Thesis Proposals
Spring 2021
Operations Management

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Management Science - DTU Management
Writing your thesis within Operations Management

Welcome to the presentation of thesis proposals offered within the Section of Operations Management group at DTU Management! With this booklet we hope to inspire you to select an intriguing topic for your coming thesis work.

Although the booklet is primarily directed towards MSc students, a large part of the topics presented will also be able to be scoped to match the academic level and aims of a BSc or BEng thesis project. The booklet could therefore also serve as inspiration to BSc and BEng students.

We encourage you to browse the topics presented for each thesis family and subsequently contact us. Please respect that contacting several potential supervisors at the same time may result in a lot of extra work for us, therefore please let us know if you already in contact with other supervisors at the time you contact us.

For some projects, the thesis may be carried out in collaboration with an external company, in this case please consider that the supervisor needs to be included in the discussion with the company from the very start of the scoping/planning process.

The following list of faculty members are potential supervisors:

- Michael Bruhn Barfod, Associate Professor (mbba@dtu.dk)
- Lars Hvam, Professor (lahv@dtu.dk)
- Martin Kidd, Assistant Professor (mpki@dtu.dk)
- Melanie Kreye, Associate Professor (mkreye@dtu.dk)
- Allan Larsen, Professor MSO (alar@dtu.dk)
- Harilaos Psaraftis, Professor (hnpsar@dtu.dk)

Please note that it is indeed also possible to write your thesis in collaboration with other research groups within the Management Science division as well as across the department.

We wish you good luck in pursuing an interesting and ambitious thesis project!

Best regards,

The Section of Operations Management
Michael Bruhn Barfod

Position:

Associate Professor, Operations Management

Research Area:

Assessment methodologies used in planning. Specific areas of interest:

- Applied decision analysis, sustainability assessments and customized decision support systems
- Problem structuring and stakeholder involvement in decision support processes
- Model building from initiation to implementation of various methodological approaches and data treatment

The research in particular applies theory in practice, and has often been carried out using real case data in various projects. These projects have besides articles (national as well as international) lead to the research results being applied both in industry and in the education provided at DTU.

Teaching:

I teach the following courses:

- 42107 Decisions in theory and practice (5 ECTS) (BSc, Spring)
- 42580 Engineering Work 1 (5 ECTS) (BSc, Autumn)
- 42583 Engineering Work 2 (5 ECTS) (BSc, Spring)
- 42584 Project work (10 ECTS) (BSc, Spring)
- 42879 Decision Support and Strategic Assessment (5 ECTS) (MSc, Autumn)
Lars Hvam

**Position:**

Professor, Operations Management

**Research Area:**

- Mass customization
- Complexity Management
- Configuration Management
- Production systems

**Teaching:**

I am teaching the following courses:

- 42406 Introduction to Production (5 ECTS) (BSc, Autumn)
- 42451 Mass customization – application of product configuration (10 ECTS) (MSc, Autumn)
- 42452 Complexity Management (5 ECTS) (MSc, January)
Martin Kidd

**Position:**
Assistant Professor, Supply Chain Management and Logistics

**Research Area:**

I am interested in supply chain management, more specifically supply chain analytics and supply chain collaboration.

Supply chain analytics involves utilizing tools from

- mathematical/stochastic modelling
- optimization
- machine learning
- game theory

to gain insights from data and enhance decision making within the supply chain contexts such as

- forecasting
- production/distribution planning
- network design
- coordination and collaboration

ultimately to assist in the improved design and management of supply chains.

When it comes to collaboration, the main research questions concern in what ways companies can collaborate within a supply chain and how to incentivize collaboration. In my research I combine both, using techniques from analytics, especially cooperative game theory, to answer questions about collaboration.

**Teaching:**

I am teaching the following courses:

- 42380 Supply Chain Analytics (5 ECTS) (MSc, Spring – from 2020)
- 42401 Introduction to Management Science (5 ECTS) (MSc, Autumn – given last time in autumn 2020)
Melanie Kreye

Position:
Associate Professor, Operations Management

Research Area:
My research focuses on service operations within the manufacturing industry (engineering services). Specific research areas include:

- Service relationships (provider-customer triads, supplier relationships, contract management etc)
- Innovation of service offerings (development of combined product-service offerings, drivers for innovation)
- Global operations in manufacturing and services
- Employee behavior and management
- Management of change in service-driven manufacturing

Teaching:
I teach the following courses:

- 42543 Management of Change (MSc, Spring)
- 42B85 Servitization (MBA, Spring)
- 42702 PhD introduction course (PhD, Fall)
Allan Larsen

Position:
Professor MSO, Operations Management

Research Area:
Digitalization and automation opens up new complex planning problems calling for advanced quantitative analytical methods within domains such as transport, logistics, supply chain management and healthcare.

