The Faculty of Engineering and Science
The Board of Studies for Industry and Global Business Development

AALBORG UNIVERSITET

Curriculum for the Master's Programme in Global Systems Design

(cand.tech.)

Aalborg University

September 2016

Godkendt d. 9/11 15

Eskild Holm Nielsen
dekan

Campus Copenhagen

The Faculty of Engineering and Science
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Preface

Pursuant to Act 261 of March 18, 2015on Universities (the University Act) with subsequent changes, the following curriculum for the Master programme in Global Systems Design is stipulated. The programme also follows the joint programme regulations and the Examination Policies and Procedures for the Faculty of Engineering and Science.

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Chapter 1: Legal Basis of the Curriculum, etc.

1.1 Basis in Ministerial Orders

The Master's programme in Global Systems Design is organised in accordance with the Ministry of Science, Innovation and Higher Education's Order no. 1520 of December 16, 2013 on Bachelor's and Master's Programs at Universities (the Ministerial Order of the Study Programs) and Ministerial Order no. 670 of June 19, 2014 on University Examinations (the Examination Order) with subsequent changes. Further reference is made to Ministerial Order no. 258 of March 18, 2015 (the Admission Order) and Ministerial Order no. 114 of February 3, 2015 (the Grading Scale Order) with subsequent changes.

1.2 Faculty Affiliation

The Master programme falls under the Faculty of Engineering and Science, Aalborg University.

1.3 Board of Studies Affiliation

The Master programme falls under the Board of Studies for Industry and Global Business Development under the School of Engineering and Science.

1.4 Board of external examiners

The Master's programme falls under the external evaluator corps *ingeniøruddannelernes censorkorps – Maskin.*

Chapter 2: Admission, Degree Designation, Programme Duration and Competence Profile

2.1 Admission

Applicants with a legal claim to admission (retskrav):

Applicants with one of the following degrees are entitled to admission:

- Bachelor of Science in Manufacturing and Operations Engineering, Aalborg University

Applicants without legal claim to admission:

Applicants with one of the following degrees meet the admission requirements:

- Bachelor of Science (BSc) in Engineering (Mechanical Engineering and Manufacturing), AAU
- Bachelor of Engineering in Mechanical Engineering and Industry, AAU
- Bachelor of Science (BSc) in Engineering (Global Business Engineering), AAU
- Bachelor of Engineering in Export Technology, AAU
- Bachelor of Engineering in Production Engineering, AAU
- Bachelor of Science (BSc) in Engineering (Nanotechnology), AAU
- Bachelor of Science (BSc) in Mathematics, AAU
- Bachelor of Engineering in Electronics and Electrical Engineering, AAU
- Bachelor of Science (BSc) in Engineering (Electronic Engineering and IT), AAU
- Bachelor of Engineering in Computer Engineering and IT, AAU
- Bachelor of Technology Management and Marine Engineering (Maskinmester)

All applicants must, as a minimum, document English language qualifications comparable to an "English B level" in the Danish upper secondary school (gymnasium) (the Admission Order).

Students with another Bachelor degree may, upon application to the Board of Studies, be admitted following a specific academic assessment if the applicant is considered as having comparable educational prerequisites. The University can stipulate requirements concerning conducting additional exams prior to the start of study.

2.2 Degree Designation in Danish and English

The Master programme entitles the graduate to the Danish designation Cand.tech. (candidatus/candidata technologiae) i globalt systemdesign. The English designation is: Master of Science and Technology (Global Systems Design).

2.3 The Programme's Specification in ECTS Credits

The Master programme is a 2-year, research-based, full-time study programme. The programme is set to 120 ECTS credits.

2.4 Competence Profile in the Diploma

The following competence profile will appear in the diploma:

A graduate of the Master programme has competencies acquired through an educational programme that has taken place in a research environment.

The graduate of the Master programme can perform highly qualified functions on the labour market on the basis of the educational programme. Moreover, the graduate has prerequisites for research (a PhD programme). Compared to the Bachelor degree, the graduate of the Master programme has developed her/his academic knowledge and independence, enabling the graduate to independently apply scientific theory and method in both an academic and occupational/professional context.

