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D2.5

Updated research educational and training program in Latvia and the region

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LIST OF ABBREVIATIONS

Abbreviation	Description
EC	European Commission
ENAEE	European Network for Engineering Accreditation
EU	European Union
HEI	Higher European Institute's
LLE	Long-life-educational
MSc	Master of Science
STIP	Sustainable Transport Interchange Program
STSE	Short-Term Staff Exchanges
SUMP	Sustainable Urban Mobility Plan
TTI	The Transport and Telecommunication Institute
UTH	University of Thessaly
WP	Work Package

Abstract

This deliverable is the update of D2.2, which linked strategically the results of D2.1 “Good practices of research, educational and training programs on smart solutions for the interconnection of transportation networks” with D2.3 “Course material on smart solutions for the interconnection of transportation networks”. The present deliverable aims to update the curricula and subjects that were used for the research educational and training program in Latvia and the region following the project’s phase of knowledge sharing. This deliverable presents the methodological steps that were followed for developing the curricula and updates results based on feedback from the assessment of the knowledge-sharing program.

For the formulation of the curricula, the methodological approach that is followed, results in the identification of 20 educational areas for passenger and freight interchanges, which with their turn are combined to result in the 12 courses that compose the Sustainable Transport Interchange Program (STIP). The identified courses are divided into three thematic areas: 1) Governance, 2) Smart solutions, and 3) Decision making; and three parts: a) Core, b) Freight transportation, and c) Public transport systems from research to decision Making. The content of the 12 courses that compose STIP is updated to reflect STIP division into three parts. Amendments in the Summer School program and other project activities are provided based on participants’ feedback.

1 Introduction

1.1 Background

ALLIANCE aims at developing advanced research and higher education institution in the field of smart interconnecting sustainable transport networks in Latvia, by linking the Transport and Telecommunication Institute – TTI with two internationally recognized research entities – University of Thessaly – UTH, Greece and Fraunhofer Institute for Factory Operation and Automation – Fraunhofer, Germany. Close collaboration of TTI with UTH and Fraunhofer enables the achievement of the goals through the following activities:

- Organization of young researchers' seminars.
- Organization of workshops.
- Organization of summer schools for trainers and young researchers.
- Development of an educational program for graduate and post-graduate students.
- Development of a training program for trainers and practitioners.
- Provision of grants for participation as authors of peer reviewed publications in conferences.
- Facilitation of Short-Term Staff Exchanges (STSE) with the aim of international collaboration, mainly publications.
- Establishment of a guidance strategy for preparing scientific publications.
- Creation of an educational forum as on-line tool for distance learning and knowledge sharing.

The overall methodology of the project is built around the analysis of the needs of Latvia and the surrounding region of the Baltic sea (Lithuania, Estonia, Poland) on knowledge gain about intermodal transport networks and the development of the tools to attain this knowledge, providing at the same time excellence and innovation capacity. The analysis, which was conducted during the first stages of the project, relies on the overarching relations among policy makers, industry and education/research.

Structured around three main pillars: 1) Organizational/governance, 2) Operational/services, and 3) Service quality/customer satisfaction, ALLIANCE will deliver a coherent educational/training program, addressed to enhancing the knowledge of current and future researchers and professionals offering their services in Latvia and the wider region. The expected impacts on the overall research and innovation potential of TTI and Latvian research community will be of high importance and TTI will benefit from ALLIANCE by:

- Improving its knowledge in methodologies for preparing, writing and publishing scientific papers.
- Strengthening its research capacity.
- Establishing international research teams in specific areas of interest.
- Generating new innovative ideas for future research work through the project's activities.
- Setting up the fundamentals for the young generation of researchers.
- Being integrated in a number of existing international transport research networks.

- Being incorporated in the European research system of transport and logistics.

In addition, the cooperation of TTI with UTH and Fraunhofer will induce benefits into several domains of everyday life at regional, national and international scope. New bases will be established concerning knowledge transfer procedures, education and interdepartmental collaboration amongst research institutes. The innovative organizational framework, which will be structured for this purpose during the project, is expected to constitute a best practice application with tangible and well estimated progress results, which will be disseminated and communicated through social events to the research community and to the respective business sector as well. Lastly, an important benefit will be the configuration of an integrated framework pertaining to the knowledge transfer techniques and the generic upgrading of the educational system with use of networking, staff exchange, webinars and other knowledge transfer methods and techniques based on a well-structured and well-tried schedule.

