Industrial Engineering and Management of European Higher Education

IE3 Master's Programme
based on the BoK guidelines
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Note
For anyone interested in having more information about the project, please contact info@ie3.eu

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A New Master Program in IE&M

Programs in Industrial Engineering and Management can be built in different ways with different program modules and different profiles. However, a program in IE&M need to fulfil common aim and common learning outcomes, which are what students gain for modules in different ways. We here present the program aim and learning outcomes, a feasible program structure, the programme modules syllabi and links to external educational and e-learning materials.

1. Program Aim

The MSc program in industrial engineering and management focuses on how to identify, analyse, solve, and communicate complex interdisciplinary problems in industry, integrating engineering and management knowledge and skills, by using mathematical tools and technological applications, and by knowing how to critically assess applied methods, procedures, and practices.

A graduate from the MSc program has the individual and professional capabilities and attitudes to take on a leading role in dynamic, industrial environments; the graduate can identify, formulate, and examine complex engineering and managerial problems in a systematic and sustainable way, both quantitatively and qualitatively. By using relevant literature and performing quantitative, as well as qualitative, empirical studies, the graduate can readily apprehend new knowledge and skills. Quantitative empirical models based on hypotheses can be tested in experiments as well as through statistical analyses. Qualitative approaches, such as case studies, can be used to create both theoretical and effective constructs and propositions.

Students are trained to work collaboratively on complex problems and tasks. Interpersonal skills, teamwork, and communication are therefore of utmost importance. This training includes contributing to group effectiveness, actively taking part in the work, creating clear roles and responsibilities, sharing knowledge, and collaboratively achieving desired goals.

At the end of the educational path, graduates are able to communicate, orally and in writing, in a correct, inspiring way orientated towards achieving goals. Effective communication is comprised of both task-related and relationship-oriented skills. Graduates must also be proficient enough in English to consider the state-of-the-art knowledge within the field and, based on this knowledge, understand, analyse, compare, and reflect on complex engineering and managerial problems, both in written text and orally.

2. Program Learning Outcomes

After having completed the whole program, the graduated engineer will be able to:

1. Identify, formulate, analyze and solve complex engineering as well as human and managerial related problems, using relevant methodology and advanced qualitative and quantitative tools, applicable to the different industrial sectors
2. Handle complex decision-making processes, by using both computer-based facilities and software tools to find and implement solutions on different engineering and managerial issues in a company or in an organization
3. Use and apply what is available in the modern digital landscape of today and tomorrow, based on broad and deep technical knowledge, to support the technical development and business environment of the company
4. Show insight into the possibilities and limitations of technology, its role in society and the engineers' responsibilities for how it is used, including social and economic aspects as well as ethical and work environment aspects

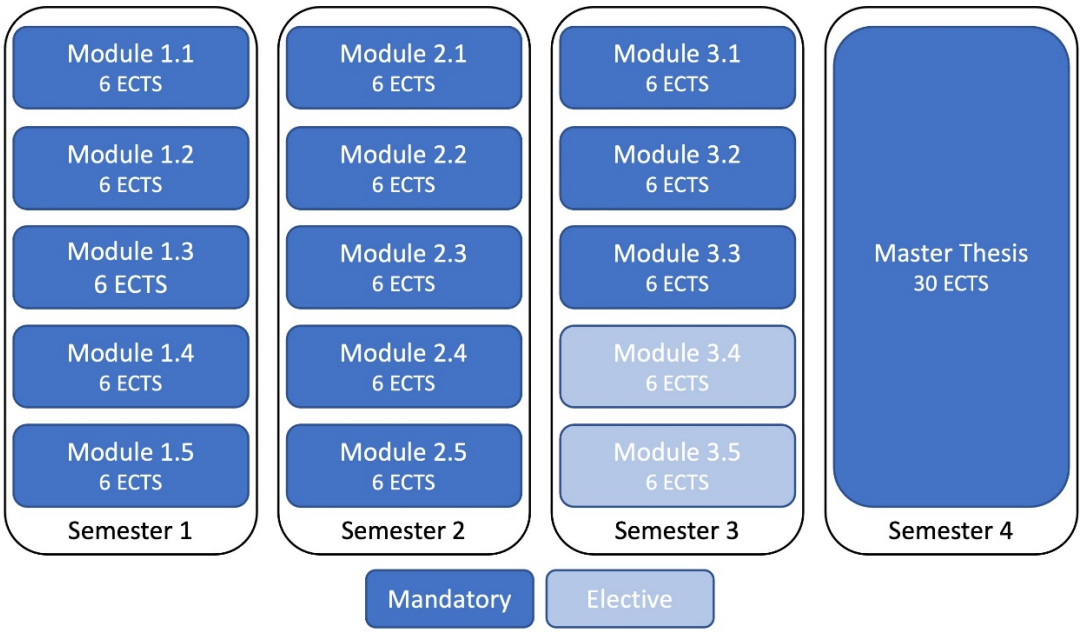
5. Demonstrate the ability to develop and design products, processes and systems related to society's goals, conditions and needs for sustainable development
6. Identify and learn how to handle operational risk management and information security
7. Work in dynamic environments with changing expectations and moving goals, and to manage projects of different size and complexity
8. Execute leadership and team management for different teams of experts in various areas, by setting goals, delegate tasks and be responsible for results
9. Develop an entrepreneurial mindset and demonstrate innovative skills in technical and organizational environments
10. Be an autonomous learner, able to identify the need for additional knowledge and constantly embrace, develop, and implement new competences

3. Program Structure

The structure of the program can be designed in different ways. The IE3 project suggests mainly program modules of 6 ECTS credits each following the regular structure as shown in Figure 1 below.