2.5 Competence Profile of the Programme

The graduate of the Master programme:

Knowledge

- Has thorough knowledge of the elements and concepts involved in manufacturing and service operations, including how these elements interact - locally as well as globally
- Has an in-depth knowledge of a selected manufacturing and service technologies; including a deep understanding of the interface and structure of a limited manufacturing and service system
- Understands the potential and limitations of modelling, calculation and simulation tools to be applied for analysis and design of products / services as well as manufacturing and service operations systems
- Can understand and, on a scientific basis, reflect over subject areas related to product / service design and business simplification, standardisation and automation
- Can demonstrate insight into how strategic / tactical or conceptual designs can be transformed into practical and profitable solutions of an industrial or public company taking client and other stakeholder requirements into consideration
- Can demonstrate insight into the implications of research work, including research ethics

Skills

- Is able to assist in business process innovation – that is simplification, standardisation and automation of business processes across different industries / sectors to benefit stakeholders of companies / public organisations – also using state of the art technology available in use as well as considering the future design of products / services
- Is able to analyse and solve technical and organizational as well as human issues with relation to business processes of a manufacturing or service facility, including:
    - Formulation of operational objectives for the performance of a manufacturing and service facility
    - Development of solutions for improving a manufacturing and service facility based on the analysis
    - Performance of a cost-benefit or sensitivity analysis of solutions in relation to the defined operational performance criteria
    - Development of a requirements specification for a manufacturing and service system through an analysis of customer and stakeholder needs
    - Development of solution concepts that satisfy the requirements specification
    - Identification of critical elements of proposed solution concepts
- Is able to identify and explain commercial and financial cost-benefits of a proposed solution
- Is able to assess limitations of the concepts, theories and methodologies applied in solution of a problem
- Is able to scout for new products, services or manufacturing and service operations technologies

Competencies

- Is able to analyse any given manufacturing and service system and prescribe measures to improve the efficiency or quality of the facility
- Is able to interact and communicate with the participants involved in the design, development and operation of manufacturing and service systems
- Is able to professionally participate in development of new products and services and their related operations systems, focusing on evaluation, selection and implementation of relevant simplification and standardisation efforts and modern automation technologies
- Is able to participate in technological and organisational innovation activities
- Is able to work independently with a project on a specific problem within his/her field of interest at the highest possible level within his/her specialisation.
- Can independently take responsibility for own professional development and specialisation.

Chapter 3: Content and Organisation of the Programme

The Master's programme in Global Systems Design aims at providing graduates with competences to solve complex manufacturing and service operations related problems and has been developed to build both theoretical understanding and practical experience of students enrolled in the programme. The programme focuses on topics as: System thinking, Product and Service Design, Manufacturing and Service Operations, Manufacturing Planning and Control, Manufacturing and Transportation Logistics, Automation, Intelligent and Digital Manufacturing, Advanced Engineering Optimization, Applied Statistics and Stochastics, Lean- Six Sigma and Project management of business improvement projects. Those topics can be applied across industrial sectors in relation to simplify, standardize and automate products and services of everything from classical manufacturing to service production, e.g. health care of patients.

The programme is structured giving the graduate the opportunity to specialise within specific areas; ranging from e.g. Product and service design, Automation and Robotics, Manufacturing and Service Operations Improvement etc. The specialisation is carried out through the project work.

The programme is structured in modules and organised as a problem-based study. A module is a programme element or a group of programme elements which aim to give students a set of professional skills within a fixed time frame specified in ECTS credits, and concluding with one or more examinations within specific exam periods defined in the curriculum.

The programme is based on a combination of academic, problem-oriented and interdisciplinary approaches and organised based on the following work and evaluation methods that combine skills and reflection:

- Lectures
- Classroom instruction
- Project work
- Workshops
- Exercises (individually and in groups)
- Teacher feedback
- Reflection
- Portfolio work.

The 3rd semester offers different ways of organisation – depending on the student's choice of content; traditional project work at Aalborg University, study visit at an educational institution in Denmark or abroad, voluntary internship with project work at a company in Denmark or abroad, or a semester programme that comprises cross-disciplinary programme elements composed by the student. The total work load of the semester must be equivalent to 30 ECTS, of which up to 15 ECTS may be elective courses. The project may be finalised with a project report or in the form of a scientific paper, or, if the project is continued on the 4th semester, with a midterm evaluation. For further information about the organisation of the module, please see the Joint programme regulations, chapter 2.3, and the programme's study guide.

On the 4th semester, the Master's Thesis is completed. The Master's Thesis may be combined with the 3rd semester in an extended Master's Thesis.

3.1 Overview of the Programme

All modules are assessed through individual grading according to the 7-point scale. All modules are assessed by external examination (external grading) or internal examination (internal grading or by assessment by the supervisor only).

