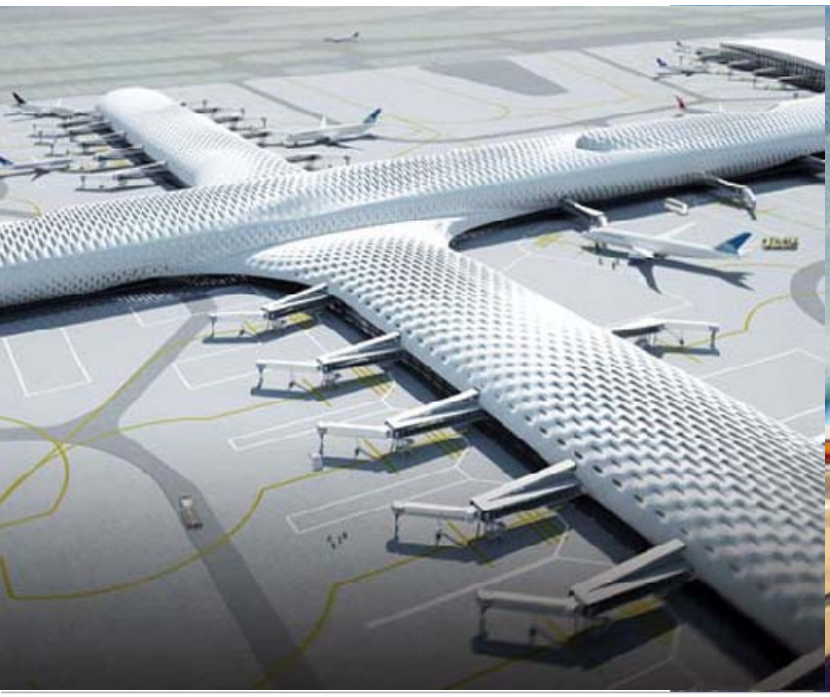
Airport of the Future

- Airport Planning, Design and Operation -

Minor code:	LR-Mi-167-11
Minor name:	Airport of the Future
Minor administration by the faculty of:	LR
Minor is jointly organized by the faculties of:	3mE, CiTG, LR and TBM
Minor coordinator:	H.G. Visser (LR)
Deputy minor coordinator:	R. Curran (LR)



TU Delft Delft University of Technology

Challenge the future

1. General minor information

Minimum number of Participants:	15
Maximum number of Participants:	80
Prerequisites Minor:	2nd semester of 2nd year of BSc program completed
Target group:	Engineering students from all bachelor programs offered at the TU Delft
Language:	English

The minor Airport of the Future is jointly organized by the faculties of Mechanical, Maritime and Materials Engineering (3mE), Civil Engineering and Geosciences (CiTG), Technology, Policy and Management (TBM), and Aerospace Engineering (LR). The minor is aimed at engineering students from all bachelor programs offered at the TU Delft, who are interested in the design, planning, management and operational aspects of airports.

The minor Airport of the Future is designed such that eligible students from all engineering disciplines can enter the minor program, without the need for specific prerequisite courses. Students from all BSc programs that enter the minor will follow one and the same minor program, without any subdivision into tracks. They are also expected to all attain the same level of knowledge and skill (i.e., meet the minor exit qualifications) after completing the minor, regardless of their background. Engineering students from the TU Delft are eligible to enter the minor once the 2nd semester of the 2nd year of their respective BSc programs has been completed. Students do that not fully, but nearly, comply with these requirements may apply for admission, but acceptance will be judged and granted on a case by case basis.

2. Minor description

An airport operates in a competitive, dynamic, complex, and unpredictable environment. Development and growth of any large airport is to a large extent determined by its ability to balance business realities, long-term expansion requirements, and environmental and social demands. The minor Airport of the Future is oriented to those engineering students who would like to understand how airports are designed, planned and operated in such a complex and uncertain environment. The issues confronting airports, both at the operational and strategic level, are truly multi-disciplinary in nature. The minor Airport of the Future is able to cover the entire multidisciplinary field of airport development, planning and operation through clustering of knowledge from various branches of science and technology available within the TU Delft.