The regular structure is based on five 6-ECTS program modules each semester, in which modules cover different subjects that characterize a modern MSc program in IE&M (see Figure 1). Typical subjects are "Operations Management", "Industrial Marketing", "Innovation Management", etc. Subject areas from earlier semesters are coming back during the following semesters with a clear progression in both breadth and depth. In the third semester, one or more electives/ specializations can be introduced so that the number of program modules in the specialization subject increases. Finally, a thesis/dissertation must be written, presented, and defended, preferably in the chosen specialization.

Figure 1 - Program Structure



Tables 1 to 4 show examples of the program modules each semester. In Table 5 the ten Program Learning Outcomes are mapped towards the different program modules.

Table 1: First semester

First Semester						
Module		**M/E**	**ECTS**	**Keys**	**Characteristics**	**Program Learning Outcomes**
1:1	Information Systems in Industrial Engineering and Management	M	6	- Data from processes - Local and cloud workflows - Data storage and process flow - Machine learning	- Business intelligence tools - PLCs and wearables - Digital controllers - Beacons and BLE - e-Learning labs	2 3 5
1:2	Big Data Analytics	M	6	- Big data in cloud - Deep learning modelling - Distributed processing and microservices - Elasticity - IT security - IT ethics and compliance	- ISO 2700x, ISO 35030, ISO18045 and ISP 24760 - ISO 26000 - e-Learning labs - e-learning module	1 2 3
1:3	Quantitative Methods in Industrial Engineering and Management	M	6	- Mathematical programming - Advanced statistics - Discrete event simulation	- Theoretical concepts - e-learning labs - Self-evaluation	1 2 3 5
1:4	Quality Management	M	6	- Organization of quality departments - Cost of quality - Total quality management and the Six Sigma methodology - Statistics for quality - Continuous improvement of products, processes, purchasing and supply chain management	- Flipped classroom. - Theoretical concepts - Exercise on statistics for quality - Group assignment - Self-evaluation	1 3 5
1:5	Problem Solving and Decision Making	M	6	- Fundamentals of decision theory - Payoff matrix - Decision tree - Multicriteria decision making	- Theoretical concepts - Work cases - Critical thinking and discussion - Team working	1 2 3

Table 2: Second semester

Second Semester						
Module		**M/E**	**ECTS**	**Keys**	**Characteristics**	**Program Learning Outcomes**
2:1	Operations Management	M	6	- Traditional and innovative paradigms of operations management - Forecasting methods - Theoretical and practical tools for medium and short-term production planning and control	- Flipped classroom. - Theoretical concepts - Work cases - Factory virtual tour - Team working - Teaching / Learning Factories - Self-evaluation	1 2 3 5
2:2	Lean Production and Continuous Improvement	M	6	- Value creation and lean concepts - Performance measures and improvements - Information-based monitoring - Lean re-design of production systems	- Flipped classroom. - Theoretical concepts - Work cases - Factory virtual tour - Team working - Teaching / Learning factories - Self-evaluation - e-learning modules	1 2 5
2:3	Digital Manufacturing	M	6	- Technology overview on Industry 4.0. - Digital processes - Digital factory - Fundamentals of extended reality - Fundamentals of additive manufacturing	- Cases - Individual & group assignments - Individual / group evaluation - Experiential learning - IEC 62264 - ISO 22400	1 2 3 5
2:4	Advanced Project Management	M	6	- Complexity dimensions of a 'Project' - Project Planning & Control - Resource allocation - Risk management - Digitalization in PM	- Flipped classroom. - Project and case studies - Discussion and score based on participation - Practical usage in the practical module - Team working - Self-evaluation - e-learning module	4 6 7 8 9
2:5	Occupational Safety and Health	M	6	- Accidents and work diseases: concepts and statistics - Safety in quality systems - Risk assessment: theory and methodologies - Case studies	- ISO 45001 (OHSAS 18001) - Work cases - Experiential learning - Team working - Self-evaluation	4 6

