University of Applied Sciences
HOCHSCHULE EMDEN·LEER

Department of Technology

Module Handbook

Master Industrial Informatics
(Examination Regulations: Version 2024)

This is an official document that has been translated from German into English using a software application. The legally binding version of this document is the German version.

Table of Contents

Module Name	**Number**
Digitalization Engineering	1010

ECTS	5
Semester Weekly Hours	4
Duration	1 semester
Semester (frequency)	1 (every winter semester)
Compulsory/Elective Duty	compulsory
Workload	60 h contact time + 90 h self-study
Examination type, scope, -Duration	Written exam 1.5h or oral exam or creation and documentation of computer programs

Prerequisite according to the examination regulations for participation
None
Recommended Prerequisite
None

Courses
• Digitalization of ICPS (2 SWS): A. W. Colombo • Digital Signal Processing (2 SWS): J.-M. Batke
Course content
Acquisition of background knowledge on the specification and implementation of service-oriented, edge and cloud-based as well as agent-based business processes. Learning the engineering process for digitizing and networking "things"/"assets" that are within an IEC 62264/IEC 61512 infrastructure and migrating them to ICPS. Learn a range of technologies and architectural patterns to enable digitization and inter-net/Ethernet-based networking of ICPS in accordance with the standards DIN SPEC 91345:2016-04 (RAMI 4.0) and Industrial Internet-Reference Architecture (IIRA). With the help of the Asset Administration Shell (AAS) as a backbone technology, students will learn technical approaches, standards, and tools for specifying and prototypically implementing the 6 layers of the vertical dimension of RAMI 4.0 into "things"/"assets" that belong to real-world use cases. "Things/assets" are treated as signals. Digitization of signals, sampling and interpolation, representation of signals via transformations (DFT, DCT), coding of signals, information theory.

Targeted learning outcomes
Via the Internet-of-Services (IoS), both internal and cross-organizational services can be provided and/or used by Industrial Cyber-Physical Systems (ICPS) participants of an entire digitized and networked value chain to carry out innovative value-added transactions. By knowing the technological concepts of ICPS, IoT and IoS, students will understand the steps required to digitize HW and SW components and systems of different ecosystems, e.g. industrial, transportation, energy, infrastructure ecosystems, systems, etc. Using Asset Administration Shel (AAS) and Digital Twin (DT) technology, both "physical" and "cyber" parts of ICPS ("digitized things" or "I4.0 components") are specified. for exemplary use cases and implemented prototypically. All digital things are digitally represented and are subject to concepts of digital signal processing. The students know the basics of implementing digital signal processing in relation to HW and SW components. You can implement basic algorithms yourself.
Teaching and Learning Methods
Lecture, Seminar
Literature
• Engineering human-focused Industrial Cyber-Physical Systems in Industry 4.0 context, doi:10.1098/rsta.2020.0366. 2021. • Digital Twin and Asset Administration Shell Concepts and Application in the Industrial Inter-net and Industrie 4.0. Industrie 4.0 Platform and Industrial Internet Consortium. 2020. • Industrial Cloud-Based Cyber-Physical Systems. The IMC-AESOP Approach, doi:10.1007/978-3-319-05624-1. 2015.
Module Coordinator
A. W. Colombo
Usability
MII

Module Name	**Number**
Group Project	1020

ECTS	10
Semester Weekly Hours	2
Duration	1 semester
Semester (frequency)	1 (every winter semester)
Compulsory/Elective Duty	compulsory
Workload	30 h contact time + 270 h self-study
Examination type, scope, -Duration	Project report

Prerequisite according to the examination regulations for participation
none
Recommended Prerequisite
none

Courses
Group Project (2 SWS): Authorized examiners according to MPO-A
Course content
Topics according to the chosen project. Note: This module can also be used as a practical accompaniment to a module offered in the current semester.
Targeted learning outcomes
The students can use the skills learned separately in different courses in a group under real conditions combined to solve a complex question. You will be able to apply project management methods in concrete projects and document the project results. The students can independently access scientific literature, derive consequences for their own work from it and implement their knowledge in a goal-oriented manner when solving the tasks within the framework of the project. By leading project teams, you will learn to take on outstanding responsibility. The project topic of the "Group Project" module is typically an internal university project, so that the students acquire the project skills needed in the "Peer Project" module in a familiar and familiar environment.
Teaching and Learning Methods
Seminar, Student Thesis
Literature
Literature topic-specific for project work
Module Coordinator
Programme Coordinator Industrial Informatics
Usability
MII