The minor covers both the development and operational aspects of the airport system – an airport and its associated subsystems, including its airlines. The minor addresses in detail each of the following development issues:

- Airport geometric design characteristics, including the layout of runways, taxiways and aircraft aprons
- The design of passenger buildings and gate facilities
- Airport logistic systems, notably baggage handling systems
- Sitting criteria for new airports including terminals
- The planning for ground access to the airport

It also gives treatment to the operational and management issues of:

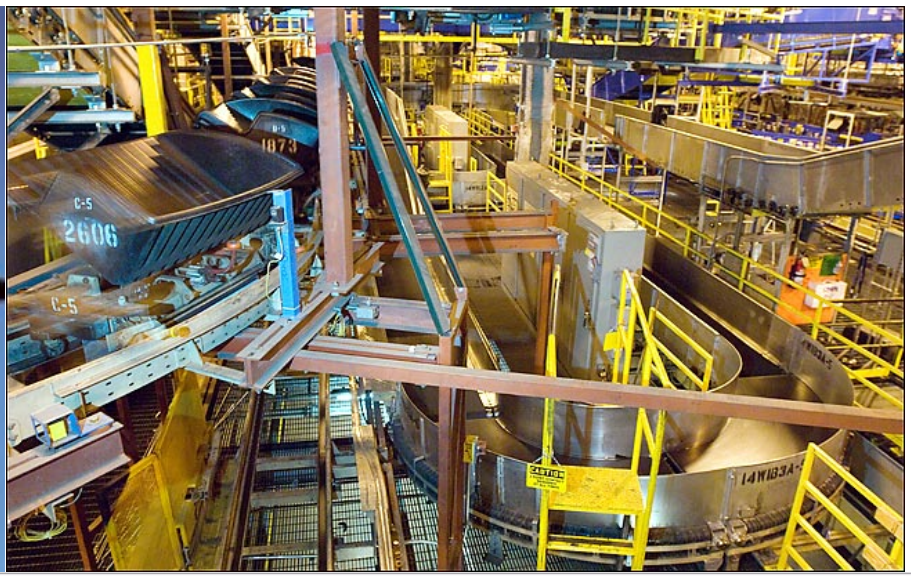
- Air traffic management
- Management of congestion and queues (passengers and aircraft)
- Demand management
- Environmental impacts
- Logistic processes
- Ownership and organizational structures
- Airport economics and finance
- Regional transport networks
- Airport strategic planning; policy analysis and uncertainty management

The minor focuses on the actual problems that can arise in airport design and operation, and on the practical effective ways to deal with them. Theory and methodology appear only to the extent that they are relevant and useful. Participating students need no specific experience or skills to successfully complete the minor.

The domain of airport design, planning and operation involves a wide range of disciplines. By harnessing all of the TU Delft's expertise in the domain of airport development and operation, the full range of aspects can be covered within the minor in a comprehensive and coherent manner, including landside issues (CiTG), airside issues (LR), policy analysis (TBM) and logistic processes and technology (3mE). Students participating in the minor will be exposed to the full array of multi-disciplinary issues, and will be part of a multi-disciplinary team, working together to produce "total solutions" for the key airport issues. In this sense, the minor Airport of Future provides an appealing opportunity to look beyond the boundaries of their own discipline.

After successful completion of the minor program Airport of the Future, a student has acquired the following competences:

- Knowledge of and insight into the system concepts that address the technological, operational, logistic, economic, regulatory, safety, security and environmental problems associated with the development of airports.
- Awareness of regulatory requirements and acquaintance with commonly adopted international airport design standards
- Understanding of the complex interrelationships and interactions among airport capacity, airport demand, policy changes, investments, and environmental issues and the effects that changes in any of these can have on airport profits and performance
- Ability to structure and formulate problems related to the design of airport airside and landside facilities and logistic processes
- Skill and knowledge to deploy computer simulation software packages and information management systems used in industry in the planning and design of airports in order to generate and synthesize the information needed to support the decision making process
- Experience in creative problem-solving in airport design, planning and operation
- Ability to make informed tradeoffs among conflicting objectives and requirements of the various airport stakeholders and policy makers
- Understanding of the need to find the right balance between economic, environmental and social interests in sustainable airport development.
- Ability to communicate, report and operate effectively as a member of a (multi-disciplinary) team



3. Minor structure

The minor comprises four “blocks” of courses and associated exercises of 6 ECTS each (each block is associated to one particular Faculty), and is concluded with a comprehensive capstone project (6 ECTS) that helps students integrate and apply the multidisciplinary knowledge and strategies learned in the various courses.

