Thesis Proposals
Operations Management

Version 2.0
APRIL 20th 2018

Management Science
DTU Management Engineering
Writing your thesis within Operations Management

Welcome to the presentation of thesis proposals offered within the Operations Management group at the department of Management Engineering! 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.

Some thesis projects are carried out internally here at DTU whereas others are performed in close collaboration with external organisations. In addition to the proposals listed in this booklet, you are welcome to suggest your own ideas for a project topic. If you do so, you need to consult a supervisor in order to scope the project so that it is academically sound, relevant and ambitious but also realistic to achieve within the project period. You should check with the potential supervisor whether you have the relevant prerequisites for carrying the specific thesis topic.

We look forward to meeting you as a thesis student in Operations Management!

The following list of faculty members are potential supervisors:

- Michael Bruhn Barfod, Associate Professor (mbba@dtu.dk)
- Steven Harrod, Associate Professor (stehar@dtu.dk)
- Lars Hvam, Professor (lahv@dtu.dk)
- Peter Jacobsen, Associate Professor (peja@dtu.dk)
- Martin Kidd, Assistant Professor (mpki@dtu.dk)
- Allan Larsen, Professor (alar@dtu.dk)
- Harilaos Psaraftis, Professor (hnpsar@dtu.dk)
Michael Bruhn Barfod

Position:
Associate professor, Operations Management

Research Area:

Assessment methodologies used in transport 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 am teaching the following courses:

- 42879 Decision Support and Risk Analysis (MSc, Autumn)
- 42995 Intelligente Transportsystemer (ITS) og projektvurdering (BEng, Spring+June)
- 42997 Sustainable Transport (BEng, Autumn)
Steven Harrod

Position:
Associate Professor, Operations Management

Research Area:
I have specific career experience in road transport, railways, software development and marketing, and database development. I have published research on simulation, job shop systems, and railway timetables and capacity.

- Simulation: model building, statistical analysis of output, and applications
- Process analysis: modeling of manufacturing and service processes, control of work in progress (inventory) and flowtime.
- Freight transport: railway transport service design and competition with road transport.
- Railway management: service and operations design, economics of railway transport.
- Railway timetabling: optimization of train paths, calculation of capacity, and pricing of services

Teaching:
I teach the following courses:

- 42878 Future Trains: Railway Fleet Acquisition and Management (MSc, June)
- 42880 Railway Operations and Management (MSc, Autumn)
- 42976 Rail Traffic Engineering (BEng, Spring)
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)
Peter Jacobsen

**Position:**
Associate Professor, Operations Management

**Research Area:**
Develop and apply methods within:
- Production systems - design, planning and optimization
- Logistics - planning and optimization of networks and supply chains
- Optimization of the complexity in production and logistics/SC systems
- Simulation - validation, verification and optimization
- Performance measurement/management
- Digitalization, big data and industry 4.0
- Industrial/healthcare area

**Teaching:**
I am teaching the following courses:
- 42371 Design of Lean Production and Service Systems (10 ECTS) (MSc, Spring)
- 42376 Operations Management in Health Care and Service Systems (5 ECTS) (MSc, Autumn)
Martin Kidd

**Position:**

Assistant Professor, Supply Chain Management and Logistics

**Research Area:**

Application of analytics (optimization, machine learning, data mining etc.) to strategic, tactical and operational planning and decision making problems in supply chain management and logistics, such as:

- Design and optimization of distribution networks
- Supplier and/or customer coordination/collaboration (e.g. VMI, contract design)
- Large-scale optimization for integrated planning problems (e.g. inventory-routing)

From a methodological point of view, my expertise and interests lie in the application of integer programming, matheuristics, and decomposition techniques.

**Teaching:**

I am teaching the following courses:

- 42457 Supply Chain Management (5 ECTS) (MSc, Autumn)
- 42401 Introduction to Management Science (5 ECTS) (MSc, Autumn)
Allan Larsen

Position:
Professor MSO, Operations Management

Research Area:
Applications of operations research based methodology such as mathematical optimisation, metaheuristics and discrete event-based simulation to planning and management problems within freight transport and logistics.
Specific interests include;
- Distribution planning, city logistics, collaborative logistics, electro-mobility for freight transport
- Transport terminal management and optimisation
- Cold chain logistics
- The digital supply chain
- Optimisation and resource scheduling within public transport

Furthermore, strong interests in the digitalization and automation of the transport and logistics domains within the context of Industry 4.0.

Teaching:
My teaching activities are centered on the following courses:
- 42875/42992 Transport logistics and transport optimization (BSc+BEng, Spring from 2019)
- 42417 Simulation in Operations Management (MSc, June 2018 and onwards)
- 42995 Intelligent Transport Systems (ITS) and project evaluation (BEng, Spring+June) (parts of)
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:

- 42884/42871 Green Transport Logistics (course responsible)
- 42885 Maritime Logistics (parts of)
Bed logistics at a hospital (MSc)

PROJECT SUPERVISOR: Associate professor Peter Jacobsen (peja@dtu.dk)

BACKGROUND: For many hospitals it is a problem to identify where, the beds are at a certain time. It is essential for the hospital to have beds available at the emergency department and not be in a situation where they are running out of clean beds. In addition, the planning of bed cleaning will be easier if the location and identification of the beds are available.

PROJECT DESCRIPTION: The project will look at the status for the hospitals and a literature research both domestic and international. The whole logistics from a patient is hospitalized and requires a bed, moved in the bed to different examinations at different departments, released from the hospital. The bed is then transported to the bed cleaning department and returned to the emergency department ready for a new patient.

PROJECT PURPOSE: The purpose of this project is to identify different technological solutions. Design of different scenarios measuring sensitivity if more beds are necessary or if newer patient treatments require other types of patient transportation. Make a cost benefit analysis and an implementation plan.

PREREQUISITES:

NUMBER OF STUDENTS: 1-2 MSc students (2 projects of 30-35 ECTS Credits).
Distribution of pharmaceuticals at a hospital (MSc)

PROJECT SUPERVISOR: Associate professor Peter Jacobsen (peja@dtu.dk)

BACKGROUND: Hospitalized patients require both customized/individual together with general pharmaceuticals products. The individual products needs to be available when needed. It is time consuming for the employees to keep track of the different types of products at the medicine room, ordering new and return old pharmaceuticals. Besides, they are forced to keep track of the products and an account as soon as the products enter the hospital.

PROJECT DESCRIPTION: The project will look at the status for the hospitals and a literature research both domestic and international and suggest solutions that are more efficient

PROJECT PURPOSE: The purpose of this project is to identify different supply chain possibilities for supplying pharmaceuticals from a supplier to the individual patients at a hospital.

PREREQUISITES:

NUMBER OF STUDENTS: 1-2 MSc students (2 projects of 30-35 ECTS Credits).
Performance of a supply chain (MSc)

**PROJECT SUPERVISOR:** Associate professor Peter Jacobsen (peja@dtu.dk)

**BACKGROUND:** Industry 4.0 is a new production philosophy. In some areas, they are also talking about a supply chain 4.0. Industry 4.0 contains new technological possibilities for companies to produce their products. In order to gain the full benefits the complete logistic chain needs to be considered.

