

Short Module Manual

Industry 4.0 (M.sc.)

XU Exponential University
of Applied Science

SHORT FACTS

Graduation Master of science

Scope 120 ECTS

Language English

Type of Study Full-time/ Part-Time

Total numbers of semesters 4/8 semesters

Matriculation Date April / October

Teaching method Seminar discussion, individual work, group work, case studies

Course and content of studies

SEMESTER 1

ITM 1 Technology Monitoring4.0

5 ECTS

- **ITM 1.1 Technology Monitoring Analytical Frameworks**
 - Analyze what is at stake for companies focusing on technology monitoring context of Industry 4.0 by understanding how technology monitoring analytics systems work.
 - Understand technology monitoring as a source of sustainable competitive advantage by identifying the scanning and forecasting technologies with the highest application potential.
 - Apply technology monitoring frameworks to analyze and respond to the challenges and opportunities of analyze and evaluate the challenges and opportunities of Industry 4.0.
- **ITM 1.2: Technology Monitoring Implementation Strategies**
 - Understand the value of technology monitoring in the development of innovation strategies for Industry 4.0 by identifying and selecting technologies that have a positive impact on market opportunities.
 - Apply technology intelligence plans to support innovative business strategies to capitalize on market opportunities.

SPS1 Smart Product Design

5 ECTS

- **LV SPS 1.1 Smart Product Design**
 - Understand product design and development as an interdisciplinary strategy-technology-market-product construct that encompasses market, product, technology and industry lifecycles as well as sustainable processes.
 - Understand technological and business challenges in the design and development of intelligent products by analyzing selected problems and deriving solutions.
 - Apply and understand strategies, methods, processes and tools of new product design and development to generate sustainable solutions.
 - Assess selected methods of market research and apply their significance for market testing and market testing and validation.

- Analyze product development processes in the context of smart product design in order to derive optimization possibilities.
- Examine and analyze complex products in the context of Industry 4.0 to understand practical challenges in product design and analyze them.
- Analyze current problems and innovative approaches in industrial product development to analyze and evaluate relevant use cases in smart product design.
- Develop, analyze and discuss the results of current best-practice research in the field of product design and development.

• **LV SPS 1.2 Smart Product Design Lab**

- Understand the design and management of an intelligent product development process in a team.
- Apply the methods they have learned in practical development work with the steps of the product development process: product development process: from the requirements analysis to the conception and prototype prototyping to the development of the product idea.
- Evaluate the project and the process of smart product development by analyzing and weighing up its evaluate its multiple dimensions.
- Present and discuss the product idea and its development process.

ITM 2

**Big Data Analytics and
Object-Oriented Programming**

5 ECTS

• **LV ITM 2.1 Big Data Analytics**

- Understand the principles and concepts of big data analytics and their applications in various areas.
- Critically evaluate the quality and suitability of data sources for big data analytics.
- Apply suitable data pre-processing techniques and algorithms for big data analytics.
- Analyze and interpret the results of big data analysis using statistical and machine learning methods.
- Designing and developing scalable and efficient big data analytics solutions.
- Evaluate and compare different big data analytics techniques for solving real-world problems.

• **LV ITM 2.2 Object-oriented Programming (Python)**

- Understand the concepts and principles of object-oriented programming (OOP).
- Design and implement object-oriented solutions to real-world problems.
- Apply the principles of encapsulation, inheritance and polymorphism when developing object-oriented programs.
- Implement data structures and algorithms using the Python programming language.
- Apply design patterns and best practices in the development of object-oriented programs.
- Analyze and optimize the performance of object-oriented programs.

FSK1

New Leadership

5 ECTS

• **LV FSK 1.1 Exponential Leadership**

- Understand classical and modern management theories and can put them into practice
- under the influence of put them into practice under the influence of exponential technologies.
- Identify and develop their individual leadership style.
- Reflect on their own role in the team and drive solution processes forward.
- Know how to build and lead a coherent and synergetic team.
- Learn how to deal with sensitive and challenging conversations and methods for conflict resolution in the work context.
- Learn how to deal effectively with change management and find out how to accompany change processes.
- Deal appropriately with organizational boundaries, hierarchies, work structures and cultures.
- Understand the importance of resilience and the prerequisites for building resilience.

• **LV FSK 1.2 Human Capital Management**

- Understand that the digital transformation is primarily a skills transformation.
- Know the possibilities and limits of human capital management for selected topics in the area of personnel and organization.
- Analyze and work on complex questions of leadership, planning and coordination tasks coordination tasks at leadership and management level.
- Discuss legal framework conditions, concepts, procedures and methods in the areas of strategic corporate management, management, leadership and personnel.
- Are familiar with incentive systems and performance stimulation and know how to apply them.