Block 1 airport logistics and technology (3mE):
Addresses airport logistics and the associated systems required to keep the continuous flow of aircraft, passengers, baggage, cargo, information, and energy moving as quickly, efficiently and environmentally friendly as possible throughout the entire air transport chain, without causing delays.
Responsible Instructor: Prof.dr.ir. G. Lodewijks

Block 2 airport landside accessibility (CiTG):
Deals with all aspects of landside accessibility, including airport and passenger services (parking and signage), analysis of traveler behavioral patterns and the planning and operation of various transportation modes servicing airports, local infrastructural development, terminal infrastructure and the complex integration of airports into regional transport systems.
Responsible Instructor: dr.ir. W. Daamen

Block3 policy analysis and uncertainty management in the context of airport planning (TBM):
Focuses on assessing the economic, environmental and social impacts of policies assessing their underlying causes, and designing policy alternatives, taking into consideration the many uncertainties that are present.
Responsible Instructor: dr.ir. J.H. Kwakkel

Block 4 air transport and airport airside planning and operations (LR):
Addresses airport airside operational processes for efficient, cost effective and low environmental impact, including the interfacing between airlines, and air traffic service providers. Block 4 also includes a course that provides an introduction to the various aspects of air transportation, including air law, aviation safety, airline economics, air transport markets, and air traffic management. The lectures will in part be provided by guest lecturers from the air transport industry.
Responsible Instructor: dr.ir. H.G. Visser

Capstone project:
The goal of the capstone exercise is to give students the opportunity to weave together the multidisciplinary elements offered in the four course blocks into an integrated (team) project. In the first edition of the minor, the capstone project will build on AE3296TU Strategic Planning for Airport Systems, a course/lab exercise that ran successfully in the years 2003-2009. Using the in-house developed software tool ABS (Airport Business Suite), which is an integrated computational platform that supports policy and business decisions relating to airport development, planning and operations, each five-member student team is asked to “design and operate your own airport”. Additional final project options are envisaged for future editions of the minor.

Overview of courses/projects:

All courses offered in the minor Airport of the Future will either be newly developed or are based on courses that were previously offered in the minor “Aerospace Operation and Exploitation” (which was terminated in 2010). The courses included have been specifically conceived for the minor program and will not be offered as elective courses in MSc programs. The minor Airport of the Future is unique in the sense that its topic is not integrally addressed in any of the BSc majors, or MSc programs.

In appendix I, a CourseBase description for the courses contained in the minor can be found. The description includes, course content, course outline, study goals, education methods, assessment forms. Appendix II contains a similar description for the final project.

The minor course load (24 ECTS) will be equitably distributed over period 1 and 2 of the semester. The final project (6 ECTS) is scheduled in period 2. The most fundamental courses will be given in the first period to ensure a proper preparation for the final project.

The quality and the extent of the knowledge the student has acquired during the courses will be largely judged on the basis of written examinations, which are typically conducted on a ‘closed-book’ basis. Written examinations will typically consist of “open-ended” questions, but for some courses a multiple-choice format will be selected. To help students prepare for the exam, lecture hours will be reserved for questioning for most of the courses. The questioning sessions can be in the form of addressing individual lecturers or in the form of a panel comprising all lecturers that contributed to the course. The course “Baggage Handling System Technology and Operation” will be concluded with a group exercise related to the conceptual design of a baggage handling system.