**PROJECT DESCRIPTION:** The project will look at the status for Industry 4.0, possibilities for automation and how the performance of the logistic chain can be enhanced by applying industry 4.0 tools.

**PROJECT PURPOSE:** The purpose of this project is to identify possibilities for enhancing the performance of the logistics by using the industry 4.0 tools.

**PREREQUISITES:**

**NUMBER OF STUDENTS:** 1-2 MSc students (2 projects of 30-35 ECTS Credits).
Car-sharing systems – simulation and optimisation

PROJECT SUPERVISOR: Professor Allan Larsen (alar@dtu.dk)

BACKGROUND: Car-sharing systems such as DriveNow and GreenMobility are gaining popularity in urban environments such as the Copenhagen area. The vision of such systems is to provide the users (citizens) with a very high degree of mobility (access to transport) by the use of an efficient and small fleet of vehicles.

PROJECT DESCRIPTION: The exact thesis topic can be scoped to match the interest of individual the student(s). Examples of relevant issues to study and analyze via either optimization or simulation include (but is not limited to):

- Real-time fleet management – where should the vehicles be parked overnight to serve the demand in the beginning of the day best as possible
- Re-charging incentives – how could users be encouraged to re-charge the vehicle after their trip has ended?
- Balancing parking, charging and flow of trips by dynamic pricing

The project may – if possible – be based on real-life data from a car-sharing service.

PROJECT PURPOSE: The thesis work should build on the newest knowledge from the scientific literature. The thesis should produce an analysis of issues as mentioned above to enlighten future potentials and challenges of car-sharing.

PREREQUISITES: The student(s) should have experience with either applied optimization or simulation modeling. This could for instance have been obtained through the courses such as the optimization courses 42881 Optimisation and Public Transport or 42885 Maritime Logistics or for the simulation methodology via 42417 Simulation in Operations Management (or a similar course).

NUMBER OF STUDENTS: 1-2 MSc students (30-35 ECTS). The project topic may also be scoped to the requirements of a BSc thesis.
Autonomy in Freight Transport and Logistics

PROJECT SUPERVISOR: Professor Allan Larsen (alar@dtu.dk)

BACKGROUND: The freight transport and logistics domain is by many researchers believed to be the first area to take up fully autonomous vehicles due to the nature of freight/goods as well as the continuous urge to cut operational costs in the supply chain.

PROJECT DESCRIPTION: This thesis topic will be scoped after discussions with the student(s) in order to match the methodological background and interest of the student(s). However, two obvious approaches exists for this topic:

1) First-mile logistics – the first steps in the transport chain linking the production/warehousing operations to the transport to a consolidation center, a freight hub or to partner up in a truck platoon.

2) Last mile logistics – the last steps in the transport chain bringing the freight/goods into the final destination, such as the inner part of a big city or a sub-urban mall. This part needs to consider city logistics issues and discuss how automation can be achieved in

This project can either look into small-sized deliveries such as distribution of parcels in e-commerce or large-sized freight transports from/to or between freight terminals.

PREREQUISITES: The student(s) should have experience with either applied optimization or simulation modeling. This could for instance have been obtained through the courses such as the optimization courses 42881 Optimisation and Public Transport or 42885 Maritime Logistics or for the simulation methodology via 42417 Simulation in Operations Management (or a similar course).

NUMBER OF STUDENTS: 1-2 MSc students (30-35 ECTS). The project topic may also be scoped to the requirements of a BSc thesis.
City logistics and urban freight transport

PROJECT SUPERVISOR: Professor Allan Larsen (alar@dtu.dk)

BACKGROUND: Freight transport in large cities is becoming an increasingly challenging task as cities are growing (higher demand), the citizens expect low response time (higher intensity) and traffic congestion is rising (lower travel speed).

PROJECT DESCRIPTION: This thesis topic will be scoped after discussions with the student(s) in order to match the methodological background and interest of the student(s). However, the projects should take departure in the area of last mile logistics, which can be described as the last steps in the transport chain bringing the freight/goods into the final destination, such as the inner part of a big city or a sub-urban mall.

The student(s) will be invited to be part of the research and demonstration project EUFAL, which deals with efficient planning and optimization methods for demonstrating the potentials of using electrical vehicles for commercial urban transport, such as city logistics.

The Danish side of the EUFAL project includes external partners such MT Højgaard and Region Hovedstaden, which will contribute with case studies from real-life.

PREREQUISITES: The student(s) should have experience with either applied optimization or simulation modeling. This could for instance have been obtained through the courses such as the optimization courses 42881 Optimisation and Public Transport or 42885 Maritime Logistics or for the simulation methodology via 42417 Simulation in Operations Management (or a similar course).

NUMBER OF STUDENTS: 1-2 MSc students (30-35 ECTS). The project topic may also be scoped to the requirements of a BSc thesis.
Humanitarian Logistics – the Quest for doing better when the Catastrophe Strikes

PROJECT SUPERVISOR: Professor Allan Larsen (alar@dtu.dk)

BACKGROUND: Humanitarian logistics can be described as the organization of delivery and warehousing of essential goods (foods, medical supplies, materials, etc.) for relief to people living/staying in an area exposed to a natural disaster such as an earthquake, a tsunami or a famine. Timely and efficient logistics operations is considered to be one of the most important tools when recovering from a natural disaster.

PROJECT DESCRIPTION: The thesis topic can be approached in either a qualitative manner or a quantitative manner. Qualitatively oriented projects should carefully study current practices within humanitarian logistics based on the international scientific literature and data from relevant international organizations to map and analyze processes and provide recommendations that improve process/supply chain performance. Quantitatively oriented projects could either take a simulation or an optimization based approach to building a model framework capable of studying specific the efficiency of a number of semi-realistic scenarios emulating a natural disaster. The project may – if possible – involve discussions and possible collaboration with external organizations and companies. The project could also combine a qualitative and quantitative approach.

PROJECT PURPOSE: The thesis work should build on the newest knowledge from both practice and scientific literature and seek to suggest how processes and planning can be improved to respond in a more efficient manner to natural disasters. The thesis should propose new planning or design concepts and/or deliver a simulation framework to test various distribution scenarios.

PREREQUISITES: The need for prerequisites depends on the approach chosen in the thesis. Independent of the approach, the student(s) must possess a good knowledge of and a strong interest in supply chain management. In case a conceptual qualitative approach is chosen, the student(s) should be familiar with the ideas of process optimization, lean concepts, performance measurement and business process management (BPM) through courses such as 42371 Design of Lean Production and Service Systems or 42376 Operations Management in Health Care and Service Systems. Alternatively, if a more quantitative oriented approach is chosen, the student(s) should have experience with simulation models obtained through for instance courses such as 42417 Simulation in Operations Management (or a similar course).

NUMBER OF STUDENTS: 1-2 MSc students (30-35 ECTS). The project topic may also be scoped to the requirements of a BSc thesis.
Reliable and Predictable Bus Transit in Metro Copenhagen

PROJECT SUPERVISOR: Assoc. Professor Steven Harrod (stehar@dtu.dk)

PROJECT ADVISORS: no formal advisors but we have an ongoing relationship with Movia

BACKGROUND: As the Copenhagen transport network becomes more complex and customers attempt to make more complicated journeys (directed by Rejseplanen.dk), the real measure of ride quality is the quality of the connections between services. What makes a reliable journey by bus in Copenhagen? How can Rejseplanen offer more accurate and reliable advice for journeys by bus? Where are the “hotspots” in the bus network?