1.2 Deliverable scope and structure

This document is the fifth deliverable of WP2 (Work Package 2) and its scope is to update the curricula and subjects that were used for the development of the research educational and training program in Latvia and the region. This deliverable updates the core deliverable of WP2, D2.2 which links strategically the results of D2.1 “Good practices of research, educational and training programs on smart solutions for the interconnection of transportation networks” with D2.3 “Course material on smart solutions for the interconnection of transportation networks” (ALLIANCE, 2016a).

Following D2.2, the events that took place within the project’s phase of knowledge sharing, including the 1st Summer School in 2017 and two train the trainers seminars (section 3), provided feedback that was used to improve and update D2.2. In summary, D2.5 presents an updated version of all course material that was used to develop the research educational and training program in Latvia and the region. Toward this direction, courses are grouped into three categories: core, freight and passenger. Core courses are covered over both Summer schools in 2017 and 2018, while the remaining courses are grouped into “Freight” and “Passenger” courses and are modified to cover freight and passenger interchanges, respectively. As a result, the 1st and 2nd Summer school focus on freight and passenger transport interchanges, respectively.

Following the introductory chapter, the subsequent sections of this deliverable include: Chapter 2, which presents the methodology that was followed for the structure of the proposed curricula and presents updated courses. Chapter 3 summarizes the program objectives, the organization and the guidelines that are followed towards the development of the curricula and briefly presents the events that have been already been organized. Lastly, Chapter 4 updates and outlines the content of each course which is based on collected information from EU educational institutes and partner organizations as well as the leaning outcomes, teaching hours and accreditation points for each course; the final course content of the educational program will be detailed in D2.6.

The designed curricula will be further developed based on target groups’ feedback and the courses’ final contents will be depicted in the subsequent D2.7.

2 Methodology and implementation

2.1 Methodological approach

As presented above, D2.5 focuses on the update of a research, educational and training program in Latvia and the region. Towards this direction, the formulation of the curricula and subjects relied on three activities (ALLIANCE, 2016a):

- Identification of good practices in research, education and training in the domain.
- Existing research, educational and training programs offered at research and educational institutes at EU level were reviewed.
- An extensive survey was designed and conducted with institutes, which are active in providing specialized knowledge on intermodal transportation, terminals and logistics, in regards to planning and operation (surveys, etc.).

Combining outcomes of the previous three activities and of D2.1, a first set of curricula was drafted. These curricula included:

- Educational and training program to be implemented during the life cycle of the project. This program is addressed to students attending Master's and PhD courses in programs offered at TTI, on "Transport Economics and Management", "Transport and Logistics" and "Telematics and Logistics".
- Long-life-educational (LLE) program, addressed to University graduates who practice their profession in the transportation industry, thus work for an authority, SME, or other organization (Trans-logistics Educational forum).

Although the core of the programs will be the same, the LLE program will be adjusted to meet the needs of transport professionals. In order to respond to different requirements set by the two proposed curricula, ALLIANCE project will consider changes in their content, as regards the level of the offered scientific background.

The methodological approach that was adopted (and presented in D2.2) comprised of two parts, as follows:

1. Identification of educational areas. Based on the identified educational requirements for Latvia and the region that were the outcome of the two-level gap analysis in D2.1, 20 educational areas were created for passenger and freight transport interchanges given the available resources that were provided by the ALLIANCE partners based on the EU experience. These educational areas provided the foundation for subsequent tasks in ALLIANCE, namely the detailed presentation of course material in smart solutions for interconnecting transportation networks.

2. Conversion to courses. The 20 educational areas that are identified in Step 1 are combined based on their content (where applicable) to shape 12 courses for passenger and freight transport interchanges. These are the 12 courses that are used for training and education in Latvia.