My research is focused on applying cutting-edge operations research based methodologies such as mathematical optimisation, metaheuristics and simulation tools to planning and management problems within transport, logistics, supply chain management and healthcare.

Specific interests include;

- Urban freight transport (city logistics)
- Electro-mobility for freight transport
- Demand-responsive transport systems (autonomous vehicles and fleet management)
- Improvements of efficiency in logistics, supply chains, warehousing, manufacturing through the use of simulation methodology
- Supply Chains in healthcare
- Healthcare Operations Management

Teaching:

I teach the following courses:

- 42587 Introduction to Operations and Supply Chain Management (BSc, Autumn)
- 42417 Simulation in Operations Management (MSc, June)
Harilaos N. Psaraftis

Position:

Professor, Transport optimisation

Research Area:

- Transport Logistics
- Specific areas of interest
- Maritime transport
- Green transport
- Vehicle routing & distribution
- Transport policy

Use of quantitative methods in planning and management of transport systems.

Selected projects:

- SuperGreen, EU FP7 project- overall consortium manager, DG-MOVE (2010-2013).
- TENTAcle, INTERREG VI project, Region Blekinge (Sweden) leader (2016-2019).
- Scandria2Act, INTERREG VI project, Region Berlin-Brandenburg (Germany) leader (2016-2019).
- BlueSiros, funded by the European Space Agency, DTU Space leader (2016-2017).
- SMART MARITIME, DTU scientific advisor, Marintek (Norway) leader, Norwegian Research Council (2016-2019).

Teaching:

- 42892 Shipping and Port Logistics (taught last time in Autumn 2020)
- 42381 Sustainable Freight and Transport Logistics (from Spring 2021)
THESIS
FAMILIES
Advised by
Assoc. Prof.
Michael Bruhn Barfod
Reducing emissions in the maritime sector (MSc)

PROJECT SUPERVISOR: Associate professor Michael Bruhn Barfod (mbba@dtu.dk), Researcher George Panagakos (geopan@dtu.dk), PhD student Amandine Godet (amcgo@dtu.dk)

BACKGROUND: In April 2018 the International Maritime Organisation (IMO) adopted its initial strategy on reduction of GHG emissions from ships. Aiming at phasing out GHG emissions as soon as possible in this century, IMO set the targets of:

- strengthening the energy efficiency design requirements for new ships;
- reducing CO₂ emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008; and
- reducing the total annual GHG emissions by at least 50% by 2050 compared to 2008.

More recently, the 4th Greenhouse Gas Study of IMO highlighted that the shipping industry has continued its trend of decoupling emissions from the global growth of seaborne trade (although there was a 40% increase in seaborne trade between 2008 and 2018, CO₂ emissions from shipping fell by 10% over the same period). Nevertheless, measures are needed in the short-, mid- and long-run to achieve the IMO targets and the Paris Agreement ambition. These would involve both improvements in the energy efficiency of new and existing vessels and the development of zero-emission technologies mainly through alternative fuels.

PURPOSE AND DESCRIPTION: Students will be working with different approaches to meet the overall goal of reducing emissions in the maritime sector. This can e.g. include:

- Examine the implications of using alternative indicators in potential measures designed for meeting the target on carbon emissions from ships
- Use available data from leading Danish companies to develop an emission reporting mechanism that combines technical and operational aspects
- From a policy perspective draw recommendations for a more appropriate use of indicators to monitor and benchmark ship efficiency
- Examine the impact of different technologies on board (e.g. waste heat recovery system)
- Examine the potential for alternative fuels as both short- and long-term measures
- Design decision support systems to assist the maritime industry in meeting the reduction targets in the most cost-effective way

PREREQUISITES:

- Good knowledge of statistics
- 42879 Decision support & strategic assessment
THESS
FAMILIES
Advised by
Assist. Prof.
Martin Kidd
Proactive disruption management in supply chains

PROJECT SUPERVISOR: Assistant Professor Martin Philip Kidd (mpki@dtu.dk)

BACKGROUND: Murphy's law states that if anything can go wrong, it will. Although tongue-in-cheek, it emphasizes an important point, especially for supply chains. In supply chains many things can go wrong, from machine breakdowns to global pandemics, causing disruptions in supply. If we do not plan proactively for potential disruptions and focus too much on "lean" principles, the effects of disruptions will be severe and might propagate throughout the supply chain. On the other hand, adding some flexibility to our plans and schedules will allow room for us to move things around when disruptions happen, and to effectively get back on our feet before things get worse. Digitalization also provides opportunities to enhance flexibility, since real-time monitoring together with machine learning can be used to signal disruptions before they happen. But flexibility usually comes at a cost, and it might be difficult to find the right balance. In this thesis family the objective is to study mathematical models for robust planning and scheduling in supply chains, where the usual objective of minimizing cost is juxtaposed with maximizing the "recoverability" of plans and schedules, given (possibly real-time) predictions of disruptions.