PROJECT DESCRIPTION: DTU is a participant in the IPTOP research project and has access to years and millions of rows of bus operating data. This data should be studied to find interesting patterns of delay, and significant factors in the reliability of connections at major hubs like Hillerød, Nørreport, and Hørsholm Midpunkt. Using database and statistical analysis tools, the data should be organized and studied to find causes of delay by route, time of day, and bus operator. The results of the analysis could actually be applied in real management of the bus network through the IPTOP project. Students will be introduced to contact persons at Movia.

PROJECT PURPOSE: The overall project purpose is to a) identify critical transfer points in the network, b) identify bus route performance trends that require management attention, and c) look for mathematical methods to better predict the journey times and connection reliability of likely customer journeys.

PREREQUISITES: Knowledge of statistics and hypothesis testing. Skills in at least one of: database management or statistical analysis software.

NUMBER OF STUDENTS: 1-2 MSc Students (30-35 ECTS)
MSc Thesis Project in Maintenance Planning at Banedanmark

**Title:** Planning of Major Track Renewal Projects

**Description:** Banedanmark is the owner and manager of most of the railway track in Denmark. Every year, some segments of track require significant renewal over many kilometers, and this work can not be accomplished during a few hours of low train traffic at night. This work is most often performed by contractors, maintenance specialists outside of Banedanmark. These renewal projects require very large and complex automated track removal and installation machines, that also complicate the scheduling because they are difficult to move from place to place.

Each year, the planning process contains two major tasks: identification of the track segments requiring work, and selecting and sequencing the segments into the available work time. There are two objectives: optimal timing for the repair of the track segments, to obtain the longest service life from those segments, and optimal movements of the track machinery, to obtain the most productive use of the machine with the least wasted time in relocation.

Maintenance operations are scheduled to take a variety of parameters into consideration, e.g.:

- Most possible maintenance actions in the time period the heavy machinery is available (maximize utilization)
- Timetabled train traffic operations should be affected as little as possible (minimize line closure)
- Working time rules for the machine crews must be respected (adhere to contract and labor agreements)
- The heavy machinery must not be present on main tracks when the morning rush hour begins (control risk of work delays exceeding agreed line closures)

**Project goals:** The result of the project should be a planning model, most likely a mathematical model, which can plan either an optimal or improved renewal schedule over a 3 month planning horizon. The model should integrate with other Banedanmark data sources and planning tools.

**Qualifications:** This project contains elements of planning and optimization. Therefore it is expected that the student(s) has/have experience in the field of operations research (OR). Furthermore it is an advantage to have a basic knowledge of railway operations and railway timetabling. Skills in programming and database (SQL) are also desirable and can be discussed further with the advisor.

**Contact person at DTU:** Steven Harrod, Department of Management Engineering

**Contact person at Banedanmark:** Portfolio manager, MSc, Niels Munk Jørgensen
Optimal Inventory in a Job Shop with Forbidden Early Shipment

PROJECT SUPERVISOR: Assoc. Professor Steven Harrod (stehar@dtu.dk)

PROJECT ADVISORS: none

BACKGROUND: Much classical manufacturing, job shop, or flow shop analysis presumes that minimizing flow time and releasing finished product as soon as possible is optimal. However, a true “just in time” supply chain demands that product is NOT shipped early. This is called “forbidden early shipment”. Holding flow back until the promised ship date disrupts the assumptions in classical queuing models, and requires an alternative analysis.

PROJECT DESCRIPTION: This project starts with a reading of a large volume of literature in the modeling of flow shops.

PROJECT PURPOSE: The overall project purpose is to a)

PREREQUISITES: Knowledge of discrete event simulation software such as AnyLogic or Rockwell Arena

NUMBER OF STUDENTS: 1-2 MSc Students (30-35 ECTS)
Cause Analysis of Danish Railway Delays

PROJECT SUPERVISOR: Assoc. Professor Steven Harrod (stehar@dtu.dk)

PROJECT ADVISORS: no formal advisors but we have an ongoing relationship with Banedanmark and DSB

BACKGROUND: Railways are complex transport services with many inter-linking parts. It is not always clear what the “cause” of a particular incident is. It is sometimes difficult to take management action because so many problems require attention and it is not clear what the most important task is.

PROJECT DESCRIPTION: DTU is a participant in the IPTOP research project and has access to years and millions of rows of railway operating data. This data has some information on the possible causes of train delays, but it is unclear if the cause originates on the listed train or actually results from other trains at other locations or times. This data should be studied to find interesting patterns of delay, and significant causes of delay that affect other trains through what are called “secondary delays”. Using database and statistical analysis tools, the data should be organized and studied to find causes of delay by route, time of day, and recorded cause. The results of the analysis could lead to management improvements and better timetable design. Students will be introduced to contact persons at Banedanmark and DSB.

PROJECT PURPOSE: The overall project purpose is to a) identify how delays in one train create delays in other trains, b) identify trends in delays by recorded cause label codes, and c) identify critical trains and locations for management action.

PREREQUISITES: Knowledge of statistics and hypothesis testing. Skills in at least one of: database management, OpenTrack, or statistical analysis software.

NUMBER OF STUDENTS: 1-2 MSc Students (30-35 ECTS)
Open Problems in Dynamic Vehicle Routing (MSc)

SUPERVISOR: Professor Harilaos N. Psaraftis (hnpsar@dtu.dk)

BACKGROUND: Dynamic vehicle routing problems (DVPRs) are defined as vehicle routing problems in which problem inputs are received and updated concurrently with the execution of the route. Such problems find applications in many transport contexts, such as city logistics, dial-a-ride systems, courier services and others. DVRPs may or may not involve stochasticity in the input data. Research in this area has grown strongly over the years and many methods and techniques have been developed. A recent survey paper has surveyed more than 100 papers and developed a taxonomy for this class of problems according to 11 criteria. Numerous open problems that merit investigation have been identified.

PROJECT PURPOSE: The purpose of this project is to advance the state of the art in DVRP methodology.

PROJECT DESCRIPTION: A thesis in this area will investigate one or more of the open problems in this area. These include further analyzing the “Dynamic Travelling Salesman Problem”, analyzing of the worst case or average performance of heuristic algorithms, including vehicle speed as a decision variable, looking at environmental criteria, exploring alternative objective functions, better exploiting ICT technologies and modifying known approaches so as to obtain better solutions, or exploiting any other idea related to DVRPs.

PREREQUISITES: Knowledge of a programming language (C++, Java, or other). 42887 Vehicle routing and distribution planning.

