement. This iteration continues during 3 years in different universities and publishable release will be produced in each iteration?

4. Syllabus/Module Handbook

Work 4.0 (MOD-W40)					
Module Owner WUNU	**Workload** 180 h	**Credits** 6 ECTS	**Semester** *1*	**Frequency** *autumn semester*	**Duration** 1 Semester

1	**Course Title**	**Contact hours**	**Self-Study**	**Planned Group Size**
	Work 4.0	4 hours per week / 60 h in total	120 h	25 students

2	**Course Description** The fourth industrial revolution as a synonym for digital transformation, introduces new technology and leads to new ways of working. Work 4.0: Brings together high technological level technologies and methods are represents new ways of working. The aim of Work 4.0 module is to develop the holistic approach to describe and learning an essence of Industry 4.0: Work 4.0 (as) productive system and processes. We argue that all Industry 4.0 systems engage humans across the lifecycle in designing, installing, maintaining, operating, and dismantling (at end of life) these systems. Attention to the demands and requirements for people, who will perform these tasks is the project design requirement to Work 4.0 system.
3	Course Structure 1. **Introduction. Re-imaging work systems with the ongoing Industry 4.0 digital transformation in the value adding production and logistic processes innovative development** (1 ECTS) • Building on the concept of Work 4.0. Taking a look at the working society of today, tomorrow and beyond in evolution: trends and scenarios regarding work organisation and digital technological innovations. • Digital technological developments fusion. Key dimensions of Industry 4.0 digital transformation and the innovative impact on work-related outcomes. • Work is proving to be a key locus of the digital transformation. The coexistence of humans and technology in the digitalised production environment from a human-cyber-physical systems (HCPS) perspective. 2. **Work 4.0 production system development based on Reference Architecture Model Industrie 4.0** (RAMI4.0) (1 ECTS) • State-of-art in development of the reference architectures and frameworks to accelerate the growth of the Work 4.0 projects. • Multidimensional technological architecture to guide structured development and promote work 4.0 interoperability, vision and scenarios. • Industry 4 projects design and implementation regarding work aspects. Socio-technical approach towards work system digital innovation and human-technology integration. 3. **Adaptive project management for the context of socio-technical digital transformation** (1 ECTS) • The methodology of adaptive project management. • Work organisational project management based on socio-technical system approach and technochange methods. • Digitalization initiatives, that opens up innovative possibilities for designing content, process, the organization of work 4.0 projects. • Industry 4.0 and Work 4.0 case studies. 4. **Operator 4.0 concept of the complex activities conducting data-driven decision-making processes and work situational awareness** (1 ECTS) • A vision for the Operator 4.0 is in the context of productive human cyber-physical systems and adaptive automation towards human-automation symbiosis work systems. • Typologies and enabling technologies to support work distributed decision making at the era of Big Data. • Managing projects, that augmenting the physical and cognitive capabilities of the operators and support human work in digitalised environment. Adaptation of production system in order to allow a dynamic and seamless transition of functions (tasks) allocation between humans and machines that optimally leverages human skills and competences. 5. **Work 4 ergonomics and human's well-being designing towards industry 4.0** (1 ECTS) • Human-centred components of the well-being at the digitalised workplace. • Framework for designing work systems in the transition to Industry 4.0 where human factor, ergonomics, work system modelling and designing strategiesare intrgrated. • Digitalization opens up innovative possibilities for designing content, process, the organization of productive work collaboration. • Rethinking work architecture, retraining people, and rearranging the organization to leverage technology to transform business by Putting humans in the loop to create value for customers and meaningful work for people. *4. IoT for Work 4.0: Healthy and safely human operators in production systems and workplaces.* 4.1 Industry 4.0 and IoT. 4.2 Sensors, actuators, controllers, protocols, smart things, Fogy/Cloud computing under industry 4.0. 4.3 Collect data from sensors and analysis the microclimate, emotional state of employees (heart rate, temperature parameters), equipment data collection: operating modes, data on failures and malfunctions energy consumption, air pollution, Integrity of premises, movement of people, violation of the perimeter, unauthorized access to equipment. 4.4 Control of microclimate (optimal rate, humidity, air conditioning, lighting), equipment (stop in case of failures, breakdowns, deterioration of working conditions, harmful emissions, physical condition of workers and other emergencies), security systems (reports of perimeter violations or access to equipment (police, management and other services), accidents (reports of medical services, police, management), premises (blocking / unlocking of premises, equipment, etc.). 5. *Big Data analysis for Work 4.0* 5.1 The Role of Big Data Analytics in Industry 4.0. What is big data analytics? How do businesses use Big Data Analytics? How is Big Data Analytics used in Industry 4.0? Big Data Analytics through Self-Service Systems Big Data Analytics and Predictive Maintenance. Production Management with Big Data Analytics. Automate. 5.2 *How big data analytics works.* Collect Data. Process Data. Clean Data. Analyze Data (Data mining, Predictive analytics, Deep learning) 5.3 *Big data analytics tools and technology*. Hadoop. NoSQL databases. MapReduce. YARN stands for “Yet Another Resource Negotiator.” Spark. Tableau. 5.4 *Issues in Big Data analysis and ways of their solving*. Data missing values, their reasons and consequences. Streaming data and tremendous growth of sensors. Methods for missing data recovery. 5.5 *The big benefits of big data analytics.* Cost savings. Product development. Market insights. 5.6 *The big challenges of big data*. Making big data accessible. Maintaining quality data. Keeping data secure. Finding the right tools and platforms.
	Application Focus Students will be guided through a case study project where they plan a digital work project for an example case. This example case will be taken preferably from a real company project. Companies can bring their digital work processes transformation projects as a case study for a block week or summer school workshop. Students form teams to prepare the respective project and present it in a kick-off presentation to the companies.
5	**Scientific Focus** Literature review and analysis. Deductive own research based on the literature. Scientific reflection and discussion in the teams.