Module Name	**Number**
Industrial Cyber-Physical Systems	1030

ECTS	5
Semester Weekly Hours	4
Duration	1 semester
Semester (frequency)	1 (every winter semester)
Compulsory/Elective Duty	compulsory
Workload	60 h contact time + 90 h self-study
Examination type, scope, -Duration	Written exam 1.5 h or oral exam

Prerequisite according to the examination regulations for participation
none
Recommended Prerequisite
none

Courses
• ICPS and Industry 4.0 (2 SWS): A. W. Colombo • ICPS Life Cycle Engineering (2 SWS): A. W. Colombo
Course content
Positioning of "Things / Assets" within DIN SPEC 91345 (3D Reference Architecture Model for Industry 4.0 (RAMI 4.0)), the Industrial Internet Reference Architecture (IIRA) and the Smart Grid Reference Architecture (SGAM). Identifying "Things/Assets -> Things"/"Assets" within an IEC 62264 (ISA'95 and PERA) / IEC 61512 (ISA'88 and PWS) infrastructure, positioned at both the operational and information technology (OT-IT) levels of an industrial ecosystem. Using the 5 Mayer principles for Systems-of-Systems (SoS) and the IEC 62890 standard, students will learn about the life cycle of the asset and the value streams it contains using examples and case studies from real industrial ICPS. Life cycles in different dimensions are examined, relevant to the development of ICPS, such as in an industrial system: (i) product; (ii) Production Order; (iii) Factory: A factory also has a life cycle, it is financed, planned, built and recycled (a factory integrates production systems and machines from different manufacturers); (iv) Machine: A machine is ordered, designed, commissioned, operated, maintained, converted and recycled, and (v) machine components.

Targeted learning outcomes
Within a modularly reconfigurable intelligent industrial environment, Industrial Cyber-Physical Systems (ICPS) manage, control and monitor physical processes, create a digital copy (Cyber-Shadow, Digital Twin (DT)) of the physical world, and provide a large, sometimes very large, digital copy (Cyber-Shadow, Digital Twin (DT)) of the physical world. communication/information network (I4.0, IIoT). Learn a range of technologies and architecture patterns to enable the digitization of industrial cyber-physical systems in accordance with the standards DIN SPEC 91345:2016-04 (RAMI 4.0) and Industrial Internet-Reference Architecture (IIRA). Students will learn (i) how to construct ICPS, how to deal with a consistent digital data and information model throughout the lifecycle of an ICPS, and (ii) how to combine the value chain for types and instances of ICPS into a unique model. Provision of the specifications of the corresponding "Digital Thread".
Teaching and Learning Methods
Lecture, Seminar
Literature
• DIN SPEC 91345: The Reference Architectural Model Industry 4.0 (RAMI 4.0). ZVEI – Platform 4.0. • A Survey on Edge and Edge-Cloud Computing Assisted Cyber-Physical Systems, doi: 10.1109/ TII.2021.3073066. • The Industrial Internet of Things, Reference Architecture, Industrial Internet Consortium (IIC); • IEC 62264 / IEC 61512 / IEC 62890 / PERA / SGAM (https://www.iso.org/standard/57308.html).
Module Coordinator
A. W. Colombo
Usability
MII

Module Name	**Number**
Industrial Internet of Things	1040

ECTS	5
Semester Weekly Hours	4
Duration	1 semester
Semester (frequency)	1 (every winter semester)
Compulsory/Elective Duty	compulsory
Workload	60 h contact time + 90 h self-study
Examination type, scope, -Duration	Student thesis

Prerequisite according to the examination regulations for participation
none
Recommended Prerequisite
none

Courses
• IIoT and Data Transport (2 SWS): D. Kutscher • IoT Data Processing (2 SWS): N. Streekmann
Course content
The development of _Industrial Cyber-Physical Systems_ (ICPS) aims to create an optimal overall package that uses existing technological and economic potential within the framework of a systematic innovation process. Various integration aspects must be taken into account, which are essentially based on structural connectivity and functional interoperability between ICPS. The module covers fundamental concepts and common technologies that can be used to generate specific data transport topologies and data processing chains for a wide range of industrial use cases. It is essential to consider an end-to-end integration of sensors and actuators at different levels up to the business level of a company. In the context of data transport, concepts and technologies such as IoT protocols, web service technologies, messaging technologies and integration patterns are considered. On the data processing side, the focus is on architectural concepts (e.g. Lambda, Kappa, Dataflow) and frameworks (e.g. Storm, Spark, Beam and Flink).
Targeted learning outcomes
The students create concrete solutions for selected tasks of data transport and data processing in industrial informatics by combining existing frameworks and program libraries for the Internet of Things in a targeted manner. To this end, they are developing their own software project to accompany the event, including documentation and final demonstration.
Teaching and Learning Methods
Seminar, Internship