Semester	Module	ECTS	Grading	Exam
1.	Manufacturing and Service Systems – Analysis and Design	15	7-point scale	Internal
	Product and Service Design	5	7-point scale	Internal
	Process Automation	5	7-point scale	Internal
	Probability, Process and Business Simulation	5	7-point scale	Internal
2.	Manufacturing and Service Systems of the Future	15	7-point scale	External
	Intelligent and Digital Manufacturing and Service Operations	5	7-point scale	Internal
	Manufacturing and Transportation Logistics	5	7-point scale	Internal
	System Thinking and Business Process Improvement	5	7-point scale	Internal
3.[1]	Innovation of International Manufacturing and Service Operations	15-30[2]	7-point scale	Internal
4.	Master's Thesis[3]	30	7-point scale	External

[1] cf. Joint programme regulations section 2.3, students are given several choices of composing an individual planned semester, including extending the master's thesis to up to 60 ECTS.

[2] By agreement with the Study Board of Industry and Global Business Development, the project may be reduced to allow for participation in course activities. However, the project must encompass at least 15 ECTS. Proposed course activity is evaluated and tested in accordance with the curriculum in which the course module is described.

[3] The Master's Thesis may be combined with the 3rd semester in an extended Master's Thesis.

3.2 Global Systems Design, 1st semester

3.2.0 Course in Problem Based Learning and Student Responsibilities at Aalborg University

Title:

Problem Based Learning and Student Responsibilities at Aalborg University

Prerequisites:

None, but the course is compulsory for students not acquainted to the Aalborg PBL model

Objective:

Students who complete the module should:

Knowledge:

- Have knowledge about the organization at Aalborg university and where to get help in different matters
- Have knowledge about how to communicate both in your project groups but also when attending courses
- Have comprehension for how a semester is structured and about the different examination forms we use at Aalborg University
- Have comprehension for how project work and laboratory work is carried out at Aalborg University including safety issues in the laboratory
- Have comprehension for issues concerning plagiarism and the consequence when doing plagiarism
- Have knowledge about the software which are used in the study
- Have knowledge about the IT systems used and how to get started
- Have knowledge about the students counselor and what they can do

Skills:

- Be able to use problem based learning and perform group work when doing projects and courses at Aalborg University
- Be able to use Moodle i. e. for finding lecture plans, time schedules etc.

Competences

- Be able to apply the concepts, theories and methods for problem based learning and group work
- Be able to account for the considerations involved in the process of formulating project reports in practice.

Type of instruction:

Lectures, discussions and group work. The course will take place on Wednesday afternoons.

Form of examination:

Internal assessment during the course/class participation according to the rules in the Examination Policies and Procedures, Addendum to the Framework Provision of Faculty of Engineering and Science, Aalborg University. In this case the assessment is primarily based on the oral performance during the course, this means that the student has to be active during the course time and participate in discussions. The course is an integrated part of the project for those not acquainted to the Aalborg PBL model, and is a precondition for participation in the project examination. In this way there will be no diploma for the course and it will not be visible on the academic transcripts.

Evaluation criteria:

Passed/not passed as stated in the Framework Provisions

3.2.1 Manufacturing and Service Systems - Analysis and Design (15 ECTS)

Title: **Manufacturing and Service Systems – Analysis and Design**

(Analyse og udvikling af produktions- og servicesystemer)

Goal: Students who complete the module are expected to:

Knowledge

- Have an understanding of the basic elements and concepts involved in manufacturing and service operations / systems
- Have an understanding of how the elements interact locally as well as globally
- Have a deep understanding of the interface and structure of a limited manufacturing and service system
- Have achieved an understanding for methods of modelling, analysing and diagnosing performance of a manufacturing and service system
- Have achieved an understanding of the role of and means of automation of modern manufacturing and service systems
- Have achieved an understanding of the relationship between product / service design and manufacturing or service operations design
- Have achieved an understanding of how to identify relevant actions, sketch alternative solutions and do cost-benefit analysis, inclusive financial payback of these.

Skills

- Skills in problem based project work in an industrial setting during the education
- Skills to reflect critically on own work and research done or knowledge provided within disciplines of the education
- Skills to identify and map causal relations between items such as product and service design, processes, process technology, layout, organisation, planning and control, IT, staff and performance measures and reward systems in a manufacturing system
- Skills to analyze and display performance of a manufacturing and service system – also using process mapping, descriptive or inferential statistics and queuing theory / stochastic simulation techniques
- Skills to formulate operational objectives for the performance of a manufacturing and service facility – taking into account requirements for costs, productivity, flexibility, lead and delivery times, economy, the working environment, sustainability and the likes
- Skills to develop innovative solutions for improving a manufacturing and service facility based on analysis and formulated objectives for future performance
- Skills to deploy process automation and IT as a strategy for radical improvements of production and service performance
- Skills to perform cost-benefit, payback and cash-flow analysis of solutions in relation to the defined operational objectives.