6	**Parameters** · ECTS: 6 · Hours of study in total: 180 · Weekly hours per semester: 4 - Contact hours: 60 - Self-Study hours: 120 · Course characteristics: compulsatory · Course frequency: every year - summer semester · Maximal capacity: 25 students · Course admittance prerequisites: none · Skills trained in this course: theoretical, practical and scientific skills and competences · Assessment of the course: contributions within case study project (team presentation) (50%) and written paper (literature review, report or survey, approx. 25 pages) and presentation (in class or at a student conference, e.g. XXX (PM Kiev)) (50%) · Teaching staff: teachers from Open Community of Practice
7	**Learning outcomes** 6.1 Knowledge • explain the basics of the Work 4.0 in organizations • explain the impacts of a digitalisation work project component on diverse stakeholders • explain methods and models for human centered digital production system formation • explain work 4.0 concept in interdisciplinary environments 6.2 Skills • analyze and develop work transformation projects • using digital literacy and to interact with digital technologies • decide and initiate action communicating with people in digital environment 6.3 Competence – ability & attitude • Students possess evidence-based approach and uses foresight techniques to explore the future digitalised work activities • Uses Real time management in digital production systems based work 4.0 • Students work in teams and set up a digital transformation project for linking people, machines and products by forming together a new production system
8	**Teaching and training methods** • lectures introducing concepts, methods and tools, own literature reading • group work in the case study project to practice concepts and methods, to develop skills and to work on case studies • presentations to communicate results and do a scientific discussion and reflection
9	**Curricula Integration** None
10	**References** 1. Oeij, P., Rus, D., & Pot, F. D. (Eds.). (2017). Workplace Innovation. Aligning Perspectives on Health, Safety and Well-Being. 2. Grzybowska K., Awasthi A., Sawhney R. (eds) Sustainable Logistics and Production in Industry 4.0. EcoProduction (Environmental Issues in Logistics and Manufacturing). Springer, Cham. https://doi.org/10.1007/978-3-030-33369-0_3. 3. Csedo, Z., Kovacs, K. & Zavarko, M. (2017): How does Digitalization Affect Change Management: Empirical Research at an Innovative Industrial Group. European Journal of Business and Management. 9 (36), 1-5 4. K. Kumar, D. Zindani and J. P. Davim, Industry 4.0: Developments towards the Fourth Industrial Revolution (SpringerBriefs in Applied Sciences and Technology), New York:Springer, 2019. 5. Ehrhart, M., Schneider, B. & Macey, W. (2013): Organizational Climate and Culture an Introduction to Theory, Research, and Practice. New York, Routledge 6. Raskino, M.; Waller, G. (2016): Digital to the Core: Remastering Leadership for Your Industry, Your Enterprise, and Yourself, Routledge 7. Rogers, D.L. (2016): The Digital Transformation Playbook - Rethink Your Business for the Digital Age, Columbia Business School Publishing

5. References

[1] EU: The European Qualifications Framework: supporting learning, work and cross-border mobility, Luxembourg: Publications Office of the European Union, 2018

[2] EU: Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG), https://enqa.eu/index.php/home/esg/, Brussels, Belgium, 2015

[3] Gruen, G.; Tritscher-Archan, S.; Weiß, S.: Guidelines for the Description of Learning Outcomes, ZOOM partnership (www.zoom-eqf.eu), 2009

[4] Rajala, S.A.: Beyond 2020: Preparing Engineers for the Future. Proceedings of the IEEE, Vol. 100, pp. 1376-1383, DOI 10.1109/JPROC.2012.2190169, 2012

[5] European Institute of Innovation and Technology (EIT), "Quality for learning" EIT Quality Assurance and Learning Enhancement Model, https://eit.europa.eu/sites/default/files/eit_label_handbook.pdf, 2016

[6] European Commision. Digitising European Industry Reaping the full benefits of a Digital Single Market. In Series of Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions (COM), 180, 2016.

[7] Hermann, M., Pentek, T., Otto, B., Pentek, T., & Otto, B. (2015). Design principles for industry 4.0 scenarios: A literature review. *Technische Universität Dortmund*.