Literature
Kleppmann, M.: Designing Data-Intensive Applications, O'Reilly, 2017. https://opcfoundation.org/
Module Coordinator
N. Streekmann
Usability
MII

Module Name	**Number**
Data Science and Analytics	1050

ECTS	5
Semester Weekly Hours	4
Duration	1 semester
Semester (frequency)	2 (every summer semester)
Compulsory/Elective Duty	compulsory
Workload	60 h contact time + 90 h self-study
Examination type, scope, -Duration	Coursework in the form of a term paper

Prerequisite according to the examination regulations for participation
none
Recommended Prerequisite
Mathematics at Bachelor's level

Courses
• Data Science (2 SWS): E. Wings • Analytics (2 SWS): E. Wings, A. W. Colombo
Course content
The importance of data analysis, especially of large amounts of data (big data), is growing in the fields of science and business. The lecture deals with concepts, algorithms and technologies for the analysis of large amounts of data. Methods from the field of machine learning, as well as their embedding in the processes CRISP-DM and KDD and their classification in Industry 4-0 standards are covered. Analytics created with digitized data and information provided by industrial cyber-physical systems are an essential part of digitized environments and support decision-making at different levels in the ecosystems of industry, transportation, energy, and health (or a combination thereof). The lecture offers the opportunity to understand different types of analytics and how they can be integrated into Industry 4.0 (RAMI 4.0) and Industrial Internet Reference Architecture (IIRA) environments.
Targeted learning outcomes
Students are able to estimate and evaluate the numerical challenge of a large amount of data. With the help of standard software, students should be able to analyze, evaluate and apply selected algorithms for high-dimensional problems with the help of the standard KDD process. After learning the key features of analytics as part of an Industry 4.0 and/or IIRA-compliant digitized ecosystem, students have the opportunity to explore and prototype different types of analytics for different application areas.
Teaching and Learning Methods
Lecture

Literature
Josh Patterson, Adam Gibson: Deep Learning: A Practitioner's Approach. O'Reilly, 2017 Jörg Frochte: Machine Learning Basics and Algorithms in Python. 3rd edition, Hanser Verlag, 2020 Bühlmann, Peter; Drineas, Petros; Kane, Michael; van der Laan, Mark: Handbook of Big Data. Chapman and Hall/CRC, 2016 The Industrial Internet of Things. Volume T3: Analytics Framework. Industrial Internet Consortium 2017. AI-Guide Platform 4.0. 2020. \url{www.plattform-i40.de/IP/Redaktion/EN/Downloads/Publika-tion/China/ai-guide.pdf} What Is Data and Analytics? \url{www.gartner.com/en/topics/data-and-analytics}
Module Coordinator
E. Wings
Usability
MII

Module Name	**Number**
Mathematical Modelling of ICPS	1060

ECTS	5
Semester Weekly Hours	4
Duration	1 semester
Semester (frequency)	2 (every summer semester)
Compulsory/Elective Duty	compulsory
Workload	60 h contact time + 90 h self-study
Examination type, scope, -Duration	Written exam 1.5h or oral exam

Prerequisite according to the examination regulations for participation
none
Recommended Prerequisite
none

Courses
• Model-based Formal Methods and Tools (2 SWS): A. W. Colombo • Algebraic Formal Methods and Tools (2 SWS): G. J. Veltink
Course content
Students will learn how to use formal methods throughout the life cycle of an ICPS. By applying them to real industrial ICPS case studies, the relevant technical methods are learned. The following methods and tools are covered: queue theory, high-level Petri net theory, functional analysis, process algebra and the specification language mCRL2. It will be shown how these methods and tools are used in the modeling, qualitative and quantitative analysis, validation and prototype implementation of ICPS.
Targeted learning outcomes
Students should be able to understand, analyze, adapt and independently develop formal specifications of ICPS. They use model-based methods, such as queue theory and Petri networks, as well as algebraic methods, such as termer substitution systems and process algebra. This enables students to apply formal mathematical modelling techniques for the different phases of the ICPS life cycle: design, development, commissioning, provisioning, operation and maintenance of the digitised industrial environment in order to analyse and evaluate the behaviour of these collaborating distributed systems.
Teaching and Learning Methods
Lecture, Seminar