2.2 Implementation of the selected method

In D2.1 the second-level gap analysis converted practice related requirements for passenger and freight transport interchanges (i.e., level-one gap analysis) into educational gaps and requirements for passenger and freight transport interchanges (i.e., level-two gap analysis). Table 2.1 summarizes the educational requirements for Latvia and the region per thematic area and topic for passenger and freight transport interchanges. Based on the findings in Table 2.1, the requirements per thematic area and topic are linked with an educational area. The educational areas were identified based on:

- Level-two gap analysis requirements
- Existing research, educational and training programs offered at research and educational institutes at EU level.

In total, 20 educational areas are identified for passenger and freight interchanges and are presented Table 2.1.

Table 2.1: Educational requirements for Latvia and the region (Level-two gap analysis)

Thematic Area	Topic	Gap I	Requirement	Educational areas
Governance	Stakeholders	-	Incorporation of organizational and business models in course material.	1. Building business models for passenger transport interchanges
	Policy	Legal framework does not focus on interchanges.	Improvement of course content on transport legal frameworks with reference to EU and partial coverage of interchanges and environmental legislation. Special attention on interchanges and environmental legislation in the courses oriented on EU transport policy issues.	2. Development and implementation of sustainability and transport policies in the EU region
		Not harmonized policy for interchanges.	**Improvement of course content on transport legal frameworks with reference to EU, freight transport and environmental legislation**	3. Development and implementation of freight transport policies in the EU region
	Ownership	Limited involvement of several authorities.	Incorporation of courses oriented on public private partnerships (PPP) models and mega infrastructure financing schemes in educational and training the program.	4. Public Private Partnerships in transport: Theory and schemes
		Limited business models development.	**Incorporation of innovative business models in course material.**	**5.** Building business models for freight transport interchanges
	Sustainable development	Limited incorporation of interchanges in regional and national development plans.	Incorporation in the program of topics with integrated development plans with reference to sustainable development and the environment.	6. Sustainable passenger transportation planning

Thematic Area	Topic	Gap I	Requirement	Educational areas
		Limited incorporation of interchanges in regional and national development plans.	**Incorporation in the program topics with integrated development plans with reference to sustainable development and the environment.**	7. Sustainable freight transportation planning
	Management	Interchange Management Plan not including all aspects of interchange functionalities and interests.	Development of material on integrated coordination and operation of mega infrastructure facilities with special reference to interchanges and the utilization of technological advances.	8. Operation and management of urban public transport systems
		-	**Incorporation of innovative business and management models in course material.**	**9.** Operation and management of urban freight transport systems
	Operation	Limited coordination among modes and operators.	Incorporation of transport operations education and training materials that will focus on multimodal systems.	10. Multimodal transport optimization for passenger transport (General and case studies)
		-	**Development of education material on integrated coordination and operation of mega infrastructure facilities with special reference to interchanges and the utilization of technological advances.**	11. Multimodal transport optimization for freight transport (General and case studies)
Smart solutions	Information	Limited multimodal information.	Exploration and utilization of technologies to respond to transport information based needs.	12. Information systems for passenger intermodal terminals
	Services	Limited integrating ticketing. Existing services do not offer	Development of course that integrates public transport with	13. Integrated ticketing and time table coordination

Thematic Area	Topic	Gap I	Requirement	Educational areas
		travellers real-time information across all stages of a multimodal trip Possible conflicts between vehicles and pedestrians. Not sufficient security level.	smart solutions (technology and policy oriented) and potential sustainability impacts. Incorporation in the program topics with interchange and terminal design and planning with reference to their special characteristics and safety issues.	14. Design and safety principles of transport terminal infrastructure
	Physical properties	Limited access for all. Insufficient cycling and walking facilities. Environmental concerns vary depending on facilities' age.	Development of education materials on transport planning and design of intermodal terminals for all users to satisfy user needs and fulfil sustainability principles.	15. Passenger terminal design
	New consolidation/distribution and logistics cooperative concepts	**Individually planned urban consolidation centers.** **Limited business and transport operational planning.**	**Development training materials for case studies of planning urban consolidation centers.**	**16.** Urban freight terminals design
	Information technologies	**Limited cooperation between publicly owned and operated Intelligent Transport Systems and enterprise-level software for supply-chain management, trip planning and fleet management.**	**Study of ITS characteristics and utilization in case studies for the effective supply chain management and trip planning.**	**17. Information technologies for intermodal freight transport**
	Smart transhipment	**Limited use of alternative, friendly to environment and energy technologies.**	**Review of policies related to alternative fuels and propulsion technologies, and estimation of environmental impacts for intermodal terminals.**	**18. Smart transhipment and alternative transport fuels**