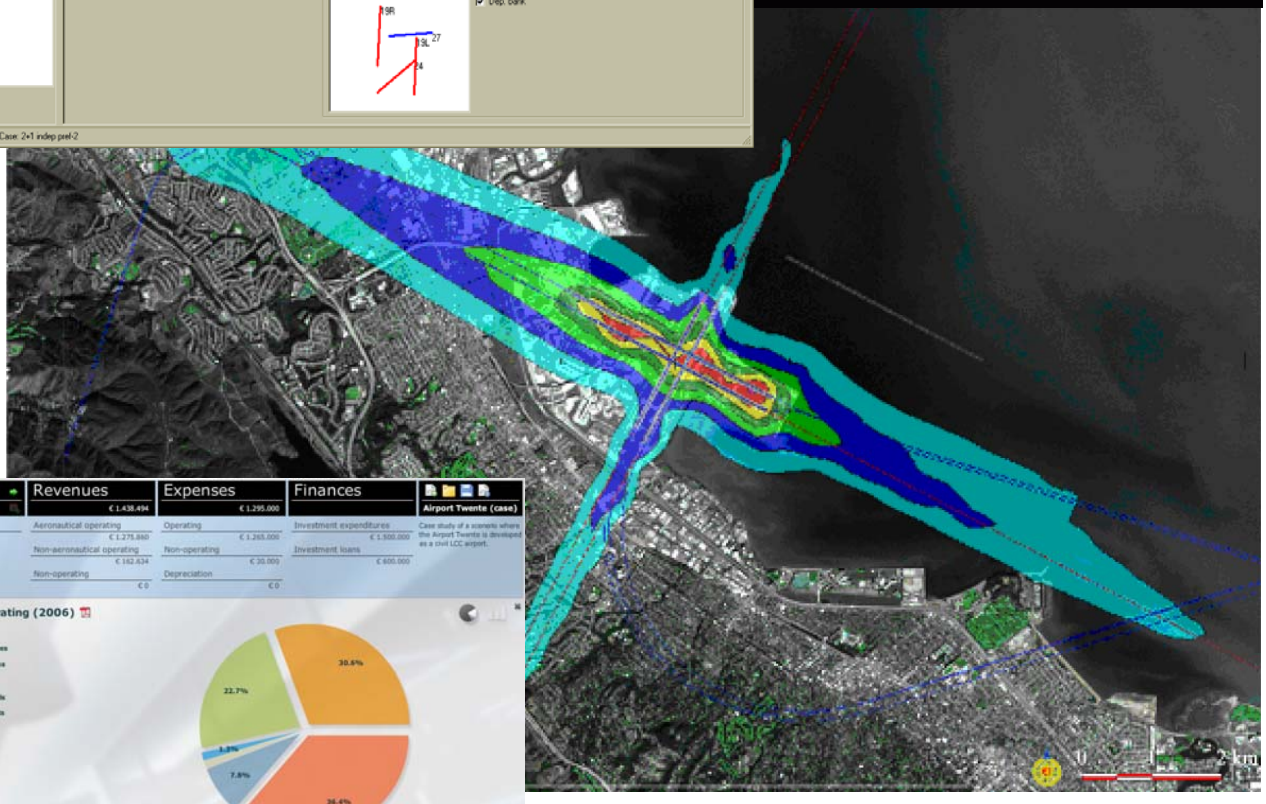
code	name	period	ECTS
CTXXXX	Landside accessibility of airports	1	6
AE3XXX	Air Transportation	1	3
AE3YYY	Airport Planning, Design and Operation	1	3
SPMXXXX	Policy Analysis, Uncertainty Management and Model Based Decision Support for Airport Strategic Planning	2	6
WBXXXX	Baggage Handling System Technology and Operation	2	6
AE3ZZZ	Strategic Planning for Airport Systems (final project)	2	6

The knowledge acquired in the various courses will be applied in the capstone project. The skill the students have gained in conducting the final project will be assessed based on the final presentation (in a mini symposium) and on the written report that describes the strategic planning analysis that has been carried out for the assigned airport.

The blackboard communication facilities will be deployed extensively throughout the course. In some of the proposed minor courses graded (homework) assignments will be issued, which are primarily intended to prepare students for the capstone project. A number of lectures will be specifically devoted to familiarizing students with the computer models to be used in the final project.