NUMBER OF STUDENTS: 1-2 MSc students (30 ECTS Credits).
Decarbonization pathways for international shipping (MSc)

PROJECT SUPERVISOR: Professor Harilaos N. Psaraftis (hnp@dtu.dk)

BACKGROUND: International shipping accounts for 2.2% of anthropogenic CO₂ emissions, and produces some 796 million metric tons of CO₂ per year (2012 fleet data). Much regulatory activity is tasked to find ways to significantly reduce CO₂ and other greenhouse gas (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). At the same time, the EEDI is plagued with various problems, which will substantially limit its effectiveness for reducing GHG emissions from ships in the future. Several other measures have been proposed, but none is expected to guarantee GHG reductions in the years ahead. In that sense, significant GHG reduction for shipping is only a wish at this point in time.

PROJECT PURPOSE: The purpose of the project is to identify viable pathways to reduce GHG emissions from ships and place them in context vis-à-vis current regulatory activity at the IMO, the EU and other bodies.

PROJECT DESCRIPTION: This project will review technical, logistics-based and market based measures that can potentially achieve significant GHG reductions for the world fleet. Obstacles for implementing such measures will be identified and the analysis will be made on selected ship and fleet scenarios. Interaction with new project ShipClean is foreseen.

PREREQUISITES: A minimum knowledge of maritime transport. Optionally: 42884 Green Transport Logistics

NUMBER OF STUDENTS: 1-2 MSc students (30 ECTS Credits).
Monitoring, reporting and verification (MRV) of CO₂ maritime emissions and emissions allocation (MSc)

PROJECT SUPERVISOR: Professor Harilaos N. Psaraftis (hnpsar@dtu.dk), Postdoc George Panagakos (geopan@dtu.dk)

BACKGROUND: The purpose of MRV is to monitor the energy efficiency and CO₂ emissions of the world merchant fleet. In order to document and track global energy efficiency gains, data from ships must be collected and a robust data collection and reporting system must be established. There are currently two MRV systems at play. The EU has adopted Regulation 2015/757, the implementation of which is currently under way. The Regulation applies to vessels above 5,000 gross registered tons (GRT) of all flags conducting voyages into, out of and between EU ports and will require annual reporting of their CO₂ emissions in line with an approved monitoring plan. The IMO MRV track has some key differences with the EU scheme, mainly on cargo reporting which is considered mandatory in the EU scheme whereas this is not the case at the IMO level. The EU MRV Regulation has a clause that it may revert to the IMO scheme in case the latter is deemed satisfactory, but at this point in time the two regimes are different and it is not clear if or when they will be harmonized. An additional challenge to the emission allocation mechanism of MRV pertains to the Ro-Ro vessels due to the multiplicity of the vehicles carried and the passenger/cargo combination (in the case of Ro-Pax).

PROJECT PURPOSE: The purpose of this project is to assess the status and prospects of MRV in maritime transport and analyze some scenarios as regards its implementation.

PROJECT DESCRIPTION: The project will review the two MRV systems that are currently at play (IMO and EU) and will assess key differences and implementation difficulties. Alternatives for a harmonized regime will be examined. The issue of emissions allocation, that is, how emissions generated by the ship are allocated among cargo, passengers and possibly other accounts associated with the ship will be examined. Links to possible Market Based Measures (MBMs) will be explored. Analysis will involve several ship scenarios.

PREREQUISITES: A minimum knowledge of maritime transport. Optionally: 42884 Green Transport Logistics

NUMBER OF STUDENTS: 1-2 MSc students (30 ECTS Credits).
Impact of global sulphur cap on carbon dioxide emissions (MSc)

ADVISOR: Professor Harilaos N. Psaraftis (hnpsar@dtu.dk).

BACKGROUND: When the new MARPOL Annex VI requirements come into force on 1/1/2020, all ships must switch from Heavy Fuel Oil (HFO) with typically 3.5% sulphur, to cleaner fuels with lower sulphur content (0.5%), or they have to clean air emissions at the ship’s exhaust via scrubbers to a level that corresponds to 0.5% sulphur.

Cleaning on board will take place in a scrubber that cleans the sulphur out of the exhaust. This scrubber is expensive in capital costs and also generally increases the engine’s carbon dioxide (CO₂) consumption and hence also fuel cost and CO₂ emissions.

Alternatively, if one removes the sulphur at the refinery level, there will be increased CO₂ upstream on the refinery, due to the energy required to remove the sulphur.

On top of this, more expensive low sulphur fuel may result in modal shifts which could ultimately increase CO₂ in the supply chain.

Last but not least, sulphur emissions result in radiative cooling in the atmosphere, hence reducing them might potentially reduce the cooling effect and potentially add to the greenhouse gas global warming effect.

The possible effects of all of the above are currently not well understood, nor is it clear which option is better. However, there is an urgent need to know better in view of the impending cap on 1/1/2010.

PROJECT PURPOSE: The purpose of this project will be to assess the potential implications of the global sulphur cap on CO₂ emissions. The focus will be the scrubber vs cleaner fuels choice.

PROJECT DESCRIPTION: Various scenarios will be examined concerning types of ships, fuel production location, and alternatives on how the global sulphur cap will be met. A cost benefit analysis will be conducted, in terms of various KPIs. The student will work closely with industrial and government stakeholders.

PREREQUISITES: A minimum knowledge of maritime transport. Permission of supervisor, or 42884 Green transport logistics.

NUMBER OF STUDENTS: 1-2 MSc students (30 ECTS Credits).
Optimizing Vessel Speed Reduction Programmes (VSRP) (MSc)

PROJECT SUPERVISORS: Professor Harilaos N. Psaraftis (hnpsar@dtu.dk); Postdoc Thalis Zis (tzis@dtu.dk)

BACKGROUND: Regulatory bodies and port authorities have been developing green agendas that seek to reduce shipping emissions in areas near ports. This can be achieved through the use of clean fuel and technologies, as well as through changing the operating patterns of the vessels near the port and specifically reducing sailing speed. While emissions per vessel call are reduced through compliance to such programs, there may be time penalties and increased operating costs for ships.

PROJECT DESCRIPTION: This project considers the emissions reduction potential of VSRP to enhance the environmental performance of ports. The implications of a complying decision to the ship costs need to be identified (e.g. costs due to delays, technological investments, increased fuel consumption) and compared with the emissions reduced at the port. The option of a convincing monetary incentive provided by the port authority to the ship operator will be considered. It is expected that the value of the incentive will influence the ship operator's decision to participate or not in the proposed emissions reduction measure. The research question can be formulated as an optimization problem whereby the objective is the maximization of emissions reduction, or the minimization of the cost per abated ton of pollutant.

PROJECT PURPOSE: The purpose of this project are to enhance an existing model that predicts emissions savings from port authority programs with a cost benefit analysis that minimizes the cost per abated ton of pollutant emissions near the port. The decision variables in the proposed optimization problem will depend on the examined policies during the project.

PREREQUISITES: At least one of the following: 42885 Maritime logistics, 42884 Green transport logistics. Some Programming experience desirable.

NUMBER OF STUDENTS: 1-2 MSc students (30 ECTS Credits).
Application of Game Theory for increasing compliance rates in environmental regulation

**PROJECT SUPERVISORS:** Postdoc Thalis Zis (tzis@dtu.dk); Professor Harilaos N. Psaraftis (hnpsar@dtu.dk);

**BACKGROUND:** The existing legislative framework poses several challenges, stemming (mainly) from a highly non-homogeneous and spatially differentiated system, with cases where the penalty fines are as low as the benefit that the violator enjoyed from not complying.