Thematic Area	Topic	Gap I	Requirement	Educational areas
Decision-making	Interchange status assessment and users' feedback	Not obligatory. Insufficient information for decision making: only few surveys, data not reliable; no network assessment at the strategic level, etc. Limited data sharing.	Development of integrated course material that will focus on assessment practices with focus on interchanges and life cycle impacts (society, environment and economy) by including users' satisfaction.	19. Risk assessment analysis, behavioural modelling, social cost benefit analysis and multi-stakeholder multi-criteria assessment
	Decision-support methods	**Limited sharing of data.**	**Incorporation of novel data collection methods and exploitation of big data opportunities in decision making and analytics of freight transport.**	**20. Innovative data collection methods to support decision making**

Note: Grey hatched cells are freight based.

Following the identification of the 20 proposed educational areas, these are combined in 12 courses related to transport interchanges as shown in Figure 2.1, and were grouped in thematic areas as follows:

1. Governance

C1. The European policy on intermodal transport
C2. Building business models for intermodal transport interchanges
C3. Sustainable development and transportation planning
C4. Operation and management of intermodal transport systems
C5. Optimization of intermodal transport systems

2. Smart solutions

C6. Intelligent services for passenger transportation
C7. Smart information technologies in freight transport logistics
C8. Design of passenger transport interchanges
C9. Design of freight transport interchanges
C10. Smart equipment for freight transhipment

3. Decision making

C11. Decision making methodologies
C12. Data collection methods: Part a - Surveys, Part b - Historical and observed data