Table 3a: Third semester

Third Semester						
Module		**M/E**	**ECTS**	**Keys**	**Characteristics**	**Program Learning Outcomes**
3:1	Innovation in operations management: value chain management in a global context	M	6	- Innovation in operations. - Smart I4.0 - Value creation and lean concepts in global contexts - Smart production and smart maintenance - Servitization	- Cases - Individual & group assignments	2 3 5 10
3:2	Innovation and Strategic management in a global environment	M	6	- Organizational business models - Transformation of the OBM by technology - CSR and values. - Transparency driven by technology - Case studies	- Cases - Individual & group assignments. - Practical usage in the practical module as proposal for organization of operations. - Introduction to research methodologies	2 3 5 8 10
3:3	Sustainable Production Systems	M	6	- Sustainability and social issues - Corporate social responsibility - Environmental management systems (EMS) - Environmental performance evaluation (EPE). - Life cycle assessment (LCA)	- Introduction to and use of standards: ISO 14000, EMAS - Cases - Individual & group assignments	1 2 4 5
3:4	Business in an interconnected world	E	6	- Technology as an opportunity - Strategic analysis of corporative decisions - Impact of Industry 4.0 - Sources and tools for corporate funding - Real options and project finance	- Cases - Individual & group assignments. - Practical usage in the practical module as proposal for organization of operations	3 6 9
3:5	Communication, Leadership and Entrepreneurship	E	6	- Human resource management - Communication techniques - Leadership and entrepreneurship - Business models for innovative ventures (start-ups) - Intellectual property	- Individual & group assignments - Individual / group evaluation - Experiential learning	3 4 7 8 9

Table 3b: Third semester

Third Semester						
Module		**M/E**	**ECTS**	**Keys**	**Characteristics**	**Program Learning Outcomes**
3:6	Digital Business	E	6	- Strategic analysis for digital business - Lean-start up and financing - Data driven analysis - Business process reengineering - Digital market and digital marketing - Marketing planning - Digital organization and HRM	- Cases - Individual & group assignments - Individual / group evaluation - Experiential learning	2 3 6 9
3:7	Cyber Security in Industry	E	6	- Background and fundamentals on cyberse-curity - Architecture and vulnerability of operating systems, data driven analysis - Cyber security and industry standards	- Cases - Individual & group assignments - Individual / group evaluation - Experiential learning	1 2 3 4 5 6

Table 4: Fourth semester

Fourth Semester						
Module		**M/E**	**ECTS**	**Keys**	**Characteristics**	**Program Learning Outcomes**
4:1	Master Thesis	M	30			1 2 4 5 7 8 9 10
4:2	Internship	E	-			5 7 8 9 10

Table 5: Program Learning Outcomes mapping for each Module

Module	1:1	1:2	1:3	1:4	1:5	2:1	2:2	2:3	2:4	2:5	3:1	3:2	3:3	3:4	3:5	3:6	3:7	4:1	4:2
Program Learning Outcomes	Enterprise Information Systems in IE&M	Big Data Analytics	Quantitative Methods in IE&M	Quality Management	Problem Solving and Decision Making	Operations Management	Lean Production and Continuous Improvement	Digital Manufacturing	Advanced Project Management	Occupational Safety and Health	Innovation in operations management: value chain management in a global	Innovation and Strategic management in a global environment	Sustainable Production Systems	Business in an interconnected world	Communication, Leadership and Entrepreneurship	Digital Business	Cyber Security in Industry	Master Thesis	Internship
(M) Mandatory/(E) Elective	M	M	M	M	M	M	M	M	M	M	M	M	M	E	E	E	E	M	E
1 Identify, formulate, analyse, and solve complex engineering as well as human and managerial related problems using relevant methodology and advanced qualitative and quantitative tools, applicable to the industrial sector		X	X	X	X	X	X	X					X				X	X	
2 Handle complex decision-making processes by using both computer-based facilities and software tools to find and implement solutions on different engineering and managerial issues in a company or in an organization	X	X	X		X	X	X	X			X	X	X			X	X	X	
3 Use and apply what is available in the modern digital landscape of today and tomorrow based on broad and deep technical knowledge to support the technical development and business environment in the company	X	X	X	X	X	X		X			X	X		X	X	X	X		
4 Show insight into the possibilities and limitations of technology, its role in society and the engineers' responsibilities for how it is used, including social and economic aspects as well as ethical and work environment aspects									X	X			X		X		X	X	
5 Demonstrate the ability to develop and design products, processes, and systems regarding society's goals, conditions, and needs for sustainable development	X		X	X		X	X	X			X	X	X				X	X	X
6 Identify and know how to handle operational risk management and information security									X	X				X		X	X		
7 Work in dynamic environments with changing expectations and moving goals and to manage projects of different size and complexity									X						X			X	X
8 Execute leadership and team management for different teams of experts in various areas by setting the goals, delegate the tasks and be responsible for the results									X			X			X			X	X
9 Develop an entrepreneurial mindset and demonstrate innovative skills in technical and organizational environments									X					X	X	X		X	X
10 Be an autonomous learner identifying the need for additional knowledge and constantly embrace, develop, and implement new competences											X	X						X	X

4. Turning training courses into e-learning courses

Preparing e-learning modules starting from already tested and used training materials is an effective educational activity. Also, referring to existing e-learning modules is an opportunity to carefully assess the quality of the content and the educational methodology. The effectiveness of blended learning courses (providing traditional classes and e-learning modules) needs to be tested. The pedagogical model involving e-learning modules (e.g. flipped classroom, learning factories, university labs) should be defined, and the effectiveness of knowledge transfer has to be assessed periodically.