**PROJECT DESCRIPTION:** This project considers the options of ship operators to comply with the low sulphur fuel requirements in place. The ship operator can either use low-sulphur fuel, invest in scrubber systems, or disregard the regulation and risk the penalty if caught. At the same time, a regulatory body has the option to inspect or not, vessels within its jurisdiction to examine whether they comply with the regulation. The task of the MSc thesis will be to analyze the status quo of enforcement in different countries, where the regulation applies, and use a game theoretic approach for a uniform violation fine system.

**PROJECT PURPOSE:** The purpose of this thesis is to complement work undertaken in a new research project entitled “SulphurGATE”. The main tasks involve data collection and analysis, as well as the formulation of a simplified mixed strategy game to examine improved penalty systems, through identification of the resulting equilibria.

**PREREQUISITES:** At least one of the following: 42885 Maritime logistics, 42884 Green transport logistics. Some Programming experience desirable.

**NUMBER OF STUDENTS:** 1-2 MSc students (30 ECTS Credits).
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)

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
Identification and quantification of Complexity cost at ETO company

The Case company produce highly complex and customized printing solutions for the B2B market. They are working with Product Modularity and are able to customize a high degree of each project (ETO product) with standard modules. But to support their customer’s needs, almost all projects have a non-standard customization need.

The purpose of this project would be to identify and quantify the complexity drivers related to these non-standard customizations, to calculate the true performance of ETO projects (including complexity cost) and based on these learnings define a complexity categorization/index of non-standard customizations that can be the basis for improved cost estimation for these. As well as identify the need for data collection, so the company will be able to follow up on complexity cost in the future.

Contact Sara Helene Markworth Johnsen at shmj@dtu.dk for more information regarding the project.

Prototyping a Sales Configuration System at ETO company

The Case company produce highly complex and customized printing solutions for the B2B market. They are working with Product Modularity and are in the process of defining a new product platform. Currently their Order specification process is based on cost estimations in excel sheets and manual product configuration, and they see a need for a configuration system.

The purpose of this project would be to develop and test a Sales configuration system prototype to improve the cost estimation in the sales phase as well as the configuration process of ETO projects.

This would require mapping the Product Family Master Plan for the new product platform. Identifying configuration rules and creating a configuration system prototype in a configuration software.

Contact Sara Helene Markworth Johnsen at shmj@dtu.dk for more information regarding the project.
PROJECTS WITH NCC

Bachelorprojekt - Altaner
Altaner har i dag en betydelig rolle i boligbyggeriet, hvor de bruges som en væsentlig del af det arkitektoniske udtryk og "lækkerhed" af lejligheder. Altanerne herunder altanophængene skal projekteres i forhold til krav til isolering (kuldebroer), statik og arkitektur, dette betyder at projekteringen af altaner udgør en væsentlig del af særøg statikprojekteringen. I NCC ønsker vi at ensrette vores måde at arbejde med altaner på. Bachelorprojektet vil handle om at etablere en produktfamilie for altaner, særligt altanophæng, samt at vurdere mulighederne for at etablere et konfigureringsystem til at støtte projekteringsprocessen. Arbejdet vil foregå under vejledning fra NCC’s afdeling for Innovation og Koncepter og i samarbejde med NCC Konstruktionsprojektering.

Master project – Daylight configurator
NCC has for some time been developing a configuration system for handling of daylight conditions. Daylight is a very important factor of the early design phases of a project. Several master theses have worked on this and have shown good results in relation to the possibility to develop a configuration system that includes parameters such as the window share of the façade, glazing type, room height, room depth, building shape, building height, external shades and more. The daylight requirements in the building code have been updated and therefore the configuration system needs to be updated accordingly and at the same time upgraded with more features, as the current configuration is fairly limited. NCC wants to continue establishing configuration systems in cooperation with DTU students, including the new requirements and calculation methods. The work will be supervised by NCC Engineering based in the sections Innovation and Concepts as well as HVAC design.

Please contact Anders Kudsk aku@ncc.dk at NCC for further details or contact supervisor Professor Lars Hvam lahv@dtu.dk
Modeling of IT services and its complexity impact (MSc)

PROJECT SUPERVISOR: Professor Lars Hvam (lahv@dtu.dk)

BACKGROUND: Today, IT services are becoming a central part of the business strategy for both the service industry and traditional manufacturing companies as IT services are used to enable or support business processes. Compared to the rigid structure of a production system, the IT enterprise architecture and computing infrastructure has the advantage of having a quite flexible setup, meaning that making an extra effort to fulfil a customer request may be an easy step to take and something the customer expects. Given the customized nature of IT services, companies can ultimately increase their service portfolio rapidly without paying much attention to its consequences, especially to a steady increase of complexity and its impact on profitability. Complexity management is therefore becoming a core part of the management agenda aiming to help companies to not miss out on profits due to non-value adding complexity costs.

PROJECT DESCRIPTION: During a case study, the Master thesis student will investigate the design of IT services or IT service management processes at a case company and relate them to cost or complexity impact. DSV A/S could serve as a case company. However, students are very welcome to bring in their own case company or IT project as basis for the thesis.

PROJECT PURPOSE: The purpose of this project is to identify how IT services can be delivered in a cost-transparent way and how non-value adding complexity costs during the lifecycle of an IT service can be identified and reduced. Therefore, different IT service models and IT service management frameworks will be applied to an existing IT service to identify the costs of delivering an IT service.

PREREQUISITES: Affiliation to IT, no coding skills required.

NUMBER OF STUDENTS: 1-2 MSc students (2 projects of 30-35 ECTS Credits).

Contact Franziska Schorr at (frsc@dtu.dk) for more information regarding the project.
MSc Projects at Configit A/S, 2018-2019

Background:
Configit is a trusted leader in Configuration Lifecycle Management (CLM), providing market-leading global manufacturers with business-critical solutions for the configuration of complex products. Based on the patented Virtual Tabulation (VT)™ technology, Configit’s solutions enable companies to reduce time to market, increase quality of configurable products, and improve process efficiency.

Assignment:
Configit offers CLM solutions to the market. CLM supports the management of multi model configurations and related data, as it covers the application of configuration and related data in all the different life cycle phases of configurable products and services. Integrating the configuration systems by using a CLM system is expected to lead to better defined outputs from the systems (e.g. Bills-of-material), and consequently to increased efficiency in e.g. the production and after service, as the specifications are more correct, complete and understandable. Since standalone configuration systems are already a proven concept both in theory and practice, this project aims to highlight additional benefits of utilizing a CLM system to improve the economic justification within a feasibility study for its adoption, and consequently sharpen its scope and set-up to improve its success rate.

Focus areas of the projects are, but not limited to:

- Benefits and impact of utilizing a CLM system.
- Scope and set-up a CLM system.
- Integration of CLM system.

Contact info:
Project supervisor: Professor Lars Hvam (lahv@dtu.dk)

Contact Anna Myrodia at amyrodia@configit.com for more information regarding the project.