Literature
• Adan, I., J. Resing: Queueing Systems. Eindhoven University of Technology, The Netherlands, 2002. • Reisig, W.: Understanding Petri Nets: Modeling Techniques, Analysis Methods, Case Studies (English Edition). Springer Verlag, 2013. • Fokkink, W.: Introduction to Process Algebra. Springer Verlag 2007. • Groote, J.F., M.R. Mousavi: Modeling and Analysis of Communicating Systems. MIT Press, 2015.
Module Coordinator
G. J. Veltink
Usability
MII

Module Name	**Number**
Peer Project	1070

ECTS	10
Semester Weekly Hours	
Duration	1 semester
Semester (frequency)	2 (every summer semester)
Compulsory/Elective Duty	compulsory
Workload	6 h contact time + 294 h self-study
Examination type, scope, -Duration	Student thesis

Prerequisite according to the examination regulations for participation
Group Project
Recommended Prerequisite
none

Courses
Peer Project: Authorized Auditors according to MPO-A
Course content
Standards for scientific publications and presentations. Other topics according to the selected project. Note: In this module, two presentations must be made. An interim presentation within the module so that the project groups inform each other. A presentation of the final results outside the module, so that interested students from all semesters can gain insights into the topics of this module.
Targeted learning outcomes
The students can use the skills learned separately in different courses in a group of two under real conditions combined to solve a complex problem. You will be able to apply project management methods in concrete projects and document the project results. The students can independently access scientific literature, derive consequences for their own work from it and implement the knowledge in a goal-oriented manner when solving the tasks within the framework of the project. In addition, they learn to document and present their research results in the form of a print-ready contribution to a conference or journal. The project topic of the "Peer Project" module is typically an external project, so that students learn to put their project skills into practice in preparation for professional life. In this module, students are also expected to learn to take responsibility and independently organize topics and projects with external partners as well as to find internal university supervisors for the project.
Teaching and Learning Methods
Student work
Literature
Literature topic-specific for project work

Module Coordinator
Programme Coordinator Industrial Informatics
Usability
MII

Module Name	**Number**
Robotic Systems	1080

ECTS	5
Semester Weekly Hours	4
Duration	1 semester
Semester (frequency)	2 (every summer semester)
Compulsory/Elective Duty	compulsory
Workload	60 h contact time + 90 h self-study
Examination type, scope, -Duration	Written exam 1.5 h or oral exam

Prerequisite according to the examination regulations for participation
none
Recommended Prerequisite
none

Courses
• Introduction Robotic Systems (2 SWS): G. Kane • Industrial Robotic Systems (2 SWS): A. W. Colombo
Course content
Overview of different types of robots, including structural and behavioural specifics: working space, energy sources, etc. Introduction to robot kinematics (forward and backward), robot dynamics. HW and SW interfaces for integrating the robot into an industrial flexible cell. Selection of different types of sensors, actuators and grippers as well as their areas of application. Overview of current and emerging areas of robotics: industrial robotics, medical robotics, delivery robotics, agricultural robotics. Overview of traditional industrial robotic processes: welding, cutting, cleaning, palletizing, tendering, assembly/disassembly: What type of robot and power source is recommended for each type of application? SW communication interfaces for connecting a robot to an ICPS-based service cloud. Introduction to ROS, IROS, SKIROS (robotic operating systems). By combining seminars and practical projects, the content will be adapted to the latest results of the I2AR Institute's research and innovation projects.

Targeted learning outcomes
The students understand and can describe the mechatronics and SW structure of robots. They have know-how in robot applications related to industrial processes. In these areas, they acquire knowledge about the hardware components of robots, their numerous sensors, actuators and physical configurations, as well as about the algorithmic kinematics and dynamics as well as the software components required to drive them. Students will learn about the periphery of a standard industrial robot cell and its interaction in the entire process environment. Knowledge of standard SW interfaces for the integration of robots into an industrial cyber-physical system is acquired by learning the robot as a CPS component within a RAMI4.0-compliant automation architecture. Students are expected to gain insight into the emerging trends in robotics, human-machine interaction, lightweight robots, soft robotics, and the expanding fields of robotics in a developed country, including medical robotics, agricultural robots, search and rescue robots, and more.
Teaching and Learning Methods
Lecture, Practical Course
Literature
John J Craig: Introduction to Robotics, Mechanics and Control. Prentice Hall 2003. Heimann, B., Gerth, G. and Popp, K.: Mechatronik, 3rd edition, Hanser 2007. Roddeck, W.: Einführung in die Mechatronik, Teubner, Stuttgart, 1997. Vogel, J.: Elektrische Antriebe, Hüthig, Berlin, 1988. Steven M. LaValle, Planning Algorithms, Cambridge University Press, 2006
Module Coordinator
G. Kane
Usability
MII