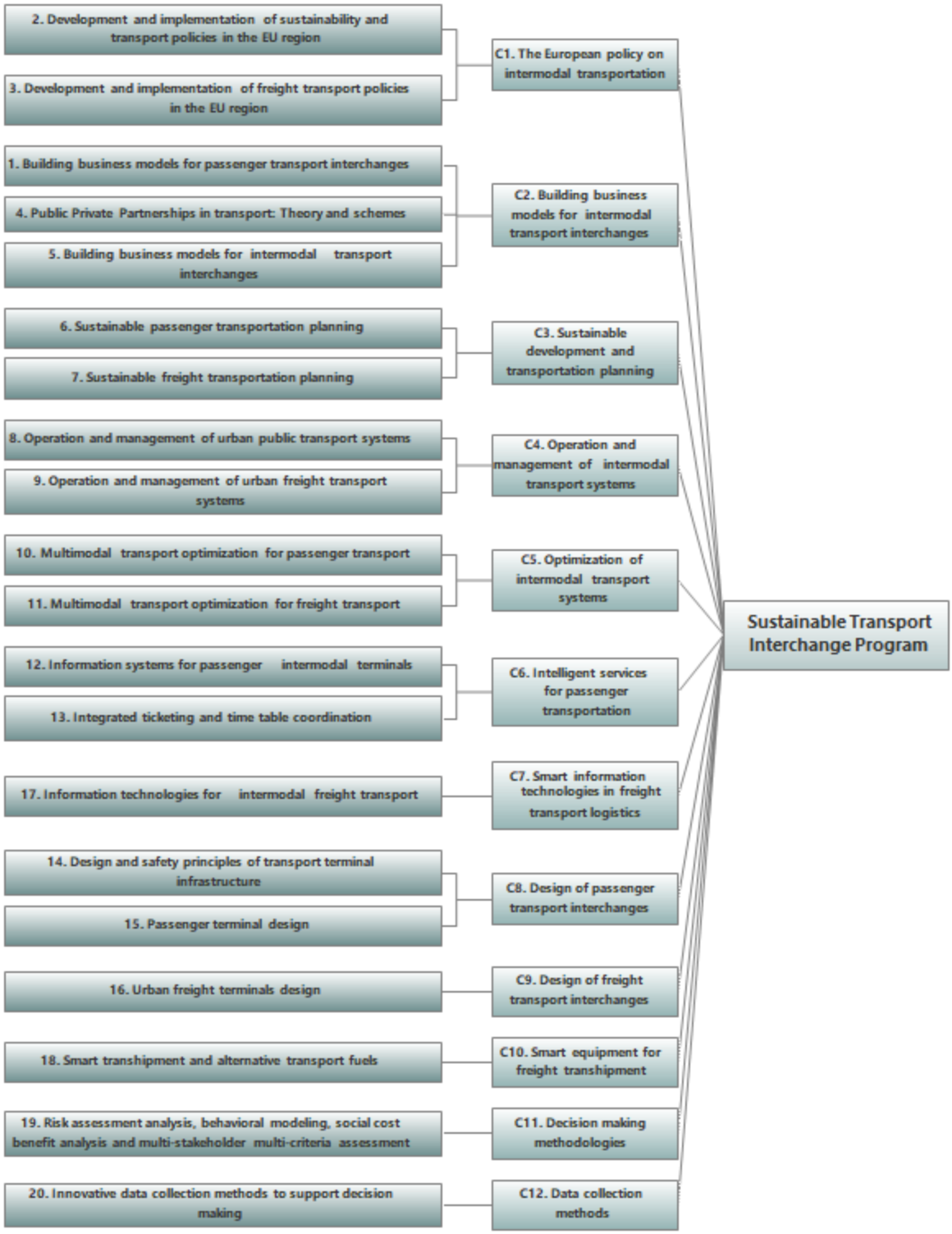

Figure 2.1 Combination of educational areas and resulting courses

Course material, based on the feedback from the assessment of the knowledge-sharing program is further divided into three parts: a) Core, b) Freight transportation, and c) Public transport

systems from research to decision making (i.e. passengers), as shown in Table 2.2, and planned to be covered over two Summer Schools (section 3.4). Core courses are covered over both Summer schools, whereas content for “Freight” and “Passenger” courses are modified to cover freight and passenger interchanges, respectively, and are covered exclusively during the 1st and 2nd Summer School, respectively. The introductory course “C0: Research methodology and teamwork setup” has been added to the course list to cover basic techniques of conducting literature review and writing scientific reports. Course title for “C7: Smart solutions for freight transport interchanges” has been updated and course “C12: Data collection methods” has been divided in parts A and B, as shown in Table 2.2.

Table 2.2. Core, freight and passenger STIP courses

Course	Core	Freight	Passenger
C0. Research methodology and teamwork setup	X		
C1. The European policy on intermodal transportation	X		
C2. Building business models for intermodal transport interchanges	X		
C3. Sustainable development and transportation planning		X	X
C4. Operation and management of intermodal transport systems		X	X
C5. Optimization of intermodal transport systems	X		
C6. Intelligent services for passenger transportation			X
C7. Smart information technologies in freight transport logistics		X	
C8. Design of passenger transport interchanges			X
C9. Design of freight transport interchanges		X	
C10. Smart equipment for freight transhipment		X	
C11. Decision making methodologies	X		
C12a. Data collection methods: Surveys		X	X
C12b. Data collection methods: Historical and observed data		X	X

3 CURRICULUM

3.1 Sustainable Transport Interchange Program

TTI with two internationally recognized research entities, UTH-Greece and Fraunhofer-Germany, developed an advanced research and higher education program in the field of smart interconnecting sustainable transport networks in Latvia capable of capturing the needs of interconnecting transportation networks and the research, educational and training requirements in Latvia and the region and complying with future infrastructural development in Latvia and the region. The developed program aims to strengthen the scientific and technological capacity of Latvia and build the grounds for a common understanding of the main components affecting sustainable intermodality and support the selection of the most optimal and applicable solutions for transport interchanges. It facilitates stakeholder collaboration and the development of strong linkage among education, research and industry and it will also assist graduates to develop the skills that are required in the complex profession of transport intermodality. While STIP is mainly addressed to graduate students who attend either program at TTI, i.e. “Transport Economics and Management” and “Transport and Logistics” students from other programs may also attend it.

3.2 Program Objectives

The program research, training and education objectives relate to the short term goal (within five years period) that its graduates expect to gain after fulfilling the requirement of the program. The educational objectives of the program are:

1. For graduates to develop essential skills on transportation intermodality and establish the engineering profile that is needed to address issues in society, environment, and economy.
2. For graduates to advance their careers to a higher position of responsibility by acquiring professional judgement and critical thinking of every day transport related problems.
3. For PhD students to become familiar with methods and tools that are prerequisites to fulfil their program and have not covered in previous earned degrees or are required in the development of their thesis.