For more information about Configit and CLM, visit the website: https://configit.com/.
Value Creation with Virtual Reality/ Mixed Reality (VR/MR) at Haldor Topsoe A/S

Supervisor: Professor Lars Hvam

Background: Recent developments emphasize the rise of a new technology that is termed ‘Wearable Augmented Reality Devices’, where Augmented Reality Smart Glasses (such as Microsoft HoloLens or Google Glass) represent prominent examples. These technologies offer huge innovation potential for companies, societies and especially Engineer-To-Order (ETO) companies. Augmented Reality Smart Glasses (ARSGs), such as Google Glass or Microsoft HoloLens, have recently gained increasing attention. Broadly speaking, ARSGs are new wearable augmented reality (AR) devices that capture and process a user's physical environment and augment it with virtual elements.

Consumers and media have discussed the advantages and potential concerns of this technology for individuals and society as a whole, such as data security concerns (Fodor and Brem 2015). However, academics and managers call for early market knowledge to gain a better understanding on the mechanisms that drive this promising technology. In these critical phases, knowledge about the opportunities and challenges created by this technology might increase the probability of successful implementation, decrease the probability of product failures, and consequently increase diffusion speed. However, early knowledge can provide an advantage for companies that might increase efficiency when using ARSGs (Hein and Rauschnabel 2016).

Most studies have focused on other applications of VR/MR on training systems, healthcare, tourism, marketing, product design and other industries. However, this project will focus into how these technologies may increase firm value and further change the behaviors of consumers and adopters in Haldor Topsoe. This project may address the available literature on strength and weaknesses of VR/MR technologies. Moreover, the study uses Haldor Topsoe as the case company to address how VR/MR can improve the performance of available tasks at the company and what will be the challenges.

Assignment: Haldor Topsoe is in the initial phase of benefiting from VR/MR technologies with proof of concept project both to introduce the technology to the company and evaluating the best areas for this investment. Therefore, this research requires a distinction between internal and external value creation factors. It is necessary to explore and assess the barriers and challenges on the way to be able to find the most profitable areas. Hence, we are looking for two MSc-students that can help us do the following:

1. To determine the internal value creation factors affecting the ways a firm’s employees effectively use smart glasses (VR/MR). The internal section could be R&D, collaborations, different equipment or process efficiency, automation in integration with other expert systems, etc.

2. To examine how companies can create external value and consequently increase revenues by offering applications for VR/MR that can be used by consumers or for
interactions with customers. External areas could be the new apps, customer interactions an etc.

3. To investigate challenges and barriers limiting the technology. These barriers may include technological barriers such as software and application barriers, lack of standards and high-speed internet and specific barriers for Haldor Topsoe and organizational barriers related to the culture of the company.

The aim of this research is to discuss a new and promising technology in the very early stages of development in an ETO company. The significance of academic and industrial contribution would make more companies to consider the development and application of this technology as their strategic future vision.

Who are you?

You communicate well and you can work independently. You have a good understanding of VR and MR and you can work with the related hardware and software. You have a systematic approach to find the relevant literature and help the company to pave the way for these technologies. If you are interested in this project, please contact sara@topsoe.com
Vehicle routing with cross-docking

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

BACKGROUND: A common problem in real world transport optimization is the option of cross-docking. The production of goods takes place at factories from which the goods can be distributed directly to the customers. Often however it may be fruitful to divide the distribution into two “legs” where the goods are transported to a cross-docking location and then repacked onto a different vehicle and transported to the customers.

It is of great interest to consider the option of cross-docking while solving these vehicle routing problems.

PROJECT ASSIGNMENT: Given real-life VRP data including factory and cross-docking locations. The student should construct an algorithm for solving the VRP which should be able to consider which orders should be cross-docked and which should not.

PREREQUISITES: OR courses, especially useful one is 42887 (Vehicle Routing and Distribution Planning), good programming skills

Vendor managed inventory

**PROJECT SUPERVISOR:** Assistant professor Martin Philip Kidd ([mpki@dtu.dk](mailto:mpki@dtu.dk))

**BACKGROUND:** In this route planning problem a number of fixed customers is serviced at regular intervals. Each customer has a stock of goods (e.g. petrol) that they gradually consume over time. It is necessary to refill the stock of the customers before they run out. However, the time at which the customers are refilled will determine both the size of the order that should be delivered as well as the expected interval before another delivery is needed.

The biggest challenge in this type of planning scenario is not solving the route planning problems themselves, but determining the right day for visiting the customers.

**PROJECT ASSIGNMENT:** Given real customer data including known stock levels and consumptions, the task is to design and test various strategies for when customers should be visited.

**PREREQUISITES:** OR courses, especially useful one is 42887 (Vehicle Routing and Distribution Planning), good programming skills

**NUMBER OF STUDENTS:** 1-2.
Auction theory

PROJECT SUPERVISOR: Assistant professor Martin Philip Kidd (mpki@dtu.dk), Professor Jesper Larsen (jesla@dtu.dk)

BACKGROUND: Kopenhagen Fur solely sell furs through auctions. 5 times during the year approx. 30 million skins are sold on auction at Kopenhagen Fur, making KF by far the biggest fur auction house in the work. The mink farmers’ turnover come from these auctions. The selling method is based on very high tacit knowledge among our auctioneers.

PROJECT ASSIGNMENT: Come up with methods to improve the average selling bid. Through video analysis, auction room behaviour, data analysis etc. Develop operational theories that can help KF auctioneers to improve the selling bid.

PREREQUISITES: Game theory would be an advantage, but is not essential

NUMBER OF STUDENTS: 1-2 MSc students (2 projects of 30-35 ECTS Credits).
Machine learning for fur quality detection

PROJECT SUPERVISOR: Assistant professor Martin Philip Kidd (mpki@dtu.dk), Professor Jesper Larsen (jesla@dtu.dk)

BACKGROUND: Kopenhagen fur sort their mink skins by quality manually using a mostly visual process. The project will look into ways to better subdivide the quality and speed up the process for a limited subset of the incoming mink skins. The quality can be subdivided into several manually detectable features.

PROJECT ASSIGNMENT: Setting up a machine learning strategy to improve the classification success rate for one or more manually detectable features. The assignment will consist of:

- Selecting filters and features on images of mink skins
- Analyzing, selecting and implementing an adaptable machine learning strategy like neural network, nearest neighbor, SVM etc.
- Finetuning the image acquisition process to optimize the results

PREREQUISITES: Operations Research, basic knowledge on machine learning. Programming ability is an advantage.

NUMBER OF STUDENTS: 1-2 MSc students (2 projects of 30-35 ECTS Credits).
Creating value for DSB through SAP S/4HANA and redesign of accounting processes aligned with company strategy

PROJECT SUPERVISOR: TBD
CO-ADVISOR: TBD
INFORMATION: Contact Prof. Allan Larsen (alar@dtu.dk).

BACKGROUND:
Can an accounting system based on innovative technology make an organization more competitive and increase efficiency? How is DSB a different organization after the implementation of project FRØ – Fremtidens Regnskab og Økonomi? Replacing a legacy accounting system including related financial/accounting processes was initiated in 2014, however what has been the tangible and intangible effects and results? FRØ is a complex and high-risk project, which affects the core of DSB as an organization and the ability to deliver ‘trains on time’ with a high degree of attention from the board of directors and other important stakeholders. Did the FRØ-project deliver the defined goals and results to DSB as expected?