Module Name	**Number**
Master's thesis with colloquium	1090

ECTS	30
Semester Weekly Hours	
Duration	1 semester
Semester (frequency)	3 (every winter semester)
Compulsory/Elective Duty	compulsory
Workload	9 h contact time + 891 h self-study
Examination type, scope, -Duration	Master's thesis with colloquium

Prerequisite according to the examination regulations for participation
See § 6 "Admission to the Master's Thesis" Master's Examination Regulations (MPO) Part B.
Recommended Prerequisite
none

Courses
Master's Thesis: Authorized examiners according to MPO-A
Course content
The Master's thesis is a theoretical, empirical and/or experimental scientific thesis with written elaboration, which is carried out individually. The thesis will be presented at the end of a colloquium.
Targeted learning outcomes
In the Master's thesis, students show that they are able to work on new complex tasks and problems from the scientific, application-oriented or professional fields of activity of this degree programme and to independently control processes in a scientific subject or in a strategy-oriented professional field of activity. The requirements structure is characterized by frequent and unpredictable changes. Students should have comprehensive, detailed and specialized knowledge at the cutting edge of knowledge in the subject areas of industrial informatics, as well as extended knowledge in related areas. Students should have specialized technical or conceptual skills to solve strategic problems and be able to weigh up alternatives even in the case of incomplete information, as well as to develop new ideas or procedures, apply them and evaluate them taking into account different assessment standards. Students should be able to lead groups responsibly in the context of complex tasks and represent their work results, promote the professional development of others in a targeted manner and lead area-specific and cross-departmental discussions. Students should be prepared for new application- or research-oriented tasks define goals while reflecting on the possible social, economic and cultural effects, use appropriate means and be able to develop knowledge independently for this purpose.
Teaching and Learning Methods
Student work

Literature
Literature topic-specific for the Master's thesis
Module Coordinator
Programme Coordinator Industrial Informatics
Usability
MII

Module Name	**Number**
Human Factors and Augmented Reality	2010

ECTS	5
Semester Weekly Hours	4
Duration	1 semester
Semester (frequency)	1 (every winter semester)
Compulsory/Elective Duty	elective
Workload	60 h contact time + 90 h self-study
Examination type, scope, -Duration	Oral examination

Prerequisite according to the examination regulations for participation
none
Recommended Prerequisite
none

Courses
• Human Factors and Assistance Systems (2 SWS): T. Pfeiffer • Augmented Reality (2 SWS): T. Pfeiffer
Course content
Theory • Basics of Human Factors • Basics of modern human-machine interfaces for worker training and worker management • Areas of application of human-machine interfaces • Criteria for the User-Oriented Design of Human-Machine Interfaces • Methods for the evaluation of human-machine interfaces • Process models for the design and implementation of human-machine interfaces Practical part • Testing of various modern user interfaces from industry • Implementation of usability evaluations of user interfaces • Development of prototypes of augmented reality applications The basic teaching content is taught in lecture form, special topics are worked on with the students in seminars and practical tasks are implemented in the laboratory.

Targeted learning outcomes
Students will be able to evaluate and design modern user interfaces for industrial systems. To do this, you will consider the basics of modern user interfaces and augmented reality technologies in the context of operating and working with industrial systems. This enables them to consider the perspective of the users when developing technical solutions and to ensure ease of use. In concrete terms, students will be able to • Understand the basics of human factors, usability and augmented reality, • use modern user interfaces, • analyze the usability of user interfaces, • Creating augmented reality applications based on frameworks.
Teaching and Learning Methods
Lecture and Seminar
Literature
Dörner, R.; Broll, W.; Grimm, P.; Jung, B.: Virtual and Augmented Reality (VR/AR): Foundations and Methods of Extended Realities (XR). Springer Verlag, 1st edition, January 13, 2022.
Module Coordinator
T. Pfeiffer
Usability
MII