Airport Business Suite V2

Airport Business Suite - [Peakday-Case Control Panel]
File Run Analyze Window Help
Schiphol 2002-2020
Cases
2+1 indep pref-1
2+1 indep pref-2
2+1 indep pref-3
Years
Baseline (2002)
2+1 indep pref-1
2+1 indep pref-2
2+1 indep pref-3
Case data
Case name:
2+1 indep pref-2
Description:
2+1 independent use of runway system. This case analyzes the 2nd preferential runway configurations.
Selected Scenario and Policy Options
Flight Schedule:
New schedule
Edit
Arr. RWY Set:
19R (A), 27 (A), 24 (D)
Edit
Dep. RWY Set:
24 (D), 19L (D), 19R (A)
Edit
Weather:
VMC
Edit
Terminal data:
Default Terminal
Edit
Save Changes
Run Case
Undo Changes
Analyze Results
Airside
Landside
Economics
Details of selected data
*** Case description ***
- Flight Schedule -
Name: New schedule
Description: Model: Default, Year: 2002, Peakday: 20
Filename: Schedule 13.mdb
- Arrival Configuration -
Name: 19R (A), 27 (A), 24 (D)
Description: 2nd preferential runway configuration for an arrival block
Runways: 19R[A], 24[D], 27[A],
- Departure Configuration -
Name: 24 (D), 19L (D), 19R (A)
Description: 2nd preferential runway configuration for a departure block
Runways: 19R[A], 24[D], 19L[D],
- Weather -
Weather: VMC
- Terminal -
Name: Default Terminal
Description: Default terminal building
Filename: IATAdb.mdb
Runways in use:
Arr. bank
Dep. bank
19R
19L
27
24
Project: Schiphol 2002-2020, Case: 2+1 indep pref-2



2006
Revenues
€ 1.438.494
Expenses
€ 1.295.000
Finances
Airport Twente (case)
Airport activity
Aeronautical operating
€ 1.275.860
Operating
€ 1.265.000
Investment expenditures
€ 1.500.000
Non-aeronautical operating
€ 162.634
Non-operating
€ 30.000
Investment loans
€ 605.000
Non-operating
€ 0
Depreciation
€ 0
Case study of a scenario where the Airport Twente is developed as a civil LCC airport.
Aeronautical operating (2006)
Landing fees
Passenger service charges
Apron charges/tie downs
FBO revenue
Cargo and hangar rentals
Security reimbursements
Miscellaneous / Other
30.4%
22.7%
7.8%
36.4%
ACe
TUDelft

Appendix I: descriptions of minor courses and final project

CT3XXX: Landside accessibility of airports

Year	BSc minor
Credits	6 ECTS
Principal Lecturer	W. Daamen
Building	Faculty of Civil Engineering
Room number	CT 4.37
Phone number	015-2785927
E-mail address	w.daamen@tudelft.nl
Additional Lecturers	S.P. Hoogendoorn + H. van Lint + R. van Nes + P. Schrijnen + ...

Contact Hours / Week x/x/x/x 4/0/0/0

Education Period 1

Course Language English

Course Content The course offers an introduction to all aspects of landside accessibility, including airport and passenger services (parking and signage), analysis of traveler behavioral patterns and the various transportation modes servicing airports, local infrastructural development, and the complex integration of airports into regional transport systems.

Course Outline

- Introduction, four phase model
- Choices of the traveller incl. multi modal choice modeling
- Traveler behavior patterns
- Elements of the spatial and traffic system
- Multimodal network design and planning
- Design, planning and operation of the public transport terminal
- Regional transport networks
- Road surface network
- Introduction into ITS
- Parking and parking guidance facilities
- Accessibility of airport (catchment areas, objective measures)
- Pedestrian flows in the terminal
- Terminal facilities and terminal design

Study Goals To gain insight into the transport system and its relation to the spatial system with the airport as the main attraction point. In this understanding, the behavior of people in these systems, depending on their various roles plays a focal role.

Education Method Lectures and assignment

Study Materials

- Reader
- Blackboard postings of presentations.

Assessment Written exam, the assignment should be handed in beforehand with sufficient result (no-claims bonus systems).

Set-up

The course consists of 14 lectures, given mainly by staff members from the TU Delft, but also with guest speakers from the air transport industry (e.g. KLM, Schiphol airport, NACO).

