Universitat Autònoma de Barcelona

2018/2019

Material Handling System Design and Analysis

Code: 42635
ECTS Credits: 10

Degree	Type	Year	Semester
4313489 Logistics and Supply Chain Management	OT	2	1

Contact

Name: Juan José Ramos González

Email: JuanJose.Ramos@uab.cat

Use of languages

Principal working language: english (eng)

External teachers

Prof. Dr. Gaby Neumann

Prof. Dr. Jens Wollenweber

Prerequisites

The student has to have successfully passed the following subjects:

- Decision making (42653)
- Material handling and transportation technologies (42651)
- Information Technology (42657)
- Supply Chain Network & Flow Management (42644)

Objectives and Contextualisation

This module has two course units: **Simulation-based analysis and design of material handling systems** (Prof. Dr. Gaby Neumann) and **Analysis and design of transportation networks** (Prof. Dr. Jens Wollenweber).

CU1: Simulation-based analysis and design of material handling systems (5 ECTS)

After the course the student will:

- Understand specific requirements of material handling systems and their design
- Be able to apply procedure, methods, tools for MHS analysis and design, esp. simulation methodology
- Understand subject, steps and constraints of tendering procedure, offer preparation and tender processing

CU2: Analysis and design of transportation networks (5 ECTS)

Students will gain an understanding of

- the decision making process in logistics and transportation
- the process of designing transportation networks
- modelling and solving related decision problems

Students will be able to solve strategic, tactical and operational decision problems

- for clustering/covering problems
- for assignment problems
- for finding optimal facility location

Skills

- Address problems of management and coordination of logistics operations in production, transport and services in a holistic approach, by means of the consistent application of the supply chain management concepts and strategies, taking into account the pertinent aspects of environment, human capital, quality, technology, and economics.
- Apply a rigorous and efficient approach to problem solving.
- Apply quantitative methods and techniques based on optimisation and/or simulation models in order to evaluate the different alternatives and select the most promising solution to be implemented
- Demonstrate abilities to document and reflect the problem-solving process in order to extract the lessons learned.
- Elaborate solid arguments based on quantitative models and analytical methods in order to convince and motivate decision makers, determine the adequate LCSM partners and then plan and coordinate the project to implement the solution.
- Face a new problem under a scientific perspective.
- Identify the main aspects to be planned in the resolution of a logistic project, specifying the project boundaries, and leading with a solution
- Select and apply the most relevant analytical methodologies, strategies and current technologies for designing solutions to the problams of management and coordination of material, information and financial flows.
- Student should possess an ability to learn that enables them to continue studying in a manner which is largely self-supervised or independent
- Students should be able to integrate knowledge and face the complexity of making judgements from information which, being incomplete or limited, include reflections on the social and ethical responsibilities linked to the application of their knowledge and judgements
- Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously
- Work collaboratively in a group.

Learning outcomes

1. Address MHS design problems from a holistic approach.
2. Apply a rigorous and efficient approach to problem solving.
3. Demonstrate abilities to document and reflect the problem-solving process in order to extract the lessons learned.
4. Elaborate solid arguments to convince/motivate decision makers.
5. Evaluate alternatives and select the MHS solution to implement.
6. Face a new problem under a scientific perspective.
7. Identify the main aspects to be planned in the resolution of a logistic project, specifying the project boundaries, and leading with a solution
8. Select and apply the right methodologies and strategies for the development of technical solutions in material handling problems.
9. Student should possess an ability to learn that enables them to continue studying in a manner which is largely self-supervised or independent
10. Students should be able to integrate knowledge and face the complexity of making judgements from information which, being incomplete or limited, include reflections on the social and ethical responsibilities linked to the application of their knowledge and judgements
11. Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously
12. Work collaboratively in a group.