MDS2

Descriptive Analytics

5 ECTS

• **LV MDS 2.1 Integrated Data Collection and Preparation**

- Can determine the benefits of integrated data capture.
- Can identify the processes of computerized data acquisition.
- Can name and evaluate various tools for integrated data acquisition and processing evaluate them.
- Can independently collect selected data using software.
- Can identify the need for data preparation before analysis.
- Can use various data preparation functions.
- Reset columns of unclear data sets.
- Change the order and categorization of data.

• **LV MDS 2.2 Automated Data Evaluation and Presentation**

- Understand the evaluation problem and can determine evaluation criteria.
- Can comprehensively clarify the results in a presentation.
- Understand the parallel processing of numerous data channels in evaluation programs.
- Can assess the possibility of sequential linking.
- Are proficient in various operators for visualizing and evaluating data in Rapid Miner.
- Can create and evaluate automatic prediction models in Rapid Miner.
- Can automatically visualize evaluated data in histograms, boxplots, time series and other formats formats.
- Can show the interpretation of all results in professionally created tables and graphs in result presentations tables and graphs.
- Can evaluate automated report generation with LaTeX and other software.

SEMESTER 1

SBI2 Impact Data Management 5 ECTS

- **LV SBI 2.1 Data Driven Decision Making**
- Know the potentials and limitations of data-driven decision-making.
- Understand the basic problems and solutions for integrating data science in organizations.
- Develop and implement statistical solutions to data-driven decision problems.
- Critically evaluate the role and impact of ethics and governance in data analysis.
- Construct and diagnose statistical models to predict effects and incorporate them into and incorporate them into strategy development.
- Identify and prioritize AI opportunities.
- Know what hard and soft skills data scientists, engineers, architects, analytics translators and other employees responsible for data analytics, data governance and the development of AI solutions need.
- **LV SBI 2.2 Sustainability Measurement**
- Know the main fields of action of sustainability management and the necessary basics.
- Can describe the most important key figures and data points and apply them, e.g. in life cycle assessments.
- Understand the conception, structure and application of key sustainability-oriented controlling instruments.

SEMESTER 2

ITM3 Industry 4.0 Strategy 5 ECTS

- **LV ITM 3.1 Digital Strategy Development**
- describe the elements of the digital strategy of organizations operating in the field of Industry 4.0.
- explain and present strategies at different levels (corporate, business area and functional area strategies) in order to meet the challenges of the fourth industrial revolution.
- Apply methods for evaluating markets, organizations and competition, business models, applications and technologies that influence existing business models or contribute to the creation of new business models.
- Apply methods of strategy evaluation and draw conclusions for strategic orientation from their analysis.
- Develop Industry 4.0 strategies, design exemplary strategic implementation plans and apply methods of strategy controlling.
- Analyze case study examples in order to apply practical experience from real-life use cases from Industry 4.0, analyze and discuss them.

SEMESTER 2

• **LV ITM 3.2 Digital Business Model Development**

- Define the term business model and describe concepts and forms of business models in Industry 4.0.
- Understand and explain the necessity and objectives of adapting existing business models and developing new business models due to digital transformation.
- Design and apply network platform-based business models to gain a deeper understanding of the different roles in value creation and exchange in an ecosystem. in an ecosystem.
- Describe approaches and methods for analyzing and evaluating business models.
- Describe the advantages and disadvantages of typical digital business models and derive conclusions and suggestions for improvement.
- Describe the principles, elements and dimensions of business model development.
- Describe the most important methods of business model innovation and apply practical examples in examples in Industry 4.0.
- Understand the concept of business model and business creation to transform organizations and exploit business opportunities in the market.
- Analyze and discuss case study examples.

SEMESTER 3

SPS 2

Smart Services 4.0

5 ECTS

• **LV SPS 2.1 Smart Services Design**

• **LV SPS 2.2 Smart Services Applied Technologies**

- Understand and apply the analytical frameworks and key functions for designing intelligent services.
- Understand the key principles of using architectures and technologies to design intelligent services.
- Analyze the trade-offs associated with the design, implementation and management of intelligent services.
- Design and explain an intelligent service and intelligent service system, identifying key areas for improvement and optimization.
- Apply the key principles of intelligent services to drive sustainable value for customers and all key stakeholders.
- Understand the principles, technologies and tools used in the design of Smart Services 4.0 design.
- Analyze the market and business requirements of Smart Services 4.0 and design effective Smart Service 4.0 solutions.
- Develop the ability to use Smart Services 4.0 design methods, tools and technologies to develop and test Smart Services 4.0.
- Apply design thinking and user-centered design principles to create and evaluate Smart Services 4.0.
- Evaluate and compare the design of Smart Services 4.0 based on user experience, usability and acceptance criteria.