An agreed action plan, including the description of the e-learning modules and the assessment of the effectiveness of knowledge transfer, will make it possible to monitor the effectiveness of the pedagogical choices made.

Beyond the pedagogical model, specific consideration must be devoted to the intended usage of the learners' platform (duration, foreseen interactions, etc.), and which non-standard elements would be required (gamification, etc.). These aspects are closer to the adopted methodology, and they are connected to the added value (strengths) of the e-learning modules.

Industrial contribution to the realization of e-learning modules is recommended. According to the experience in the company, technical staff at management level can cooperate in different ways depending on the focus of the module and their specific skills. Mutual trust between academic Institutions and companies is needed to run and assess the effectiveness of e-learning modules.

The IE&M program designed in this project (see tables 1-5), will benefit from four e-learning modules available at the project's website through this link, using the Moodle compressed xml format to easily enable the usage. Although experimental, and following different pedagogical models, they give a comprehensive picture of different topics that can be developed within an IE&M MSc programme.

5. Course Modules Syllabi

Module 1:1
Enterprise Information Systems in Industrial Engineering and Management

6 ECTS

Program Module Aim

In the last 50 years, many enterprise information systems have emerged and consolidated. Ranging from integrated Enterprise Resource Planning (ERP) packages to smart factories, Industry 4.0 and the cyber physical production systems. Incorporating cloud-based manufacturing, cloud storage and Business Intelligence tools, this module sets out to address the common information systems in **IE&M**.

Intended Learning Outcomes

After completing the module, the student should (on an advanced level) be able to:

- account for basic knowledge in relevant information systems;
- describe, assess and reflect on the structure and application fields of IT-based enterprise systems, and the mutual influence of the systems on organization and organizing;
- describe and discuss analysis, acquisition, adaptation, implementation and effects of enterprise systems;
- critically review, problematize, and consider enterprise systems as IT artefacts in organizational contexts.

Content

The module consists of several information system related to areas such as:

- Smart factories and MaaS (Manufacturing as a Service).
- Industry 4.0.
- Cyber Physical Production.
- Local and cloud workflows.
- Data storage and process flow.
- PLCs and wearables.
- Digital controllers.
- Beacons and BLE.

Module 1:2
Quantitative Methods in Industrial Engineering and Management

6 ECTS

Program Module Aim

The module covers modelling in optimization and simulation using advanced statistics. Optimization deals with mathematical theory and methods, aiming at analyzing and solving decision problems. The module gives a broad orientation of the field of linear and mixed integer optimization, and it also gives some insight into its use for analyzing practical optimization problems. The module also provides students with basic knowledge in discrete-event simulation (DES) methodology and application in the analysis of supply chain systems. Advanced level statistics are used to analyze data in both optimization and simulation.

Intended Learning Outcomes

After completing the module, the student should (on an advanced level) be able to:

- explain important classes of optimization problems and be able to classify them according to their properties;
- model mathematical models of linear and mixed linear optimization problems;
- explain and apply basic principles for solving some common types of optimization issues;
- describe fundamental concepts in discrete-event simulation;
- list and explain advantages and disadvantages of simulation as an analysis tool;
- build simulation models of supply chain systems;
- analyze data and fit statistical distributions to empirical data;
- explain and use statistical inference in the context of optimization and simulation.

Content

The module introduces main concepts and tools for optimization and simulation based on a foundation on advanced statistics.

- Convexity
- Linear, mixed linear and network problems
- Modelling linear, mixed linear and network problems and solving them using a modelling language
- Solution methods for standard optimization problems such as Dijkstra’s algorithm, simplex method
- Greedy algorithms and Heuristics
- Optimality conditions
- Fundamental concepts in discrete-event simulation.
- Simulation study methodology.
- Verification and validation of simulation models.
- Experimentation and statistical output analysis.
- Statistical inference.

Module 1:3
Big Data Analytics

6 ECTS

Program Module Aim

The module introduces main concepts and tools for storing, processing and analyzing Big Data, which are necessary for professional work and research in data analytics. The aim of the module is to provide the student with advanced level knowledge of Big Data Analytics, with a focus on its applications in **IE&M**.

Intended Learning Outcomes

After completing the module, the student should (on an advanced level) be able to:

- collect and store Big Data in a distributed computer environment;
- perform basic queries to a database operating on a distributed file system;
- account for basic principles of parallel computations;
- use the MapReduce concept to parallelize common data processing algorithms;
- be able to modify standard machine learning models to process Big Data;
- use tools for machine learning of Big Data.