AE3YYY: Airport Planning, Design and Operation

Year	BSc minor
Credits	3 ECTS
Principal Lecturer	H.G. Visser
Building	Faculty of Aerospace Engineering
Room number	LR 12.07
Phone number	015-2782095
E-mail address	h.g.visser@tudelft.nl
Additional Lecturers	Warren Walker (TBM), Paul Roling, Sander Hartjes, TBD

Contact Hours / Week x/x/x/x

4/0/0/0

Education Period

1

Course Language

English

Course Content

The course Airport Planning, Design and Operation aims to provide students with an understanding of the complex interrelationships and interactions among airport capacity, airport demand, policy changes, investments, and environmental issues and the effects that changes in any of these can have on airport profits and performance.

Course Outline

- Introduction; the future of the airport industry
- Forms of airport planning: master planning, dynamic strategic planning
- The policy analysis process in the context of airport strategic planning
- Airport organization and financing; regulation; user charges
- Demand management and forecasting
- Air Traffic Management aspects of airport operations
- Airfield design
- Airside capacity
- Airside delays
- Landside issues: terminal design, ground access, gate management
- Environmental capacity: noise, safety and emissions
- Integrated impact modeling
- Cost-Benefit analysis
- Introduction to the Airport Business Suite (ABS)

Study Goals

- Estimate the capacity of any airport configuration and understand the influence of weather, aircraft mix, and other operational parameters on capacity
- Estimate the (future) demand for transport of both passengers and freight.
- Estimate the flight delays at an airport given the capacity of the facility and daily demand factors.
- Analyze the noise impacts of aircraft in the vicinity of airports using computer models
- Estimate the geometric design characteristics of an airport including taxiways, aprons and runways
- Estimate siting criteria for new airports including terminals
- Conduct a Cost-Benefit analysis for new airport infrastructure developments
- Present and defend the policy recommendations consistent with the long-terms vision for the airport

Education Method Lectures and homework assignments

Study Materials
- Book: Richard de Neufville and Amedeo R. Odoni, Airport Systems: Planning, Design, and Management, 2003.
- Blackboard postings of presentations.

AE3XXX: Air Transportation

Year	BSc minor
Credits	3 ECTS
Principal Lecturer	H.G. Visser
Building	Faculty of Aerospace Engineering
Room number	LR 12.07
Phone number	015-2782095
E-mail address	h.g.visser@tudelft.nl
Additional Lecturers	P.C Roling, F.M. v.d. Zwan, J.A.A.M. Stoop + guest lecturers from industry

Contact Hours / Week x/x/x/x 4/0/0/0

Education Period 1

Course Language English

Course Content The course offers an introduction to the various aspects of air transportation, including air law, regulatory frameworks, airline economics, airline network and fleet planning, air transport safety, airport development, environmental impact, and air traffic management.

Course Outline
- Introduction; airline characteristics; the future of the airline industry
- Economic regulations of air services
- Airline costs and revenues
- Airline network and fleet planning
- The economics of passenger charters
- The economics of air freight
- The low-cost business model
- Airline marketing
- Air Traffic Service provision
- Air transport safety; civil aviation authorities; airworthiness regulations
- Aircraft accident investigation; third party risk; safety oversight
- Airport environmental management
- Airport planning and design
- Regional airports

Study Goals To gain insight in the working principles of the air transportation system, its organizational structure, its goals and the means to establish these goals in a safe and efficient fashion.

Education Method Lectures

Study Materials
- Book: R. Doganis, Flying off course, the economics of international airlines, London, Routledge, 2010 4th. Ed
- Blackboard postings of presentations.

Assessment Written exam.

Set-up The course consists of 14 lectures, 7 of which are given by various guest speakers from the air transport industry (KLM, Martinair, Schiphol airport, Rotterdam The Hague airport, LVNL, IVW, NACO). The remaining 7 lectures are presented by staff members from the TU Delft.

WBXXXX: Baggage Handling System Technology and Operation

Year	BSc minor
Credits	6 ECTS
Principal Lecturer	Prof.dr.ir. Gabriel Lodewijks
Building	Faculty of Mechanical, Maritime and Materials Engineering
Room number	3mE 8B-1-10-O
Phone number	15 27 88793
E-mail address	G.Lodewijks@tudelft.nl
Additional Lecturers	TBD

Contact Hours / Week x/x/x/x 0/4/0/0

Education Period 1

Course Language English

Course Content This course focuses on the design and operation of baggage handling systems at airports.