3.3 Program Outcomes

Learning outcomes or competences gained specify what students will learn and what skills they will develop and are strongly linked with the courses and consequently with the objectives of the transport program (ALLIANCE, 2016b). For these reasons, the ALLIANCE project has adopted the 8 outcomes specified by the European Network for Engineering Accreditation (ENAEE, 2015). The Program Outcomes specified by ENAEE are intended to be applicable to the full range of graduate degree programs in engineering offered in European Higher European Institute’s (HEI). They have to be considered as the ‘minimum threshold’ defined by the ENAEE community and to be fulfilled in order to assure the quality of engineering programs. These are:

1. Knowledge and understanding

The learning process should enable Master Degree graduates to demonstrate:

- in-depth knowledge and understanding of mathematics and sciences underlying their engineering specialisation, at a level necessary to achieve the other program outcomes;
- in-depth knowledge and understanding of engineering disciplines underlying their specialisation, at a level necessary to achieve the other program outcomes;
- critical awareness of the forefront of their specialisation;
- critical awareness of the wider multidisciplinary context of engineering and of knowledge issues at the interface between different fields.

2. Engineering analysis

The learning process should enable Master Degree graduates to demonstrate:

- ability to analyse new and complex engineering products, processes and systems within broader or multidisciplinary contexts; to select and apply the most appropriate and relevant methods from established analytical, computational and experimental methods or new and innovative methods; to critically interpret the outcomes of such analyses;
- ability to conceptualise engineering products, processes and systems;
- ability to identify, formulate and solve unfamiliar complex engineering problems that are incompletely defined, have competing specifications, may involve considerations from outside their field of study and non-technical – societal, health and safety, environmental, economic and industrial – constraints; to select and apply the most appropriate and relevant methods from established analytical, computational and experimental methods or new and innovative methods in problem solving;
- ability to identify, formulate and solve complex problems in new and emerging areas of their specialisation.

3. Engineering design

The learning process should enable Master Degree graduates to demonstrate:

- ability to develop, to design new and complex products (devices, artefacts, etc.), processes and systems, with specifications incompletely defined and/or competing, that require integration of knowledge from different fields and non-technical - societal, health and safety, environmental, economic and industrial commercial – constraints; to select and apply the most appropriate and relevant design methodologies or to use creativity to develop new and original design methodologies;
- ability to design using knowledge and understanding at the forefront of their engineering specialisation.

4. Investigations

The learning process should enable Master Degree graduates to demonstrate:

- ability to identify, locate and obtain required data;
- ability to conduct searches of literature, to consult and critically use databases and other sources of information, to carry out simulation in order to pursue detailed investigations and research of complex technical issues;

- ability to consult and apply codes of practice and safety regulations;
- advanced laboratory/workshop skills and ability to design and conduct experimental investigations, critically evaluate data and draw conclusions;
- ability to investigate the application of new and emerging technologies at the forefront of their engineering specialisation.

5. Engineering practice

The learning process should enable Master Degree graduates to demonstrate:

- comprehensive understanding of applicable techniques and methods of analysis, design and investigation and of their limitations;
- practical skills, including the use of computer tools, for solving complex problems, realising complex engineering design, designing and conducting complex investigations;
- comprehensive understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations;
- ability to apply norms of engineering practice;
- knowledge and understanding of the non-technical – societal, health and safety, environmental, economic and industrial - implications of engineering practice;
- critical awareness of economic, organisational and managerial issues (such as project management, risk and change management).

6. Making judgements

The learning process should enable Master Degree graduates to demonstrate:

- ability to integrate knowledge and handle complexity, to formulate judgements with incomplete or limited information, that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgement;
- ability to manage complex technical or professional activities or projects that can require new strategic approaches, taking responsibility for decision making.

7. Communication and team-working

The learning process should enable Master Degree graduates to demonstrate:

- ability to use diverse methods to communicate clearly and unambiguously their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences in national and international contexts;
- ability to function effectively in national and international contexts, as a member or leader of a team, that may be composed of different disciplines and levels, and that may use virtual communication tools.