Competencies

- Have the foundation to analyse, diagnose and improve smaller large scale manufacturing and service systems.
- Be able to analyse any given manufacturing and service system – both its structural design and performance - and to prescribe solution alternatives and measures to improve the efficiency of the facility
- Be able clarify how elements and concepts involved in manufacturing and service operations interact and impact performance - locally as well as globally
- Be able to work with modern manufacturing and service technologies
- Be able to apply simple analytical and software tools for modelling, calculation and simulation of business processes in a manufacturing and service context
- Be able to develop recommendations for design of products / services to match competitive needs of manufacturing and service operations systems
- Be able to interact and communicate with the participants involved in the design, development and operation of manufacturing and service systems

Teaching Method: The module is carried out as group-based, problem-oriented project work. The group work is carried out as an independent work process in which the students themselves organise and coordinate their workload in collaboration with a supervisor. The project is carried out in groups with normally no more than 6 members.

Form of examination: Oral examination.

Evaluation criteria: As stated in the Joint programme regulations.

3.2.2 Product and Service Design (5 ECTS)

Title: **Product and Service Design**

(Udvikling af produkter og services)

Goal: Students who complete the module are expected to:

Knowledge

- Have an understanding of the fundamental principles of product and service design and business / market analysis and innovation
- Have an understanding of the relationship between product and service design and operations (design for manufacturing and automation)
- Have an understanding of product modelling and product configuration and its implications for manufacturing and service operations as well as the larger business community (also taking environmental aspects into account)
- Have an understanding of advanced methods for product and production process design / validation as Design of Experiments (DOE)
- Have an understanding of how various IT tools can be used to support the design and innovation process.
- Have an understanding of method for evaluating pay-back and cash-flow of product innovation decisions

Skills

- Skills in basic system theory, methods, models and approaches, including the domain theory for design of manufacturing and service systems
- Skills in product modelling in support of design and as a means of integration
- Skills in various design for X methods, inclusive user centric or craddle2craddle design methods
- Skills in using inferential statistics on problems related to design of products / services and validation of their manufacturing process performance
- Skills in systematic methods for specification and development of product / service modules and platforms
- Skills in different IT tools to represent product / service and production data
- Skills in methods for evaluating pay-back and cash-flow of product innovation decisions

Competencies

- Have the ability to systematically develop new products and services to be integrated into modern competitive manufacturing and service systems taking into account aspects of profitability, environmental requirements, user and market needs
- Have the ability to interact with product and service designers, enabling design for manufacturing / logistics / user / environment etc.
- Have the ability to select and apply various IT solutions supporting product / service design

- Have the ability to conduct payback and cash-flow analysis of product innovation initiatives

Teaching Method: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Oral/written examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Joint programme regulations.

3.2.3 Process Automation (5 ECTS)

Title: **Process Automation**

(Proces automatisering)

Goal: Students who complete the module are expected to:

Knowledge

- Have gained an understanding of the different classes of Automation
- Have gained an understanding of automation technologies and material handling – including robots.
- Have gained an understanding of relevant sensor technologies including vision
- Have gained an understanding of highly flexible and integrated automation technologies
- Have gained an understanding of the concepts, methods and tools of software development and computer programming for automation
- Have gained an understanding of how to apply software for technical computing as e.g. Matlab and Simulink

Skills

- Be able to use tools and methods to analyse an automation system
- Be able to analyse a company's automation hardware
- Be able to analyse the automation process using technical computing and statistical methods and software as Matlab and Simulink

Competencies

- Have gained the insight and tools necessary to analyse automation technologies
- Have gained an insight into tools and methods for technical analysis and computing in automation projects
- Have gained awareness and a holistic understanding of the automation technology and their interactions the entire production process and running a business facility.

Teaching Method: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Oral/written examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Joint programme regulations.

3.2.4 Probability, Process and Business Simulation (5 ECTS)

Title: Probability, Process and Business Simulation

(Statistisk analyse og simulering af fremstillings- og forretningsprocesser)

Goal: Students who complete the module are expected to:

Knowledge

- Have gained understanding of the problem based learning method, fundamentals of philosophy of science and quantitative and qualitative research methods typically applied within the education and related research areas
- Have gained an understanding of methods and tools for mapping or modelling processes
- Have gained an understanding of fundamental statistics, i.e. probability, descriptive statistics and selected methods for inferential statistics for displaying and analyzing process performance
- Have gained an understanding of queuing theory, modelling and simulation of business processes, through discrete event simulation techniques and software (Arena, Matlab or similar)
- Have gained an understanding of the risk/uncertainty aspect of a complex system, where many different factors are stochastic.