Module Name	Number
Innovation Engineering	2020

ECTS	5
Semester Weekly Hours	4
Duration	1 semester
Semester (frequency)	2 (every summer semester)
Compulsory/Elective Duty	elective
Workload	60 h contact time + 90 h self-study
Examination type, scope, -Duration	Written exam 1.5h or oral exam or study paper

Prerequisite according to the examination regulations for participation
none
Recommended Prerequisite
none

Courses
• Digital Economy (2 SWS): J. Mäkiö • Innovation Management (2 SWS): A. W. Colombo

Course content
Due to the digitization of society, the boundaries between countries and cultures are becoming increasingly less important. This change can be observed in particular at the organizational and individual level. Consequently, organizations, companies, governments and individuals are facing new opportunities and challenges due to the digitization of products and processes. The digitization process is a challenging change for everyone involved. This change must be managed in order to be successful. The first topic of this course deals with the connections and dependencies between digital technology and organizational digitization as well as their effects on the economy, society, organizations and individuals. Innovation in engineering and software development, creative problem solving and idea generation, idea evaluation techniques, writing workshop, key features of the open innovation paradigm (OI2.0), innovation model based on extensive networking and co-creative collaboration between all actors in society, industrial patent processes linking innovation and patentability, the use of patent office databases, validation of "patentability" and "Innovation aspects", new business models related to IoT and IoS paradigms, application of service level agreements to innovation processes, intellectual property rights (IPR management and risk analysis, technology readiness levels (TRLs) and innovation capabilities, understanding and management of the process of generating research and innovation actions Understanding the requirements is key to successful ICPS engineering: building an ICPS system to fulfill its purpose depends on understanding the exact problem that needs to be solved. The purpose of this course is to learn challenges, principles and practices for identifying, analysing and managing requirements from relevant sources, both at the beginning and during an ICPS development project. The course teaches challenges, principles, and concrete practices related to requirements management, including topics such as requirements analysis, collection, analysis, documentation, negotiation, verification and validation, requirements management, change management, and traceability.
Targeted learning outcomes
This course consists of three main themes: digital economy, open innovation and requirements engineering. The first topic deals with the digital economy and society, including the identification, analysis and description of the challenges of the digital age for institutions and individuals. Students are able to describe changes and challenges in digital technology and the economy and to analyze their interdependencies. Students learn to develop a new business model that is oriented towards the requirements of the digital age. The second topic deals with open innovation. Students will understand this new paradigm based on the principles of integrated collaboration, jointly created shared values, a nurtured innovation ecosystem, exponential technologies unleashed, and extraordinarily rapid adoption. In addition, students learn collaborative learning and research to accelerate the innovation process towards tangible and especially service-oriented intangible products and solutions. The third topic deals with the requirements management of industrial cyber-physical systems. Students will learn how requirements are recorded, which aspects of both functional and non-functional requirements need to be considered particularly carefully and how these are identified, analyzed and described, how the requirements development process is organized and how ICPS requirements are documented.
Teaching and Learning Methods
Lecture, seminar, student thesis

Literature
Brynjolfsson, E., McAfeeRace, A.: Against The Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy, Digital Frontier Press, 2011 Kehal, H., Singh, V.: Digital Economy: Impacts, Influences, and Challenges, Idea Group Publishing, 2005 Peitz, M., Waldfoge, J.: The Oxford Handbook of the Digital Economy, Oxford University Press, 2012 Brynjolfsson, E., McAfeeRace, A.: Against The Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy, Digital Frontier Press, 2011 Kehal, H., Singh, V.: Digital Economy: Impacts, Influences, and Challenges, Idea Group Publishing, 2005 Peitz, M., Waldfoge, J.: The Oxford Handbook of the Digital Economy, Oxford University Press, 2012 Petry, T.: Digital Leadership: Successful Leadership in Times of the Digital Economy, Haufe, 2016 Albach, H., Meffert, H., Pinkwart, A. Reichwald, R. (eds.): Management of permanent change. New York, Springer Gabler 2015. Missikoff, M., Canducci, M., Maiden N., Enterprise Innovation: From Creativity to Engineering, WILEY, 2015. Intel Labs Europe, EU-OISPG: Open Innovation 2.0: A new paradigm EU HORIZON2020, Extract from Part 19 - Commission Decision C(2014)4995 https://esto.nasa.gov/files/trl_definitions.pdf L. Martins, T. Gorschek: Requirements Engineering for Safety-Critical Systems, River Publishers, 2022 P. A. Laplante: Requirements Engineering for Software and Systems, Auerbach Publications, 2017
Module Coordinator
J. Mäkiö
Usability
MII