8. Lifelong Learning

The learning process should enable Master Degree graduates to demonstrate:

- ability to engage in independent life-long learning;
- ability to undertake further study autonomously.

3.4 Organization of Sustainable Transport Interchange Program

The STIP is going to be elaborated and organized as a summer school which is delivered over summers 2017 and 2018 and lasts one intensive week. Specific material is developed for the train-the-trainers session (section 3.6), which transfers knowledge to TTI's staff on the topics, and involve them in the teaching activities during the summer schools. The two Summer schools are:

- 1st Summer School "Sustainable Transport Interchanges Program (STIP) - Part 1: Freight transportation"
- 2nd Summer School "Sustainable Transport Interchanges Program (STIP) - Part 2: Public transport systems from research to decision making"

Final and preliminary course schedules for 1st and 2nd Summer Schools, presenting hours and the responsible institute per course are shown in Table 3.1 and Table 3.2, respectively. Courses are presented in detail in Chapter 4.

Table 3.1 1st Summer School STIP - Part 1: Freight transportation (2017)

Time	Monday	Tuesday	Wednesday	Thursday	Friday
9:00-10:00	Introduction	C2 - Fraunhofer	Invited lecture	Invited lecture	C12 - Fraunhofer/UTH
10:00-11:00			C9 - UTH	C5 - UTH	
11:00-12:00	C1 - UTH	C4 - UTH			
12:00-13:00					
14:00-15:00	C11 - UTH	C3 - UTH	C10 - Fraunhofer	C7 - Fraunhofer	Project time
15:00-16:00				Project time	
16:00-17:00	C0 -TTI	C11 -UTH	Project time	Technical visit	
17:00-18:00	Project time	Project time			

Table 3.2 2nd Summer School STIP - Part 2: Public transport systems from research to decision making (2018)

Time	Monday	Tuesday	Wednesday	Thursday	Friday
9:00-10:00	Introduction	Invited lecture	Invited lecture	Invited lecture	C12 - Fraunhofer/UTH
10:00-11:00		C2 - Fraunhofer	C8 - UTH	C5 - UTH	
11:00-12:00	C1 - UTH				Project time
12:00-13:00		C4 - UTH			
14:00-15:00	C11 - UTH	C4 - UTH	C6-Fraunhofer	Project time	Project time
15:00-16:00		C3 - UTH	Project time		
16:00-17:00	C0 -TTI			Technical visit	
17:00-18:00	Project time	Project time			

The educational program is addressed mostly to TTI's training staff, professors and students. However, this does not exclude any SMEs' (Small and Medium-sized Enterprises) personnel from participating in the educational and training course activities. On the contrary, the courses are available and free of charge to all TTI's collaborative bodies and companies originated in the domain of passenger and freight transport, just like open post graduate university courses, in the form of life-long education and training. This will enable both amateurs and professionals to take

the course while also bringing together theory and practice, bridging the gap between university and SMEs, providing a more integrated approach and establishing new collaborative schemes. In addition, through the dissemination actions, there will be an attempt to get in contact with staff from SMEs originated in the field of passenger and freight transport, such as operators, drivers' associations, shipping companies, logistics service providers and local authorities. This may contribute both to the broadening of the staff's knowledge and expertise, while also setting the base for the establishment of new communication and collaboration channels between research and market towards more integrated business schemes.

The 1st Summer School "Sustainable Transport Interchanges Program (STIP) - Part 1: Freight transportation" took place in Riga, Latvia from 16th to 22nd July, 2017. The Summer School was organized by the Transport and Telecommunication Institute (TTI), the Traffic, Transportation and Logistics Laboratory of the University of Thessaly (TTLog) and the Fraunhofer Institute for Factory Operation and Automation (IFF). In total 25 young researchers from Latvia, Lithuania, Greece and Germany participated in the Summer school, which was realized at the premises of TTI in collaboration with the other two institutes' staff who will be the main providers of the teaching material, knowledge and know-how. Students had the opportunity to visit Riga's Commercial port, attend two special lectures by Graham Ellis (UK) "Freight terminals – facing the challenges, a real world perspective" and Jens Klauenberg (Germany) **"**Current status and future trends in freight transport" and form collaboration teams for the student's project.