Skills

- Skills to prioritize and operationalise various scientific research or problem solving methods in a business or industrial context
- Skills in mapping / modelling manufacturing and service business processes with various methods and tools
- Skills in applying fundamental statistics, i.e. probability, descriptive statistics and also selected methods for inferential statistics for displaying and analyzing process performance
- Skills in applying queuing theory, modelling and discrete event simulation techniques and software (Arena, Matlab or similar)on process improvement problems

Competencies

- Able to plan and conduct scientific research or problem solving studies in a business or industrial context
- Able to map / model manufacturing and service business processes with various methods and tools
- Able to apply fundamental statistics, i.e. probability, descriptive statistics and also selected methods for inferential statistics for displaying and analyzing process performance
- Able to apply queuing theory, modelling and discrete event simulation techniques and software (Arena, Matlab or similar) on process improvement problems

- Able to conduct a risk analysis in a quantitative manner, by identifying the stochastic characteristics of all factors and varying the factor parameters within their statistical constraints.

Teaching Method: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Oral/written examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Joint programme regulations.

3.3 Global Systems Design, 2nd semester

3.3.1 Manufacturing and Service Systems of the Future (15 ECTS)

Title: **Manufacturing and Service Systems of the Future**

(Fremtidens produktions- og servicesystemer)

Prerequisites: This module is based on knowledge gained on 1st semester of the Master's programme in the Global Systems Design or the like.

Goal: Students who complete the module are expected to:

Knowledge

- Understand the fundamental principles of manufacturing and service operations of the future
- Understand the role and means of digital and intelligent manufacturing for competitiveness of future manufacturing and service systems
- Understand strategic design of product / services and operations in a global context
- Understand the role of a manufacturing or service systems from a logistical perspective
- Understand the use of advanced optimization (operations research) and simulation tools with regards to analysis and solution design and performance evaluation of solutions for manufacturing and service systems
- Understand the use of state-of-art approaches, tools and techniques of lean-six sigma applied across industries for simplification, standardisation and automation of business processes
- Understanding methods for managing improvement projects and stakeholders as well as enablers / barriers for implementation success
- Understand the assumptions and limitations of the theories, methods and tools used in a project.

Skills

- Skills in scientific and problem based project work in an industrial setting during the education
- Skills to reflect critically on own work and research done or knowledge provided within disciplines of the education
- Skills to develop a requirements specification for a competitive manufacturing and service system of the future through an analysis of customer and stakeholder needs
- Skills to design digital and intelligent manufacturing and service systems
- Skills to develop (strategic) solution concepts that satisfy the requirement specification developed
- Skills to transform strategic / tactical solutions designed into operational or realizable processes and technologies leading to further simplification, standardisation and automation of business processes
- Skills to identify critical elements of proposed solution concepts.

- Skills to use appropriate advanced optimization (operations research) and simulation tools for developing and evaluating performance of solutions
- Skills to plan and management business improvement project's using lean-six sigma approaches dealing with design of products / services and / or manufacturing and service systems.

Competencies

- Have the foundation to analyse, diagnose and improve smaller large scale manufacturing and service systems.
- Be able to analyse any given manufacturing and service system – both its structural design and performance - and to prescribe solution alternatives and measures to improve the future competitiveness of the facility
- Be able clarify how elements and concepts involved in manufacturing and service operations interact and impact performance - locally as well as globally
- Be able to work with digital and intelligent manufacturing and service technologies
- Be able to work with improvement of manufacturing and service systems from a logistics and supply chain perspective
- Be able to apply advanced optimization and simulation tools for modelling, calculation and simulation of business processes in a manufacturing and service context
- Be able to apply lean-six sigma methods to improve performance of manufacturing and service operations
- Be able to interact and communicate with the participants involved in the design, development and operation of manufacturing and service systems

Teaching Method: The module is carried out as group-based, problem-oriented project work. The group work is carried out as an independent work process in which the students themselves organise and coordinate their workload in collaboration with a supervisor. The project is carried out in groups with normally no more than 6 members.

Form of examination: Oral examination with participation of an external examiner.

Evaluation criteria: As stated in the Joint programme regulations.

3.3.2 Intelligent and Digital Manufacturing and Service Operations (5 ECTS)

Title: **Intelligent and Digital Manufacturing and Service Operations**

(Intelligente og digitale produktions- og servicesystemer)

Prerequisites: This module is based on knowledge gained on 1st semester of the Master's programme in the Global Systems Design or the like.