• **LV SPS 3.1 Smart Production Systems**

- Design and explain an intelligent production (and maintenance) system, identifying key areas for improvement and optimization. identify key areas for improvement and optimization.
- Understand the role of networked machines, communication mechanisms, computing power and automation in smart factories (as cyber-physical systems).
- Evaluate the effectiveness and efficiency of a smart production (and maintenance) system using appropriate metrics and benchmark analysis.
- Analyze the trade-offs involved in the design, implementation and management of a and management of a smart factory system with its production and maintenance components.
- Apply the key principles of smart manufacturing to sustainably increase value for customers and all key stakeholders.
- Developing and implementing intelligent production and maintenance strategies for Companies operating and competing in Industry 4.0.
- To analyze and discuss the results of current best practice research in the field of intelligent production and intelligent maintenance.

• **LV SPS 3.2 Smart Planning and Control Systems**

- Understand the analytical framework and key variables for the intelligent planning process of production systems in a team and how to apply them.
- Understand the relevance of data analytics and artificial intelligence in the context of intelligent planning and control systems. control systems.
- Understand the most important frameworks and tools of intelligent data analysis for decision-making in the planning and control of smart factory systems in Industry 4.0.
- Present and discuss a smart factory system (including its production (and maintenance), planning and control systems) and its development process.

MSK 2 Research Skills

5 ECTS

- **LV MSK 2.1 Quantitative Research Methods and**
- **LV MSK 2.2 Qualitative Research Methods**
- Are able to name, describe and explain key aspects of quantitative and qualitative research.
- Are able to describe research processes and plan and implement a study (including the research process, phases of the research process, research approaches and research designs).
- Can explain selected research methods and apply them in the context of a challenging practical project (measurement methods, methods of sampling, methods of data collection, methods of data analysis). data collection, methods of data evaluation).
- Can develop a data collection procedure (personal/written/online survey, ...).
- Can collect, process and evaluate data and information and present and defend the results defend the results.
- Are proficient in statistics/data and information processing programs (e.g. IBM SPSS) and can use them use them for data preparation and data analysis.
- Can recognize and assess social and ethical challenges of research and take them into account in their actions.

MDS 5 Predictive Analytics

5 ECTS

- **LV MDS 5.1 Predictive Models and Business Applications**
- Can explain the historical background of predictive models and business applications and highlight current developments.
- Can correctly classify the significance of predictive models and business applications in the context of correctly classify digitization.
- Can differentiate between the terms "prediction" and "interpretation".
- Can weigh up and discuss to what extent data scientists are allowed to work with which data ("Which analyses and interpretations are okay, which are too private?").
- Can determine the key elements of predictive models.
- Can distinguish data transformations for single predictors from data transformations for multiple predictors and predictors and determine key characteristics.
- Can assess and evaluate selected case studies.

• **LV MDS 5.2 Predictive Modeling/Analytical Techniques**

- Can prepare data for predictive modeling.
- Can summarize and visualize data sets using suitable tools.
- Can identify techniques for predicting continuous and discrete results.
- Can plan and carry out several data processing steps.
- Can evaluate regression methods for predicting the value of continuous variables.
- Can determine concepts of predictive modeling (e.g. cross-validation, model selection and overfitting).
- Can create predictive models with the software tool XLMiner,
- Can run logistic regression models to predict the value of binary variables predict the value of binary variables.
- Can identify concepts for classification (cross-validation, confusion matrix, cost-sensitive classification and ROC curves).
- Can create classification models using the XLMiner software tool.
- Can evaluate advanced prediction models (e.g. trees and neural networks) and create.

DTM 3 Future Economics

5 ECTS

• **LV DTM 3.1 Exploring Crisis Status-Quo**

- Understand the various current crises and their context and draw historical comparisons. draw historical comparisons.
- Analyze and interpret the latest sustainability reports and the latest studies on economic change. interpret them.
- Recognize and understand the status quo of selected sustainability aspects and concepts.
- Know and discuss the most important current legislation and regulatory frameworks.
- Know and critically reflect on current sustainability strategies and approaches in selected companies.

• **LV DTM 3.2 Sustainable Economic Frameworks**

- Discuss the macroeconomic conditions under which sustainable economic activity takes place.
- Understand the functioning of markets and identify where they can fail.
- Evaluate alternative models to conventional economics and enter into a discourse on the different perspectives. perspectives.
- Assess the values, norms and goals of society in relation to sustainability and develop visions for an optimistic future.