POTENTIAL RESEARCH DIRECTIONS: Different planning contexts can be studied, e.g. robust machine scheduling, robust network design, etc. Different approaches to finding robust solutions can be studied, e.g. adding robustness measures to an optimization problem, following a scenario-based approach to optimization (where constraints are added for different possible disruption scenarios), or to use simulation to study the effects of disruptions.

METHODOLOGIES: Robust optimization, simulation, machine learning

PREREQUISITES: Decent programming skills, e.g. in Python, Java, C++. Experience with formulating and solving MIPs in e.g. Julia or Python. Also useful but not strictly necessary would be knowledge of basic theory on simulation and experience with using machine learning packages, e.g. in Python.
Configuring collaborative planning in supply chains

PROJECT SUPERVISOR: Assistant Professor Martin Philip Kidd (mpki@dtu.dk)

BACKGROUND: Considerable value can be generated through collaboration in supply chains. This is especially true when it comes to planning, where different decision makers across a supply chain are responsible for planning production, distribution and inventory. The ideal would be full collaboration, where the optimization problems concerning production, distribution and inventory are solved collaboratively as a single, integrated optimization problem - as opposed to each decision maker solving its own local optimization problem. However, collaboration often requires investments of time and money and can increase the complexity of the planning process, as more entities need to communicate with each other across the supply chain. In this thesis family the objective is to study the value of collaboration in supply chain planning as we move from no collaboration to full collaboration. In particular, the following questions will be addressed: How can we effectively solve integrated supply chain optimization problems? How many supply chain members in a given supply chain need to collaborate to get close to the value of full collaboration? How can we identify the optimal collaborative relationships for a given supply chain? How can we ensure that all collaborators get their fair share of collaborative gains?

POTENTIAL RESEARCH DIRECTIONS: Formulating and solving different integrated optimization problems in supply chains. Formulating and solving "coalition formation" problems that tries to find the optimal coalitions in a given supply chain - this can be formulated as a set partitioning problem that contains subproblems for each potential coalition’s integrated optimization problem. Using simulation to study the value generated by different collaborative structures. Developing fair benefit sharing mechanisms for different collaborative supply chain planning settings.

METHODOLOGIES: Optimization, simulation, cooperative game theory

PREREQUISITES: Decent programming skills, e.g. in Python, Java, C++. Experience with formulating and solving MIPs in e.g. Julia or Python. Also useful but not strictly necessary would be knowledge of basic theory on simulation and cooperative game theory.
THESIS

FAMILIES

Advised by

Professor

Lars Hvam
Product configuration

Supervisor: Professor Lars Hvam (lahv@dtu.dk)

Background: Product configurators are increasingly being used to support sales and engineering for making specifications like quotations, and other product and production specifications. Configurators are a means to control the product assortment and increase efficiency in sales, engineering and production.

Project description: A master project on product configuration may cover one or more of these areas:

- Defining scope and business cases for product configurators
- Modelling products for a product configurator
- Making a prototype product configurator
- Modelling and developing sales and engineering processes
- Analyzing impact from using product configurators
Complexity management

**Supervisor:** Professor Lars Hvam ([lahv@dtu.dk](mailto:lahv@dtu.dk))

**Background:** Industry and service companies experience increasing complexity in their products and operations. There is a strong management on reducing complexity and the potential benefits for the companies are significant.

**Project description:** A master project on complexity management may cover one or more of these areas:

- ABC analysis of products and customers
- Identification and quantification of the most significant complexity cost drivers and allocation of complexity costs to products
- Quantification of other impact than costs e.g. impact from complexity on delivery performance or quality
- Identification of initiatives for reducing complexity in products and/or processes
- Quantifying expected and cost benefits from each suggested initiative and plan for implementation
THESIS

FAMILIES

Advised by

Professor MSO

Allan Larsen
Simulation in Operations & SCM

BACKGROUND: Operations and supply chain management are home to a wide range of complex planning problems. Simulation modelling is often a well-suited methodology for studying and analyzing the behavior of such problems. In this thesis family, students work on specific topics within logistics, freight transport, supply chain management as well as production planning. The starting point of the theses are discrete-event based modelling but also agent-based modelling and even in some cases system dynamics may be chosen as the method employed.

RESEARCH TOPICS: Potential thesis topics include (but are not limited to):

- Analysis of alternative last-mile delivery concepts within sustainable eCommerce logistics
- Simulation of reverse logistics systems for efficient handling of waste, food, etc.
- Analysis of potentials of electric vehicles in short and medium haul freight transport
- Simulation of distribution networks within the pharmaceutical industry

PREREQUISITES: 42417 Simulation in Operations Management and preferably 42587 Introduction to Operations & Supply Chain Management or 42401 Introduction to Management Science (or similar).