Content

The module introduces Big Data Analytics in the following areas:

- Introduction to Big Data: concepts and tools;
- Basic principles of parallel computing;
- File systems and databases for Big Data;
- Querying for Big Data;
- Resource management in a cluster environment;
- Parallelizing computations for Big Data;
- Machine Learning for Big Data;
- IT security;
- IT ethics and compliance.

Module 1:4
Quality Management

6 ECTS

Program Module Aim

The module covers the basic principles of organization of quality department, the designof systems of quality management and the quality of tools. It Presents the essence of using mathematics modern methodologies and tools in quality management. Students are expected to acquire the practical ability to apply quality management methods and tools to processes, products, systems, and costs of quality.

Intended Learning Outcomes

After the module, the student should be able to:

- know the requirements of quality management standards;
- know the conditions of designing quality management systems;
- analyze data and information obtained from implemented processes;
- collect quantitative data on the quality of products and processes;
- apply advanced mathematics quality management methodologies and tools to model phenomena occurring in processes and products;
- correctly interpret the results and draw conclusions from the methods and quality management tools used;
- critically analyze the results of the application of quality methods and tools, and then propose a concept for improving the studied phenomena taking into account technical, organizational and economic aspects;
- the student knows how to model processes and phenomena related to quality management in organizations using mathematical statistics methods and tools
- know how to use quality management methods and tools to model information processes and decision-making processes;
- carry out cause-and-effect analysis for processes and phenomena that occur in organizations, using methods appropriately selected and tools of quality management.

Content

- Roles, tasks and responsibility of quality department;
- Interpretation of standard ISO 9001;
- Design and application of FMEA, MSA, Ishikawa, 5 why, Pareto analysis;
- Design and application of six sigma;
- Design and application of statistics method;

Module 1:5
Problem Solving and Decision Making

6 ECTS

Program Module Aim

Creative problem solving is increasingly recognized as the most sought-after skill in IE&M. This is true across a wide range of industries, and across both private and public sectors. Entrepreneurs, employees, managers, and leaders are all required to find valuable opportunities, generate, and develop new ideas, and then trial and implement innovative solutions. The module covers the structured process of identifying problems and generating a wide range of ideas for solving IE&M problems. Connected to problem identification, this module promotes the usage of data for different technical and/or business purposes, including for example visualization tools to understand trends, and to train the attendees in communication and in interpretation of information to support decision-making processes.

Intended Learning Outcomes

After the module the student should be able to:

- Understand the role of creativity in problem solving;
- Application of Design Thinking to different types of problems;
- Recognize and develop his/her own creative skills;
- Analyze decision-making theories and principles;
- Compare main decision-making models and assess their effectiveness regarding uncertainty and complexity.

Content

- Creativity and Thinking approaches;
- Problem definition;
- Ideas generation;
- Solution development;
- Creativity in context;
- Decision making principles and theories;
- Qualitative versus quantitative decision-making techniques;
- Data based frameworks for decision making applications.
- Visualization tools for interpretation of information;

Module 2:1
Operations Management

6 ECTS

Program Module Aim

Students will learn to face the multidimensional performance evaluation of Operations at a strategic, tactical, and operational level. They will acquire methodologies and tools to design, analyze, and continuously improve the operations performance of manufacturing and service companies under the industry 4.0 data-driven environment. Additional didactic supports will also stimulate the learning ability in designing, planning, evaluating and operating lean systems: industrial simulation tools, numerical exercises, serious games and industrial case studies designed to increase learners' learning abilities. The module will provide students with the analytical skills needed to approach case studies related to real business systems. The student will find the optimal solution for each case regarding technical parameters, constraints and peculiar decision-making variables.

Intended Learning Outcomes

After the module, the attendant should be able to:

- understand the traditional and innovative paradigms of Operations Management;
- develop analytical skills in forecasting methods;
- know theoretical and practical tools for medium and short-term production planning and control;
- refine technical knowledge and judgment skills to identify the best operations strategies by considering alternative scenarios in serious games and simulations;
- develop advanced communication skills, both oral and written, using appropriate technical terminology acquired by participation in traditional lectures and specialized seminars tenured by industry professors, in student's discussions and presentations, and involvement in guided industrial tours;

Contents

- Production systems: Paradigms and taxonomy of production systems;
- Forecasting analysis: Time-series models: constant/linear trend, simple/double moving average, exponential smoothing model, seasonal models. Elements of Machine Learning;
- Operations and Performance. Losses in production. The Overall Equipment Effectiveness (OEE). Process Analysis and Process Design. Industry 4.0: Standards and Data integration for PMS;
- Production Planning and Control. Stages and time horizons of operations management. Strategic Planning. Aggregate Planning: Strategies and Trade-off. Bill of Materials. Master Production Schedule. Short-term Planning: Loading and Scheduling;
- Inventory Management. Inventory, KPIs and Costs. Replenishment models: EOQ, POQ, Safety Stocks. ABC Classification. Material Requirement Planning (MRP). ERP: Production Planning module and shop floor integration in SAP.