SPS 4

Advanced Virtual Environments 4.0

5 ECTS

• **LV SPS 4.1 Virtual Reality and Augmented Reality**

- Understand the key challenges and opportunities of immersive technologies such as VR and AR in Industry 4.0 by analyzing the environmental context in Industry 4.0.
- Understand the key benefits for organizations of using immersive technologies such as VR and AR in the context of sustainable manufacturing by analyzing the value of such technologies in Industry 4.0.
- Recognize and explain the framework conditions for companies taking on increasingly collaborative tasks by using VR and AR.
- Apply the basic technical knowledge of VR and AR to interact in immersive organizational contexts.
- Understand and demonstrate practical applications through the use of VR and AR tools and devices in the context of Industry 4.0 and demonstrate them.

• **LV SPS 4.2 Mixed Reality and Expanded Reality**

- Understand the key challenges and opportunities of advanced virtual environments such as XR understand.
- Understand the main benefits for organizations of using advanced virtual environments such as VR in the context of context of Industry 4.0.
- Explain the framework for organizations that adopt and implement XR early, to increase value and reduce overhead and operational costs.
- Apply the basic technical knowledge of XR to collaborate in Industry 4.0 organizational contexts.
- Understand and drive various practical applications through the use of XR tools and devices in sustainable sustainable manufacturing.

MSK3

Consulting Skills

5 ECTS

• **LV MSK 3.1 Digitization Consulting**

- Describe the basics and development of consulting.
- Understand the concepts of external and internal management consulting and the associated associated consulting roles.
- Recognize and explain the framework conditions for companies taking on increasingly collaborative tasks by using VR and AR.
- Reflect on and adapt consulting concepts and roles in the context of digitalization processes in companies and adapt them.
- Understand the phases of the consulting process, apply various tools and techniques for analysis analysis, problem definition and diagnosis and customize consulting sessions.
- Recognize and classify the different interests of those involved in the digitalization process.
- Apply project management tools to control digital change projects in the various consulting phases consulting phases.
- Explain the principle of lean consulting.
- Reflect on their role and responsibility as a consultant.

• **LV MSK 3.2 Digitization Consulting Project**

- Provide companies/business or functional areas with recommendations on aspects of the successful of the successful digitization process.
- Independently design the phases of the consulting process, clarify the order and prepare the offer prepare an offer.
- Collect and analyze internal and external company data and derive conclusions.
- Evaluate strategies for achieving goals, propose and justify corrections.
- Develop proposed solutions and concepts.
- Create implementation plans and accompany implementation processes.
- Evaluate the achievement of objectives, assess and evaluate the degree to which objectives have been achieved.
- Communicate appropriately, deal professionally with disruptions and conflicts in communication.
- Critically reflect on their role and professional behavior as a consultant.
- Assess and discuss the consequences of decisions.
- Give and accept feedback.

SA 1 Study Abroad 20 ECTS (Siehe MHB)

- Act and work academically in different cultural contexts.
- Use the opportunities offered by a new academic environment to further develop personal and professional professional skills.
- Apply knowledge about local and international contexts and specifics of their respective subject areas categorize and apply.
- Work together with fellow students in a new (academic) environment.
- Apply and deepen their language skill.

SA 2 Internship 10 ECTS

- Apply independently for suitable internships, if necessary with the support of the internship supervisor apply for suitable internships.
- Combine the theoretical knowledge acquired during their studies with professional practice and solve technical problems based on the skills they have learned.
- Develop skills such as teamwork, communication skills, conflict resolution, self-organization and time management in professional practice.
- Find their way in new situations and react flexibly to challenges.
- Understand the processes in the internship provider's organization and the roles of colleagues, classify and reflect on them.
- Assess, evaluate and reflect on the professional and personal challenges of the internship reflect.

MT 2 Master Thesis set-up 5 ECTS

- **LV MT 2.1 Master Thesis Colloquium**
 - Develop and answer a larger scientific question independently within a given period of time question within a given period of time.
 - Are able to acquire knowledge in a subject area in a limited amount of time and to present it present it in a scientifically adequate manner.
 - Can present their work, deal with scientific criticism and defend their own results in scientific discourse,.
 - Discuss contributions from fellow students and give feedback.
- **LV MT 2.2 Master Thesis Reflection/Coaching**
 - Systematically search for and process international literature on the current state of research on the topic to be dealt with.
 - Present theories and models for the scientific analysis of the problem and apply them.
 - Independently conduct and evaluate empirical studies.
 - Develop well-founded new perspectives on the topic based on their research and investigations.
 - Document their work process.

SEMESTER 4

MT3

Master Thesis

15 ECTS

IN TOTAL

120 ECTS