Content

CU1: Simulation-based analysis and design of material handling systems (5 ECTS)

Introduction to material flow planning

- Terminology
- Principles and procedure in material flow planning
- The use of simulation in material flow planning
- Knowledge management in material flow planning

Analysis of materials handling systems

- Overview: How to investigate material flows
- Procedure and methods for material flow analysis
- Evaluating material flows
- Approaches for optimizing material flows
- Case 1: Analysing a materials handling system

Introduction to the DOSIMIS-3 simulation package

- Philosophy and functionality of the DOSIMIS-3 simulation package
- Exercise: Simulation of a circulating chain conveyor

Design of materials handling systems

- Overview: How to design material flows
- Specific planning problems: planning material flows in production, warehouse planning, planning order picking systems, designing logistics buildings
- Approaches for evaluating alternative solutions in material flow design
- Case 2: Designing a materials handling system

Tendering procedure and supplier selection

- Tendering procedure
- Requirement specification and tendering
- Preparation of offers
- Tender processing incl. analysis and evaluation of alternative offers

CU2: Analysis and design of transportation networks (5 ECTS)

Part A: Selected theoretical basics for logistical decisions

1. Model building
2. Decision making and optimisation
3. Optimisation software

Part B: Modelling and solving of selected logistical decisions

1. Clustering Algorithms/Covering problems
    - C-means algorithms
    - Fuzzy C-Means algorithm
    - Set Covering problems
    - Maximum covering problems
2. Logistical Assignment Problems
    - The Standard Assignment Problem
    - Maximum Cardinality Problems
    - Generalised Assignment Problems

3. Location Problems

- Facility Location Problems
- Hub Location Problems

Methodology

CU1: Simulation-based analysis and design of material handling systems (5 ECTS)

The course is organized by means of traditional lectures combined with seminars and practical work. The learning process will combine the following activities:

- Classroom sessions: include theory lectures and guest lectures by Industry logistics management professionals and experts. Aims to understand specific requirements of material handling systems and their design; specify procedure for material handling system analysis and design; explain simulation application in material handling system analysis and design; understand subject, steps and constraints of tendering procedure, offer preparation and tender processing
- Lab sessions: include calculation exercises, guided exercises in software application, classroom discussions. Aims to calculate material handling system performance limit; build, validate, run simulation models using DOSIMIS-3 simulation package; evaluate and discuss alternative material handling system solutions.
- Case study: group work, project reporting, student presentation. Aims to apply procedures, methods, and tools for material handling system analysis and design, esp. simulation methodology; evaluate different alternatives and select the material handling system solution to be implemented; elaborate solid arguments to convince and motivate decision makers; run and manage a material handling system design project in a market setting.
- Autonomous work: reading, self-testing, reflecting. Retrieve and analyse information from different sources; reflect learning and problem solving processes in order to derive lessons learned.

CU2: Analysis and design of transportation networks (5 ECTS)

The course is organized by means of traditional lectures combined with seminars and practical work. The learning process will combine the following activities:

- Classroom sessions: include theory lectures and classroom discussions. Aims to understand theoretical issues of the decision making process in logistics environments and for modelling and solving selected logistics decision problems.
- Computer lab: includes supervised use of decision support software and classroom discussion. The students will be able to analyse selected logistics decision problems, to formulate the mathematical model, to allocate the required data and to solve it with Optimization Studio.
- Case study: group work, project reporting, student presentation. Aims to design, model and solve decision problems, esp. related to transportation networks; design and optimize a transportation network including the retrieval and evaluation of relevant market and cost data
- Autonomous work: reading, self-testing, reflecting. Retrieve and analyse information from different sources; reflect learning and problem solving processes in order to derive lessons learned.