Module 2:2
Lean Production and Continuous Improvement

6 ECTS

Program Module Aim

The module deals with lean concepts in manufacturing. Sources of time waste are analyzed, and the "Value stream" mapping for waste detection and removal is described. Critical success factors in production planning and control, as well as in inventory management, are provided. Furthermore, Key Performance Indicators (KPIs) of the production value stream, like takt and cycle Time, as well as Overall Equipment Effectiveness and Flow Time, will be defined. Practical cases will be developed to apply concepts and evaluate KPIs.

Intended Learning Outcomes

After the module, the attendant should obtain the following:

- the ability to understand the concept of Lean Transformation of industrial systems
- the ability to understand the concept of Lean Production and the related main models and tools
- the ability to analyze and improve production processes and their bottlenecks.

Further learning outcomes are:

- autonomy of judgment: the ability to analyze the resource wastes and to reduce them
- communication skills: acquisition and use of the lexicon of lean production
- learning skills: ability to use tools and techniques of lean production and operations management

Content

- What a Value Stream is: Basic concepts about Lean, wastes in production.
- KPIs for the Value Stream: Cycle time analysis and definition of losses in production, the
- Overall Equipment Effectiveness, Throughput Time Calculation.
- How to map a Value Stream: Elements of a Value Stream, Value Stream Mapping, Symbols.
- How to improve a Value Stream: Continuous improvement and PDCA cycle, Value Stream
- Design.
- Tools for lean re-engineering: Decoupling: Buffer and supermarket, Production leveling and control, Closed loop Kanban circuits.

Module 2:3
Digital Manufacturing

6 ECTS

Program Module Aim

The module provides background and concepts of the Industry 4.0 paradigm focusing on innovation in digital processes and manufacturing. The module will describe equipment, sensing devices and control technologies. Operational performance measures and related international standards will be introduced. Furthermore, the module will cover the fundamentals of extended reality, additive manufacturing and reverse engineering in digital manufacturing.

Intended Learning Outcomes

After the module, the attendant should be able to:

- know the fundamentals of the Industry 4.0 paradigm
- know information technologies for digitizing processes and factories
- apply concepts and standards for digital system monitoring
- perform data-driven decision-making on digital manufacturing

Content

- Industry 4.0: technology overview.
- Digital Processes and Digital Manufacturing.
- Digital Factory. Twins models.
- Performance Measurement Systems (PMS). International standards.
- Extended reality (Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR)) technologies.
- Additive Manufacturing and Reverse Engineering.

Module 2:4
Advanced Project Management

6 ECTS

Program Module Aim

Main goals of this module are focused on enabling students to manage any kind of project inside an organization. As long as Project Management is becoming a critical capability more and more connected with the strategy without getting disconnected from the operational arena (as already claimed by the Project Management Institute (PMI)), the project manager is the key link between the organizational strategy and the project team. Projects look to add value to organizations and society as a whole, where such added value can have different shapes such as improved business processes, new product development, or new service configurations. Indeed, they can handle company answers when the environment, market or competitors are changing as well. The understanding and techniques selection and application, as well as practices, require to be extended through personal attitudes from the project management team, such as ethical behavior, or interpersonal and context related, which are crafted facing different real or simulated situations. There are two main strands in this subject, the theoretical one, focused on learning about concepts and tools which will be carried out mainly in an asynchronous personal way, in kind of flipped classroom, and the practical application cases, which has been configured as synchronous implementation of collaborative actions involving different agents.

Intended Learning Outcomes

After the module the student should be able to:

- understand the value creation for Project Manager as well as their typology,
- understand the relevance and responsibilities for all the legal entities around the project,
- understand the work for different contractors as well as their relationship,
- understand the implications for the project owner / product owner,
- understand the Project Engineering roles and responsibilities,
- understand the teamwork involved in both, project execution and project management,
- being able to apply specific methodologies to lead mid-term complex projects,
- being able to audit the status of any project, with recommendations and suggestions.

Content

- Introduction
- Digitalization and Projects.
- Project Management Methodologies
- Scope Management
- Time and Cost Management
- Project Execution Monitoring
- Risk Management
- Quality Management
- Communication and Stakeholder Management
- Agile Project Management
- Management of the R&D projects
- Maturity Models

Module 2:5
Occupational Health and Safety

6 ECTS

Program Module Aim

After introducing the concepts and statistics of accidents and work diseases in work environments, the module will deal with theoretical concepts and normative definitions of occupational health and safety risks. Methodological tools of risk assessment will be provided.

Intended Learning Outcomes

After the module, the student should be able to autonomously evaluate the health and safety conditions of the work environment to prevent hazardous situations and reduce or remove related risks. In more detail, the attendant will be able to:

- have a fundamental knowledge of occupational health and safety
- be aware of relevant and common hazards in industrial sectors
- investigate the hazardous situation
- carry out risk assessment and risk management processes
- search for practical solutions for risk reduction or removal
- identify KPIs for monitoring occupational health and safety
- communicate technical solutions identified.