THE PROJECT:
You will focus on a cost benefits analysis on the FRØ project and its implications and clear value adding benefits. The focus should also be whether the use of new innovative technology aligns with the overall strategy in DSB or not, only supported by a business case. Your focus should be on identifying the tangible and intangible variables of why SAP S/4HANA as a modern accounting system is beneficial and creates competitive advantages for DSB. Applying IT strategy, organizational (e.g. theory of the firm) and corporate managerial economics theory aligned with an economical perspective is recommended.

Alternatively, processes and sub deliveries could also be taken into consideration in the analytical process since a redesign of normative structures and habits has been key part of project FRØ. A managerial approach where organizational and managerial theory can be applied is also seen as potential focus. Your focus should be on identifying tangible variables that has contributed to the current state of DSB Finance department, both negative and positive. Using a process perspective could also include e.g. methodology such as SCRUM or PRINCE 2.

Your job will be to include new ideas on what could have been done differently to optimize efficiency and benefits. That being technology, processes or products. And present what you believe should be a recommendation for future initiatives strategic, technology and product wise. Your job will also include a business case presentation of why FRØ has been a success or a failure. What are the generic business case for choosing the platform of SAP S/4HANA for other organizations?

LEVEL: Best suited for an MSc thesis, however can be applied a BSc project as well.

NUMBER OF STUDENTS: 1 preferred, potentially 2 if agreed upon.
Transport Project Evaluation: Decision Support and Multi-Criteria Decision analysis (MSc)

PROJECT SUPERVISOR: Associate professor Michael Bruhn Barfod (mbba@dtu.dk)

BACKGROUND: Recent research has shown that conventional cost-benefit analysis is inadequate as a decision support tool for appraising transport infrastructure projects as it fails to capture criteria of a more strategic and qualitative character. Multi-criteria decision analysis (MCDA) can be applied to the appraisal scheme to deal with this issue.

PROJECT DESCRIPTION: Current research deals with the difficult task of identifying the most suitable decision aids for supplementing the cost-benefit analysis. Several MCDA techniques have been suggested suitable for decision making in the transport sector when dealing with selections among a limited number of alternatives. However, these techniques become inappropriate when dealing with large a number of alternatives and criteria such as in a screening phase.

PROJECT PURPOSE: The purpose of this project is to look into the possibilities of using outranking methods belonging to the so-called constructive MCDA approach. These methods are able to handle a large number of alternatives and criteria simultaneously using a sort of voting mechanism. The different methods can be applied to a suitable case study and the results can be benchmarked against the outcome of a conventional analysis.

PREREQUISITES: 42879 Decision support & Risk analysis.

NUMBER OF STUDENTS: 1-2 MSc students (2 projects of 30-35 ECTS Credits).
Transport Planning: Decision Support and Planning workshops (MSc)

PROJECT SUPERVISOR: Associate professor Michael Bruhn Barfod (mbba@dtu.dk)
PROJECT ADVISORS: Professor Steen Leleur (stle@dtu.dk)

BACKGROUND: Tendencies in the transport sector has revealed a growing need for involving stakeholders more in the decision support process in order to capture all aspects of the very complex decision problems. Planning workshops has been suggested to deal with this issue by gathering relevant stakeholders and decision makers with the purpose of generating a fruitful discussion to improve the final decision making.

PROJECT DESCRIPTION: Planning workshops consist of three main elements: group processes, decision analysis and information technology. The purpose is to link these three elements and use the best from each of them in the decision support process. The composition of such a workshop will, however, depend on the decision context, the participants’ affiliations, the participants’ level of power, and many other issues.

PROJECT PURPOSE: The purpose of this project is to test how the planning workshop concept can be used for real decision support. The implementation of the concept can be tested through a current running decision problem, where workshops e.g. can be held on different levels (citizens, municipality, regional, or organizational) to improve the actual decision support in form of more diverse and detailed information to the final decision makers.

PREREQUISITES: 42879 Decision support & Risk analysis.

NUMBER OF STUDENTS: 1-2 MSc students (2 projects of 30-35 ECTS Credits).

NB! A smaller version of the project can be aligned to suit both BSc and BEng student theses.
Integrating life-cycle assessment into transport cost-benefit analysis (MSc)

PROJECT SUPERVISOR: Associate professor Michael Bruhn Barfod (mbba@dtu.dk)
PROJECT ADVISORS: Post Doc Stefano Manzo (stman@dtu.dk)

BACKGROUND: Traditional transport cost-benefit analysis commonly ignores the indirect environmental impacts of a project deriving from the overall life-cycle of the different project components. Such indirect impacts are instead of key importance in order to assess the long-term sustainability of a transport project. In the present study we suggest to overcome this limit by combining life-cycle assessment approach with standard transport cost-benefit analysis.

PROJECT DESCRIPTION: Based on the outcome from the Brundtland report (UN, 1987), Holden et al. (2013) derived four main dimensions of sustainable development: satisfaction of human needs, intra- and intergenerational equity and longterm ecological sustainability. Having the latter dimension in mind, it can be argued that traditional transport project evaluation frameworks commonly fail to provide decision makers and stakeholders with a complete picture of the full environmental costs deriving from the implementation of transport projects. In fact, while direct environmental costs, such as air pollution from vehicles operation, are normally included in the project evaluations, indirect environmental costs, such as the energy and emissions associated with vehicle manufacturing, are usually not. The indirect environmental costs derive from the entire life-cycle of the project components and are commonly quantified in studies on sustainability through Life-Cycle Assessment (LCA) techniques.

PROJECT PURPOSE: The aim of the present study is to fill this gap by, first, outlining a framework combining LCA and CBA and, second, implementing a case study to compare the results from a standard CBA and the suggested framework. As first step, a tool developed to implement transport projects CBA will be applied and tested. Then, a case study e.g. referring to the planned construction in Frederikssund (Denmark) of a new road bridge across the Roskilde Fjord can be analysed.

The effects of the new infrastructure on the overall Danish transport system are then estimated by using the Danish National Transport Model (NTM), an activity-based model meant to establish a unified reference model for transport policy analyses and project evaluations in Denmark.

PREREQUISITES: 42879 Decision support & Risk analysis

NUMBER OF STUDENTS: 1-2 MSc students (2 projects of 30-35 ECTS Credits).
Supporting Copenhagen Green Mobility initiatives with state-of-the-art decision support tools (MSc)

PROJECT SUPERVISOR: Associate professor Michael Bruhn Barfod (mbba@dtu.dk)

EXTERNAL ADVISOR: Annette Kayser, Project Manager, City of Copenhagen, Technical and Environmental Department

BACKGROUND: Sustainable transport appraisal and planning is a complex socio-technical challenge. Copenhagen municipality is currently revising their 2012 “Action Plan for Green Mobility” that included 25 initiatives as part of its green mobility package. The selection and prioritization of these measures was complex and difficult to operationalize in practice. A set of criteria for the selection of the initiatives was defined, including green mobility, environment, safety, city life and health. However the qualitative nature of the judgments and the different priorities between stakeholders made it difficult to provide a fact-based approach with clear results to bring to decision-makers. There is thus a need for revising this plan by applying decision-support tools and scenario analysis to prioritize the proposed measures and review the plan according to a more systematic and transparent process. Such tools can help highlight differences but also potential overlaps in preferences between stakeholders – and thus provide maneuver for negotiation and improve the decision-making process.