Goal: Students who complete the module are expected to:

Knowledge

- Have gained an understanding of different approaches and techniques for digital production preparation
- Have gained an understanding of relevant technologies enabling the design of intelligent manufacturing systems
- Have gained understanding of options for integrating Product Lifecycle Management and Manufacturing Execution Systems
- Have gained an understanding of virtual simulation
- Have gained an understanding of rapid prototyping and 3D printing technologies
- Have gained an understanding of virtual commissioning
- Have gained an understanding of advanced sensor technologies
- Have gained an understanding of advanced flexible and intelligent automation technologies in manufacturing and service
- Have gained an understanding of databases, Business Intelligence and Data Warehouse / mining technologies

Skills

- Be able to use various digital simulation tools to test the automation approach against a model
- Be able to develop digital models and use rapid prototyping technologies
- Be able to use various technologies to provide manufacturing and service systems with intelligent capabilities (reasoning, knowledge, planning, learning, communication, perception and the ability to move and manipulate objects)
- Be able to integrate and implement intelligent machines as well as performance monitoring systems into a small and limited manufacturing system.

Competencies

- Have the foundation to participate in projects aiming at designing, modelling and simulating (intelligent) automation systems.
- Have the foundation to participate in projects aiming at digitally designing, modelling, simulating and prototyping products.

Teaching Method: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Oral/written examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Joint programme regulations.

3.3.3 Manufacturing and Transportation Logistics (5 ECTS)

Title: **Manufacturing and Transportation Logistics**

(Produktions- og transportlogistik)

Prerequisites: This module is based on knowledge gained on 1st semester of the Master's programme in the Global Systems Design or the like.

Goal: Students who complete the module are expected to:

Knowledge

- Have gained an in-depth understanding of important concepts and methods of manufacturing and transportation logistics
- Have gained an in-depth understanding of forecasting, manufacturing planning and control methods (MRP, MRPII, JIT), inventory and capacity management and link to ERP systems
- Have gained an in-depth understanding of application of operations research techniques and possible application in areas of manufacturing and transportation logistics
- Have gained familiarity with pricing and revenue / yield optimization and application at various industrial settings
- Have gained familiarity with supply chain logistics and the ways of ensuring supply chain coordination dealing with bullwhip / forrester effect problems

Skills

- Skills for designing systems for manufacturing and transportation logistics, including coherent systems for forecasting, planning and control and implementation of these in ERP systems
- Skills in applying operations and research and optimization techniques in the context of forecasting, pricing, inventory and capacity management
- Skills in designing systems and processes as well as measures for forecasting, pricing and revenue / yield optimization for various industrial settings
- Skills in analyzing and diagnosing as well as mitigating supply chain bullwhip / forrester effect problems

Competencies

- Able to apply the concepts, theories and methods for design of systems for manufacturing and transportation logistics, particularly planning and control systems and procedures implemented in ERP solutions
- Able to apply operations research and optimization techniques for solving problems related to forecasting, pricing, inventory and capacity management in manufacturing or transportation industries
- Able to design systems, processes and measures for forecasting, pricing and revenue management solution of operations and optimisation problems
- Able to ensure proper supply chain coordination and minimize bullwhip / forrester effect in manufacturing and transportation supply chains

Teaching Method: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Oral/written examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Joint programme regulations.

3.3.4 Systems Thinking and Business Process Improvement (5 ECTS)

Title: **Systems Thinking and Business Process Improvement (Lean-Six Sigma)**

(Systemtænkning og procesforbedringer (Lean-Six Sigma))

Prerequisites: 1st semester of the Master's programme in the Global Systems Design or the like.

Goal: Students who complete the module are expected to:

Knowledge

- An understanding of concepts and methods for Operations and Business Strategy formulation and implementation
- A coherent and profound understanding of approaches, tools and techniques of business process Business Process Excellence, Lean, Six Sigma, TPM, TQM to be used for continuous simplification, standardization, automation and improvement of business processes in industry and service organizations
- Understanding of various principles, tools and techniques to be applied in business improvement projects, as e.g. SIPOCs, process mapping, value stream mapping, KPI and PPI analysis, root cause analysis, control charts, box plots, regression analysis, Design of Experiments (DOE), 5S, value, waste, 5Rs for process redesign, flow, pull, jidoka, pokayoke, cash flow analysis, stakeholder management etc.
- Understanding of how to display and analyze process performance and quality levels of business processes with control charts in manufacturing and service systems, as well as doing validating quality of measurement systems and sampling of process data
- Have developed skills for validating scale and impact of root causes / options for problem solving on business processes of manufacturing and service systems and their performance through use inferential statistics and similar methods
- Have been trained in use of standard statistical software as Excel, Minitab etc.