SUPERVISOR: Professor MSO Allan Larsen (alar@dtu.dk). Potential involvement of PhD students if relevant.

EXAMPLES OF PREVIOUS PROJECTS:

- Exploration of Discrete Event Simulation in Process Manufacturing Industries
- Analysis of supply chain flexibility requirements in Novo Nordisk
- Simulation and optimisation of a free floating car sharing system
- Efficiency improvements of warehousing operations through increased automation - Simulation study for DHL Supply Chain Denmark
- Assessing the sustainability of electro-mobility for the routing of service technicians
Healthcare Operations Management

BACKGROUND: The population growth and the change in demographics we are currently witnessing makes efficient use of resources within healthcare systems even more vital to the modern society. The healthcare domain holds a wide range of complex planning problems which are well-suited to be analysed via advanced simulation modelling. Methodologies such as simulation modelling and process optimization may help decision makers to make better use of resources.

RESEARCH TOPICS: Potential research topics for student theses (MSc as well as BSc level) includes (but are not limited to):

- Analysis of the operational performance of a specific hospital department taking into account fluctuations in demands (patient flows) and resources available (human resources such as doctors and nurses as well as physical resources such as rooms, beds, equipment etc.)
- Efficient management of the flows of goods (medicine, food and other supplies) are vital to large hospitals. The project should build an optimization and/or simulation model capable of analyzing various logistics concepts. Projects within this topic can potentially be based on the notion of Hospital 4.0 extending the Industry 4.0

Theses within this topic may be set under the umbrella of the Copenhagen Health Innovation collaboration (please see https://cobox.dk/#video for more information). The thesis projects may involve a hospital department or a central planning entity of the healthcare system.

PREREQUISITES: 42587 Introduction to Operations & Supply Chain Management or 42401 Introduction to Management Science (or similar). 42417 Simulation in Operations Management (or a similar course).

SUPERVISOR: Professor MSO Allan Larsen (alar@dtu.dk). Potential involvement of PhD students if relevant.

EXAMPLE OF PROJECTS:

- “Simulation of patient flows for the Emergency Department at Hvidovre Hospital”, ongoing MSc thesis project.
THESIS

FAMILIES

Advised by

Professor

Harilaos Psaraftis
Technical, logistics-based and market-based measures for GHG emissions reduction in maritime transport (MSc)

PROJECT SUPERVISOR: Professor Harilaos N. Psaraftis (hnpsar@dtu.dk), Senior Researcher Thalis Zis (tuis@dtu.dk), PhD student Sotiria Lagouvardou (sotla@dtu.dk)

BACKGROUND: According to the 4th IMO greenhouse gas (GHG) study (2020), total maritime GHG emissions, both international and domestic, including CO₂, CH₄ and N₂O, and expressed in CO₂ equivalent emissions (CO₂e), have increased from 977 million tonnes in 2012 to 1,076 million tonnes in 2018 (a 9.6% increase). Roughly 98% of these are CO₂ emissions. Much regulatory activity is tasked to find ways to significantly reduce GHG emissions. Shipping is not yet included in the Kyoto protocol, that being the mandate of the International Maritime Organization (IMO). The IMO, on its part, has adopted in 2011 the only mandatory GHG reduction scheme to date, in the form of the Energy Efficiency Design Index (EEDI), and has decided in 2018, among other things, to reduce GHG emissions by 2050 by at least 50% vis-a-vis 2008 levels and reduce carbon intensity by 2030 by at least 40% vis-à-vis 2008 levels. A broad variety of candidate measures have been proposed, but no decision has yet been made. Short-term measures (2018-2023) include speed optimization and speed reduction, various goal-based measures and engine power limitation. Medium-term measures (2023-2030) include Market Based Measures (MBMs). Long-term measures (2030-2020) include low carbon fuels, use of electricity and innovative energy saving devices such as sails, rotors, air bubbles, cold ironing in ports and others. In parallel, the EU is looking at including shipping within its Emissions Trading System (ETS). This project provides a great opportunity to contribute to the IMO and EU debates.

PROJECT PURPOSE: A number of distinct MSc thesis variants can be defined under the above umbrella. The purpose of each project will to analyze possible measures, appropriately defined, for various shipping markets, tramp and liner, in terms of reducing GHG emissions and other criteria. Short-term and/or long term impacts of these measures will be analyzed.

PROJECT DESCRIPTION: This project will examine the potential impacts of the measures under examination for various scenarios in international shipping, possibly including the role of ports and terminals. Interaction with research projects MBM SUSHI and/or AEGIS is foreseen.

PREREQUISITES: A minimum knowledge of maritime transport and/or maritime technologies. Optionally: 42892 Shipping and Port Logistics.

NUMBER OF STUDENTS: 4-5 MSc students (30 ECTS Credits).