PROJECT DESCRIPTION: In this project you will review and assess the current initiatives as described in the “Action Plan for Green Mobility”. With input from the Technical and Environmental Department, the criteria for success will be reviewed and defined based on sustainability principles and applicable sustainable mobility goals for the municipality. Using AHP (Analytic hierarchy process, or similar complex decision-support tool), the judgments for the prioritization of the criteria for each type of stakeholders will be collected through various means (past data, survey, interviews etc). The expected performance of each initiative will also be assessed through expert evaluations. The project concludes with an improved, systematic and transparent decision-support process and impact assessment for Copenhagen’s new “Action Plan for Green Mobility”.

PROJECT PURPOSE: The purpose of this project is to provide the Technical and Environmental Department of Copenhagen Municipality with a state-of-the-art decision-support tool for complex, multi-stakeholder, assessment of sustainable mobility initiatives.

PREREQUISITES: 42879 Decision support & Risk analysis

NUMBER OF STUDENTS: 1-2 MSc students (2 projects of 30-35 ECTS Credits).
Smart parking in Copenhagen (MSc)

PROJECT SUPERVISOR: Associate professor Michael Bruhn Barfod (mbba@dtu.dk)

EXTERNAL ADVISORS: Annette Kayser and Kasper Brenøe Isbrand, City of Copenhagen, Technical and Environmental Department

BACKGROUND:
Since 1995 the number of cars in Copenhagen has increased with 40% and there are no indications that the development will stop within the near future. On the contrary it seem that the already desperate situation will worsen further in the years to come. A part of the explanation on this development is the extensive urban renewal which has attracted socioeconomically more advantaged families to the city. The establishment of parking spaces has, however, not followed the rapid increase in cars, and Copenhagen is for this reason struggling with problems related to an insufficient number of parking spaces.

PROJECT DESCRIPTION:
The project is focused on establishing a new, smart parking strategy for Copenhagen aiming at optimizing the parking space usage, improving the efficiency of parking operations and help traffic in the city flow more freely. Several technological solutions already exist within private parking companies that allows the users to pay using an app and/or guide the user to a parking house with empty spaces. However, a more comprehensive solution that includes all parking spaces in the city on a common platform does not exist.

PROJECT PURPOSE:
The purpose of this project is to propose a frame for a common, comprehensive platform that aims at improving the issues above. In this respect it will be necessary to consider both current technological options and governance issues related to such a task. The smart system will need to work in an environment with many stakeholders as well as political barriers. A key issue will be to propose a system that can mediate between the different interests of conflict.

PREREQUISITES:
NUMBER OF STUDENTS: 1-2 MSc students (30-35 ECTS Credits).
Sustainable highway rating systems – a comparative analysis (MSc)

PROJECT SUPERVISOR: Associate professor Michael Bruhn Barfod (mbba@dtu.dk)

BACKGROUND: There is increased interest in assessment frameworks and tools that can support an evidence-based transition towards a sustainable transport paradigm. In the US, frameworks such as the Federal Highway Administration Infrastructure Voluntary Evaluation Sustainability Tool (INVEST) or The Sustainable Transportation Analysis and Rating System (STARS) are increasingly being used to assess transportation projects. Although one may challenge the concept of a ‘sustainable highway’, departments of transport (DOTs) in the US have been particularly keen to use such systems for highway and bridge projects. In the UK, the sustainability assessment, rating and awards scheme for civil engineering (CEEQUAL) serves a similar purpose. A previous DTU Transport research project for the EU National Road Administration also proposed a Sustainability Rating System Framework (SUNRA).

The increasing number of such tools raises the question: how do they compare, and how strong is the level of sustainability they are likely to provide?

PROJECT DESCRIPTION: You will analyse existing sustainable transport assessment frameworks (minimum 2 of your choice) with regards to their strength and weaknesses. Your analytical framework will cover the conceptualisation, operationalization, and utilization of indicators. How does the framework connect to principles of sustainability? How were these principles translated into indicators? How is this evidence utilized in their context? Depending on the chosen focus between the three themes above, this comparative study will consist of mixed methods (desktop analysis, interviews with practitioners in targeted countries). You will use real cases to illustrate your analysis.

PROJECT PURPOSE: The purpose of this project is to analyse the strengths and weaknesses of existing sustainable transport rating systems with regards to their design and application in real life.

PREREQUISITES: 42879 Decision support & Risk analysis

NUMBER OF STUDENTS: 1-2 MSc students (2 projects of 30-35 ECTS Credits).
Inaccuracy in road transport infrastructure projects (MSc)

PROJECT SUPERVISOR: Associate professor Michael Bruhn Barfod (mbba@dtu.dk)
EXTERNAL ADVISOR: Risk Manager Trine Holst Veicherts, (Danish Road Directorate) (thv@vd.dk)

BACKGROUND: Recent research has proven that construction costs are embedded with substantial degrees of uncertainty, which ultimately can lead to wrongful input to decision support models.

PROJECT DESCRIPTION: Currently, the Danish Road Directorate possess information with regard to construction costs within a large database system. This project seeks to investigate and assess the data material within the database in order to benchmark estimated costs against realized costs for road projects.

PROJECT PURPOSE: The purpose of this project is to structure, validate and verify the huge amount of data within the database and hereby to investigate whether there in fact is bias in the estimating of construction cost within road transport projects.

PREREQUISITES: 42879 Decision support & Risk analysis

NUMBER OF STUDENTS: 1-2 MSc students (2 projects of 30-35 ECTS Credits).
Sustainable Decision Support: Sustainable transport and infrastructure planning (MSc)

PROJECT SUPERVISOR: Associate professor Michael Bruhn Barfod (mbba@dtu.dk)
PROJECT ADVISORS: Professor Steen Leleur (stle@dtu.dk)

BACKGROUND: There is a growing focus on sustainable transport planning in order to reduce CO₂ emissions as well as congestion. This is a global focus which has to be dealt with locally, thus implying challenges in defining the main planning objectives.

PROJECT DESCRIPTION: The project can either take its starting point in a specific case of transport or infrastructural planning or in the development and testing of an assessment methodology. It should consider the different structural and sectorial frameworks related to the planning process and thereby approach the problem of defining and assessing sustainability within infrastructural planning, which so far remains unsolved.

PROJECT PURPOSE: The purposes of this (these) suggested project(s) are to clarify potential obstacles for the implementation and realization of a sustainable transport network as well as to present a possible assessment and evaluation method for advancing and encouraging sustainable development within transport and infrastructural planning.

PREREQUISITES: 42879 Decision support & Risk analysis.

NUMBER OF STUDENTS: 1-2 MSc students (2 projects of 30-35 ECTS Credits).

NB! A smaller version of the project can be aligned to suit both BSc and BEng student theses.