All theoretical issues will be also discussed by using Optimization Studio which is an industrial standard software suit for modelling and solving mathematical optimisation problems. Optimization Studio is provided by IBM.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
CU1. Practical sessions	30	1.2	1, 2, 3, 4, 5, 8, 12

CU1. Theory lectures	30	1.2	1, 4, 5, 8
CU2. Practical sessions	30	1.2	1, 2, 3, 5, 6, 12
CU2. Theory lectures	30	1.2	1, 4, 5, 8
Type: Supervised			
CU1. Case Study	50	2	2, 3, 6, 7, 8, 10, 11, 12
CU2. Case Study	50	2	2, 3, 6, 8, 10, 11, 12
Type: Autonomous			
CU1. self-learning	14.5	0.58	1, 4, 5, 8, 9
CU2. self-learning	14.5	0.58	1, 4, 5, 8, 9

Evaluation

CU1: Simulation-based analysis and design of material handling systems (5 ECTS)

The final mark of this course will be calculated from the assessment of following evaluation activities:

- Case study MHS. For a given scenario current system design and performance is to be described in a formalized way, represented by a simulation model and analysed by use of simulation technology. Needs for improvement are to be specified as well as future system requirements. For matching them, appropriate (alternative) technical solutions are to be developed, investigated, evaluated and selected. The favourite solution is to be presented in respective tender documents. Procedure and outcomes of the case study are described and discussed in a project report and presented to decision makers in an attractive way.

CU2: Analysis and design of transportation networks (5 ECTS)

The final mark of this course will be calculated from the assessment of following evaluation activities:

- Final exam. Theoretical questions and small calculations on topics addressed throughout the semester in order to present an understanding of analysing transportation networks.
- Case study. For a certain geographical region an entire network planning and optimisation process has to be developed and executed, applying proper decision models. Procedure and outcomes of the case study are described and discussed in a project report and presented to decision makers in an appropriate way.

CU1 and CU2

The student passes the module if each of the case studies and the final exam are evaluated "sufficient" (grade 4.0 corresponding to a minimum of 50% of the maximum performance per evaluation activity) at least. The student fails if performance in at least one of the evaluation activities does not reach the 50% threshold or if reports on case studies are not submitted within the due dates specified by the professor.

In case of fail the student needs to retake just that part of module exam s/he failed. The decision about this is in hands of the examiner. If any of the case studies is failed, the student will either be provided with a new case study or asked to re-submit its report according to the corrections/indications provided by the professor.

Students who fail an exam may be permitted the opportunity to retake this examination twice at a maximum. After that his/her right for examination terminates. Retaking an exam is allowed only in case the student previously failed, but not to improve grades achieved so far.

Examination dates are announced in due time, but at least two weeks prior to the respective exam. Submission deadlines for case studies and any presentation activities related to them are announced when giving case studies to students. The final exam and a first opportunity for eventually retaking it are scheduled within specified examination periods. Specific examination dates are published on the university's website.

The weights of each evaluation activity are given in the table below.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
CU1. Case Study	50%	0	0	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12
CU2. Case Study	25%	0	0	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12
CU2. Final exam	25%	1	0.04	1, 2, 8, 10

Bibliography

Bode, W.; Preuß, R. W.: Comprehensive introduction to intralogistics. A reference book by the STILL Akademie, 2005.

Gudehus, T.; Kotzab, H.: Comprehensive Logistics; 2nded., Springer: Berlin and Heidelberg, 2012.

Hillier F., Lieberman G.: Introduction to Operations Research, 10thed., Irwin Industrial Engineering, 2014

Law, A. M.: Simulation Modeling and Analysis, 5thed., McGraw-Hill: New York, 2015.

Rodrigue, J.-P.: The Geography of Transport Systems, 4thed., Routledge, New York, 2017.

Rushton, A.; Croucher, P.; Baker, P.: The Handbook of Logistics and Distribution Management; 5thed., Kogan Page: London and Philadelphia, 2014

ten Hompel, M.; Schmidt, T.: Warehouse Management. Automation and Organisation of Warehouse and Order Picking Systems; Springer: Berlin and Heidelberg, 2007.

Tompkins, J.; White, J.; Bozer, Y.; Frazelle, E.; Tanchoco, J.; Trevino, J.:

Facilities Planning; 4. ed.; John Wiley&Sons: New York, 2010.