Skills

- Skills for strategic design of manufacturing and service systems, taking competitive the global context, and opportunities and threats into account
- Skills in conducting operations and business process improvement projects as well as kaizen activities according to Systems Thinking, PDCA or DMAIC methods including application of relevant methods, tools and techniques
- Skills in displaying and analyzing process performance and quality levels of business processes and validating impact of root causes / options for problem solving on business processes of manufacturing and service systems
- Skills in using relevant standard statistical software as Excel, Minitab etc.
- Skills in leading operations and business improvement projects towards meeting deliverables and broader stakeholder objectives, also taking role of human resources into account
- Skills in financial cost-benefit analysis, project management and stakeholder management of business improvement projects
- Skills designing and leading larger scale organizational transformations centered around lean-six sigma approaches towards sustainable practices of continuous improvement – also ability to identify enablers / barriers for success, e.g. the role

that governance of IT investments play in enabling process improvement projects to succeed

Competencies

- Able to discuss the complex of problems associated with global competition for manufacturing and service operations to outline the different paths and strategies a company may choose for its manufacturing or service operations and evaluate costs-benefits of proposed / recommended solutions
- Able to craft and implement relevant operations and internal as well as external logistics strategies
- Able to apply knowledge and skills in relation to business process excellence (Lean-Six Sigma, TPM, TQM) on specific business process improvement projects running in a manufacturing or service organisation
- Able to apply methods for measurement system analysis, sampling of process data quality, statistical quality and process control and inferential statistics on problems related to design of products / services and their industrial / business process performance
- Able to do financial cost-benefit analysis, project management and stakeholder management of business improvement projects
- Able to do project and stakeholder management of business improvement projects in own organization and able to take part in larger organizational transformations

Teaching Method: The teaching is organized in accordance with the general forms of teaching, see chapter 3.

Form of examination: Oral/written examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Joint programme regulations.

3.4 Global Systems Design, 3rd semester

3.4.1 Innovation of International Manufacturing and Service Operations (15-30 ECTS)

Title: **Innovation of International Manufacturing and Service Operations**

(Innovation af fremstillings- og serviceproduktion i en international kontekst)

Prerequisites: This module is based on knowledge gained on 2nd semester of the Master's programme in Global Systems Design or the like.

Goal: Students who complete the module are expected to:

Knowledge

- Understand how to conduct innovation of processes for manufacturing and service operations in a selected international company / organization to the benefit of customers and other business stakeholders
- Understand how to enable improved business profitability and competitiveness in an Danish or International Organization through improvement of manufacturing and service process performance as well as customer value added
- Understand various theories, methods, techniques and tools for simplification, standardisation and automation of manufacturing and service processes – also taking impact on design of products / services on process innovation opportunities into a account
- Understand how to work with innovation of manufacturing and service processes and systems design from a holistic perspective – taking into account the interdependence of process automation and digital technologies and human / social elements
- Understand how to work with manufacturing and service operations innovation in a systematic and scientific manner, also critically evaluating own use of theories, methods, tools and techniques for creation of results

Skills

- Skills in innovation of processes for manufacturing and service operations through improving business process performance in an international company / organization to the benefit of customers and other business stakeholders
- Skills in various theories, methods, techniques and tools for simplification, standardisation and automation of manufacturing and service processes – also taking impact on design of products / services on process innovation opportunities into a account
- Skills in formulating operational objectives for a manufacturing and service process automation or improvement project
- Skills in analyzing the baseline situation of a manufacturing or service facility and current performance levels and identification of improvement options
- Skills in scouting new product / service as well as manufacturing and service technologies and their potential for process improvement for the company or organization

- Skills in development of process solution alternatives, as well as doing performance and financial cost -benefit or sensitivity analysis of these solutions in relation to the defined operational performance criteria
- Skills in scientific thinking and systematic problem solving applied on own work

Competencies

- Be able to participate in manufacturing and service process innovation and improvement activities.
- Be able to apply theories, methods, techniques and tools for simplification, standardisation and automation of manufacturing and service processes on specific industrial or business challenges
- Be able to consider the role of design of products / services for enabling manufacturing and service process innovation
- Be able to scout new automation and digital technologies of potential relevance and ensure integration into manufacturing and service processes to enable improved process performance
- Be able to work with manufacturing and service innovation from various perspectives, either technological, human / organizational, customer value, sustainability or financial perspectives
- Be able to achieve competencies in manufacturing and service process improvement comparable to a Lean-Six Sigma Green Belt / Black Belt level certification if project work / tasks are carried out in collaboration with an external company and have sufficient scope and complexity.