Course Outline A baggage handling systems starts at the point where baggage is checked in and ends at the point where baggage is loaded into an aircraft. Over the last couple of years many new innovative components were added to baggage handling systems including self-check-in for luggage and baggage handling robots. During this course a student learns how to conceptually design a baggage handling system based on an airport characteristics like capacity, required security, type of passengers (OD versus transfer), number of flights, type of aircraft and the equipment used. Further detailed attention is given to the design of components of a baggage handling system like a baggage handling robot or a baggage truck, and the logistic operation of baggage handling systems.

Study Goals see course outline

Education Method Lectures + group assignment

Study Materials Blackboard postings of presentations.

Set-up The course consists of six lectures and is finished by a practical group assignment.

SPMXXXX: Policy Analysis, Uncertainty Management and Model Based Decision Support for Airport Strategic Planning

Contact Hours / Week x/x/x/x	0/4/0/0
Education Period	1
Course Language	English
Course Content	The course offers an introduction to Policy Analysis, Uncertainty Management and Model Based Decision Support applied in the context of airport strategic planning
Course Outline	• Introduction to policy analysis applied to airport systems • Adaptive policy making • Real options • Scenario's • Forecasting • Exploratory modeling • Noise perception • Comparison of Master Plans related to major international airports • Aircraft Technology's Contribution to Sustainable Development • Review lecture • Panel discussions
Study Goals	• Being able to make explicit and rationalize multi actor problems in airport strategic management. • Being able to use some common policy analytical techniques in the analysis of complex, multi actor problems in strategic airport management. • Being able to identify key uncertainties in airport strategic management. • Being able to specify a way for managing these uncertainties appropriately. • Being able to use the results of the analysis to facilitate decision makers and policy makers in the airport strategic management. • Being able to specifically use model based analysis results in the policy making process. • Being able to specifically use model based analysis results to facilitate decision makers and policy makers in the airport strategic management.
Education Method	Lectures, workshop
Study Materials	• Book, Airport Systems: Planning, Design, and Management, by Richard de Neufville and Amedeo R. Odoni (2003) • Blackboard postings of presentations.
Assessment	Written exam
Set-up	The course consists of 12 lectures, 3 of which are given by guest speakers

Appendix II: Final project "Strategic Planning for Airport Systems"

Year	BSc minor
Period	2
Credits	6 ECTS
Principal Lecturer	H.G. Visser
Building	Faculty of Aerospace Engineering
Room number	LR 12.07
Phone number	015-2782095
E-mail address	h.g.visser@tudelft.nl
Additional Lecturers	P.C. Roling, M. Arntzen and S. Hartjes

Detailed Description

The airport business is high-paced, dynamic and unpredictable. Airport decision makers are faced with the continual challenge of having to make strategic plans and business decisions regarding infrastructure, market positioning, and commercial activities at the airport. The final project will explore the various aspects of strategic planning for airport systems

Objectives

The major goal of the capstone project is that it aims to provide students with an understanding of the complex interrelationships and interactions among airport capacity, airport demand, policy changes, investments, security and environmental issues and the effects that changes in any of these can have on airport profits and performance. Using a policy analysis/system-modeling framework, the full range of airport strategic planning issues will be addressed.

Set-up

The final project involves a lab exercise in which each team of (5) students is asked to "design and operate your own airport" in a simulated environment based on the in-house developed Airport Business Suite (ABS). ABS is an integrated computational platform that will support policy and business decisions relating to airport development, through an integrated impact analysis. The lab exercise is directly linked to the lectures of the course Airport Planning, Design and Operation. The final project is to be concluded with a written report, along with a presentation in a mini-symposium. The laboratory exercise is scheduled in period 2 and will be conducted in one of the project rooms of the faculty LR. The exercise will be supervised by an experienced team of staff members of the faculty LR.

Course Material

Course material consists of slides/handouts from the lecturers and the use of a book:

- Richard de Neufville and Amedeo R. Odoni, *Airport Systems: Planning, Design, and Management,* 2003.