Content

- Concepts of Accident and Occupational diseases
- European Statistics on Accidents and Occupational diseases by industrial sectors
- Concepts of Hazard and Risk
- Risk estimation and Risk Evaluation
- International Standards for Risk Assessment (ISO 28001, ISO 45001)
- KPIs for monitoring occupational health and safety
- Case studies and

Module 3:1
Innovation in operations management: value chain management in a global context

6 ECTS

Program Module Aim

The module is designed to make students knowledgeable of the fundamentals and advanced topics in the domain of Operation management. The topics covered are both theory and practical applications. The module engages both presentations and cross discussions of operation management topics, guided through experiential learning of teams of about 5 to 10 attendees tackling real operations management issues facing client contexts.

Intended Learning Outcomes

After the module the attendant should be able to:

- understand the value considering welfare, safety, social equity, and resource utilization across a range of product production or services
- understand the value creation concept as well as the waste reduction in terms of processes
- identify opportunities to improve operations
- design effective and efficient solutions.
- understand how digital technologies can contribute to the effectiveness of the management in product or service development
- develop a particular focus on lean manufacturing and management with the help of the digital solutions.

Content

- Operation management: Competitiveness, strategy, and productivity
- Digital tools helping in process selection and Facility layout
- Work Design and measurement: IoT technology
- Quality control and quality management
- MRPs and ERPs
- Aggregate planning and Scheduling
- Inventory management
- JIT and Lean production
- Supply chain management
- Management service operations
- Lean management
- Integration of Virtual Reality and Augmented Reality technologies
- Industry 5.0

Module 3:2
Innovation and Strategic Management in a Global Environment

6 ECTS

Program Module Aim

The overall aim of the module is for students to acquire knowledge and critical thinking about Corporate Social Responsibilities (CSR), Organizational Business Models (OBM), and an introduction to Research Methodologies. Focus is placed on the global context incorporating different global competition models.

Intended Learning Outcomes

After completed module, the student should on an advanced level be able to:

- describe and discuss Corporate Social Responsibility (CSR) theories and concepts and relate them to general organization theories,
- describe and discuss Organizational Business Models (OBM) theories and concepts and relate them to general organization theories,
- explain the rationale, internal as well as external, for developing CSR programs,
- critically evaluate CSR programs of selected firms, relate them to current challenges and suggest improvements,
- assess the relevance of different research methods for different types of research,
- assess and discuss ethical questions in research,

Content

The module introduces CSR and OBM in the following areas:

- What is CSR? The major concepts and theories of Corporate Social Responsibility: The interrelation between firms and stakeholders.
- What is OBM? Concepts and theories are presented.
- Firm practices such as human resource management and supply chain management as drivers and challengers of Corporate Social Responsibility.
- External forces as drivers of Corporate Social Responsibility.
- CSR programs and practices at leading corporations and criticize and analyze them.
- An overview of Research Methodologies connected to the assessment on suitable research methods and ethical considerations.

Module 3:3
Sustainable Production Systems

6 ECTS

Program Module Aim

The module develops students' awareness of the relationships between production systems, the environment and society. Under the framework of sustainable development, the module analyzes which role companies play and the ways they can reduce their environmental impact and create value for the society, possibly operating in connection with other companies. To this end, several approaches to managing real sustainability problems will be analyzed.

Intended Learning Outcomes

After the module, the attendant should be able to:

- understand traditional and innovative paradigms of sustainable management of production systems
- understand the principles of environmental performance evaluation of production systems and of products and services
- identify and assess the primary sources of environmental risks related to industrial activities subject to regulation and subject to permitting procedures
- know methods and tools for industrial eco-efficiency.

Content

- Sustainability and the context: environment and economy. Sustainable development.
- Sustainability and the company: communication and accountability. Guidelines and standards related to Corporate Social Responsibility (CSR). Global Reporting Initiative and sustainability reporting.
- Environmental externalities. Input-output models for the environment. Circular economy production models.
- Environmental impact of production systems. Environmental management systems (EMS). International standards and regulations. EMS design and actuation. Integrated management systems (QSE - Quality, health and Safety, Environment). Case studies.
- Environmental performance evaluation (EPE). International standards and regulations. Environmental condition and performance indicators. Audit.
- Sustainability and tools: Eco-design and Life Cycle Assessment (LCA). LCA principles and methods. The Carbon Footprint of products and processes. Case studies.

Module 3:4
Business in an Interconnected World

6 ECTS

Program Module Aim

Digitization matters. Look at the stock markets. Much of the growth in wealth lies in new, fast-growing, IT-intense enterprises. How do they function? How do they interact with their surrounding? How are they valued? What challenges do they face? How do they affect us? In this module, you will learn to see behind the hype and will acquire tools to autonomously evaluate business models against a backdrop of technical and economic possibilities, standards, and trends. The overarching aim of the module is to provide a realistic view of digitization, its business potential, and consequences. More specifically, the strategic analysis of corporative decisions under the influence of Industry 4.0 is covered. Financing upcoming IT-intense enterprises using financial models is addressed as a novel problem facing enterprises.