Organisation: Dependent on student's choice of content and organization of the semester; the student may choose between project work at Aalborg University or a voluntary traineeship at a company in Denmark or abroad. The total work load of the semester has to be equivalent to 30 ECTS. If carried out at Aalborg University, the project may be finalized with a project report or in the form of a scientific paper. If continued at the 4th semester, the project is evaluated with a midterm evaluation. For further information about the organisation of the module please see the Joint programme regulations, chapter 2.3., and the study guide for the M.Sc. program in Manufacturing Technology.

Teaching Method: Dependent on student's choice of content and organisation of the semester;

- If the semester is carried out as an internship, the student is included in the company's daily work. Concurrent to the work in the company, the student makes a report which is evaluated after ending the internship;
- The project work is carried out as an independent work process in which the students themselves organise and coordinate their workload in collaboration with a supervisor. The project may be carried out individually or in groups.

Form of examination: Oral examination (for further information, please see the programme's study guide).

Evaluation criteria: As stated in the Joint programme regulations.

3.5 Global Systems Design, 4th semester

3.5.1 Master's Thesis (30 ECTS)

Title: **Master's Thesis**

(Kandidatspeciale)

Goal: Students who complete the module are expected to:

Knowledge

- Know how to acquire and apply knowledge relevant to solve a practical or scientific problem related to process performance improvement and competitiveness of international manufacturing and service operations.

Skills

- Be able to demonstrate business, engineering and/or scientific skills within the line of specialisation and be able to display their ability to perform engineering and business process improvement work with good results in an industrial or business context and/or scientific work.

Competences

- Be able to work independently with a project on a specific problem within their field of interest on the highest possible level within their specialisation.

Teaching Method: In this module, the Master's project is carried out. The module constitutes independent project work and concludes the program. Within the approved topic, the Master's project must document that the level for the program has been attained.

Form of examination: Oral examination with participation of an external examiner.

Evaluation criteria: As stated in the Joint programme regulations.

Chapter 4: Entry into Force, Interim Provisions and Revision

The curriculum is approved by the Dean of the Faculty of Engineering and Science and enters into force as of September 2016.

Students who wish to complete their studies under the previous curriculum from 2012 must conclude their education by the summer examination 2017 at the latest, since examinations under the previous curriculum are not offered after this time.

Chapter 5: Other Provisions

5.1 Rules concerning Written Work, including the Master's Thesis

In the assessment of all written work, regardless of the language in which it is written weight is also put on the student's spelling and formulation ability, in addition to the academic content. Orthographic and grammatical correctness as well as stylistic proficiency are considered basis for the evaluation of language performance. Language performance must always be included as an independent dimension of the total evaluation. However, no examination can be assessed as 'Pass' on the basis of language performance alone; similarly, an examination cannot normally be assessed as 'Fail' on the basis of poor language performance alone. The Board of Studies can grant exemption from this in special cases (e.g., dyslexia or a native language other than Danish).

The Master's Thesis must include an English summary.[4] If it is written in English, the summary must be in Danish.[5] The summary must be at least one page and maximum two pages. The summary is included in the evaluation of the project as a whole.

5.2 Rules concerning Credit Transfer (*merit*), including the Possibility for Choice of Modules that are Part of Another Programme at a University in Denmark or Abroad

In the individual case, the Board of Studies can approve successfully completed (passed) programme elements from other Master programmes in lieu of programme elements in this programme (credit transfer). The Board of Studies can also approve successfully completed (passed) programme elements from another Danish programme or a programme outside of Denmark at the same level in lieu of programme elements within this curriculum. Decisions on credit transfer are made by the Board of Studies based on an academic assessment. See the Joint programme regulations for the rules on credit transfer.

5.3 Rules for Examinations

The rules for examinations are stated in the Examination Policies and Procedures published by the Faculty of Engineering and Science on their website.

[4] Or another foreign language (upon approval from the Board of Studies).
[5] The Board of Studies can grant exemption from this.

5.4 Exemption

In exceptional circumstances, the Board of Studies can grant exemption from those parts of the curriculum that are not stipulated by law or ministerial order. Exemption regarding an examination applies to the immediate examination.

5.5 Additional Information

The current version of the curriculum is published on the Board of Studies' website, including more detailed information about the programme and exams.

5.6 Completion of the Master Programme

The Master programme must be completed no later than four years after it was begun.

5.7 Rules and Requirements concerning the Reading of Texts in Foreign Languages and a Statement of the Foreign Language Knowledge this Assumes

It is assumed that the student is able to read academic texts in modern Danish, Norwegian, Swedish and English and use reference works, etc., in other European languages.