Intended Learning Outcomes

After completed module, the student should on an advanced level be able to:

- using business ecology tools, identify and analyze prerequisites and consequences of digitization,
- assess fast-growing, IT-intense enterprises through fundamental analysis,
- evaluate financing solutions for fast-growing, IT-intense enterprises,
- autonomously and with a critical stance identify and reflect on connections between digitization and its influence on society, industry structures, organizations and individuals,
- evaluate different enterprise solution based on investment valuation.

Content

The module covers digitalization, Industry 4.0, and how fast-growing, IT-intense enterprises should be analyzed and valuated, more specifically the module contains the following topics:

- Business Ecology.
- Business environment and its surroundings.
- Fundamental Analysis.
- Financing in fast-growing, IT-intense enterprises.
- Investment Valuation.

Module 3:5
Communication, Leadership and Entrepreneurship

6 ECTS

Program Module Aim

The module covers aspects connected with contemporary management, including human resources management. Human resources are crucial for a company's ability to adapt to a changing environment and grow in a dynamic market. Yet to be efficient and effective, explore their talents and potential human need to communicate within the company and with its external environment, namely customers, suppliers, cooperants and competitors. Hence, the module offers presentation of communication techniques and leadership models. To meet ever changing requirements of the business environment, stay competitive and strive in business environment companies and specifically their managers need to be entrepreneurial and innovative. The module covers basic principles of entrepreneurship, innovativeness and presents crucial aspects of IP protection, as well as the opportunities and risks connected with such forms of entrepreneurship as start-ups, scale-ups and spin-offs.

Intended Learning Outcomes

After the module the student should be able to:

- explain the importance of human resources in a company
- discuss basic aspects of human resources management
- practice different communication techniques
- be able to explain basic principles of entrepreneurship as a process of searching for market opportunities and human features
- compare different models of leadership dependent on organizational structure and personal skills of the leader
- explain the concept of innovation dissemination at state and corporate level
- be able to define start-up/spin-off/scale-up business models
- identify features of start-up/spin-off/scale-up and potential domains where start-up/spin-off/scale-up might arise

Content

- Human resources management
- Communication techniques
- Leadership and entrepreneurship
- business models for innovative ventures (start-up, spin-off, scale-up)
- intellectual property

Module 3:6
Digital Business

6 ECTS

Program Module Aim

The module deals with the innovation of company business by Information and Communication Technologies applied to internal and external processes of firms. The module module will provide concepts, methodologies, and tools to assess conditions for and develop digital innovation in internal and external company processes.

Intended Learning Outcomes

After the module, the attendant should be able to:

- know the strategic role of digital innovation in differently sized companies
- learn potentialities and fields of applications of digital tools like the Internet of Things, Artificial Intelligence, cloud computing, eProcurement and digital marketing
- identify strategic approaches, methodologies, and tools to analyze traditional and new businesses in view of their digitalization
- use methodologies and tools to digitalize traditional or new businesses (start-up).

Content

- Strategic analysis and Models for digital business. SWOT / Value analyses. Competitive advantage/forces. Criticalities' identifications. Business model design.
- Lean start-up approach and financing. Resource gathering and allocation.
- Data driven analysis and Business process reengineering.
- Digital market and digital marketing. Digital commerce and supporting technologies. Customer profiling. Marketing planning and KPI.
- Digital operations.
- Digital Organization and Human Resource Management.

Module 3:7
Cyber Security in Industry

6 ECTS

Program Module Aim

The module provides basic technical concepts and open-source tools useful to a Cybersecurity Analyst as an independent professional or an employee of an industrial company. Concepts relate to network security, endpoint protection, incident response, threat intelligence, penetration testing, and vulnerability assessment.

Intended Learning Outcomes

After the module, the attendant should be able to:

- know the fundamentals of cybersecurity
- apply open-source security tools for data protection, endpoint, and system protection
- get knowledge for incident response.

Content

- Fundamentals on Cyber-security. Terminology. Basic concepts and tools.
- Taxonomies for Security: Network, Application, operating, Disaster protection and recovery, User training
- Attack taxonomy: Unsophisticated Attackers, Sophisticated Attackers, Corporate Espionage, and Advanced Persistent Threat.
- Examples of industrial cyber attacks (Steel factories, Water plants, etc.)
- Cybersecurity compliance and industry standards. Incident response.
- Critical infrastructures
- OT and IT dimensions of cybersecurity. Legacy systems and trends
- Industrial networks and Isolation principles; Modern threats: IIoT and IoT
- Monitoring tools & Defense strategy
- Cybersecurity Strategy of the European Union. European Agenda for Security: NIS Directive and eIDAS regulation
- ISO 27001 and ISO22301: Governance and Tools