The teaching material includes PowerPoint theoretical presentations, educational videos from real world applications and on-site visits, as well as homework, gaming quiz or puzzle games via open access internet platforms in order to raise awareness of the audience.

3.5 Program Evaluation

Summer schools are followed by an analytic examination process at the end of the week that takes place at TTI's premises with the participation of all trainees in order to assess the degree of knowledge transfer and understanding.

Trainees are expected to actively participate in a project-teamwork throughout the duration of the project; the resulting technical report is submitted and presented upon completion of summer school. For the project formulation, trainees are grouped into teams and each team has a designated advisor (i.e. one of the trainers) to lead them.

Trainees are evaluated by two trainers from the University of Thessaly (TTLog) and the Fraunhofer Institute for Factory Operation and Automation (IFF) and one member of TTI in order to guarantee meritocracy. Passing the exams, the students are granted 6 ECTS for the program.

3.6 Train the Trainers Seminar

The Train the Trainer seminar took place prior to STIP Summer Schools; during this seminar all twelve courses were presented in summary by each responsible Institute within 20 minutes. The Train the Trainer seminar aims to disclose the syllabus that is going to be presented in detail during

the duration of the STIP, to address potential issues that might have occurred from the implementation of the STIP, as well as to present advancements in the domain of intermodal terminals. The outcome is the dissemination of knowledge, the networking of the involved partners' personnel and the development of a clear ground for joint research activities and collaboration in the near future.

The first Train the Trainer seminar was held in Riga, Latvia in October 19, 2016, during the 16th International Conference on Reliability and Statistics in Transportation and Communication (RelStat'16). The schedule of this seminar is shown in Table 3.3.

Table 3.3 Train the trainer seminar schedule (2016)

Time	Topic	Responsible
10:00 -10:45	Good practices of research, educational and training programs on smart solutions for the interconnection of transportation networks in EU.	UTH
10:45 -11:15	Good practices of research, educational and training programs on smart solutions for the interconnection of transportation networks in BSR.	TTI
11:15 -11:45	Review of the gap and developed in frame of project study program particularities and characteristics	UTH
11:45 - 12:00	Discussion of the study program	
Courses detailed presentation		
12:00 – 12:20	C1. The European policy on intermodal transportation	UTH
12:20 – 12:40	C2. Building business models for intermodal transport interchanges	Fraunhofer
12:40 – 13:00	C3. Sustainable development and transportation planning	UTH
14:00 – 14:20	C4. Operation and management of intermodal transport systems	UTH
14:20 – 14:40	C5. Optimization of intermodal transport systems	UTH
14:40 – 15:00	C6. Intelligent services for passenger transportation	Fraunhofer
15:00 – 15:20	C7. Smart information technologies in freight transport logistics	Fraunhofer
15:20 – 15:40	C8. Design of passenger transport interchanges	UTH
15:40 – 16:00	C9. Design of freight transport interchanges	UTH
16:30 – 16:50	C10. Smart equipment for freight transhipment	Fraunhofer
16:50 – 17:10	C11. Decision making methodologies	UTH
17:10 – 17:30	C12a. Data collection methods: Surveys C12b. Data collection methods: Historical and observed data	Fraunhofer/ UTH

The second Train the Trainer seminar took place during the 17th International Conference on Reliability and Statistics in Transportation and Communication (RelStat'17) in Riga, Latvia on October 19 and was entitled "Experience and impressions after 1st Summer School". In addition to its aim to disclose the syllabus that is going to be presented in detail during the duration of the forthcoming STIP, its objective was to organize a discussion with all involved parties about the results of the 1st Summer school "Sustainable Transport Interchange Program (STIP) – Part 1: Freight transportation", which was organised in July, 2017. Specifically, the main goal was to receive feedback from students, trainers and lecturers from TTI regarding their vision on introducing STIP courses to the TTI new or existing study program. Table 3.4 presents the schedule for the second Train the Trainer seminar in 2017.

Table 3.4 Trainers' seminar schedule (2017)

Time	Topic	Responsible
16:00 - 16:15	Overview of developed Sustainable Transport Interchanges Program (STIP)	UTH
16:15 - 16:30	Feedback from participants from 1st Summer School "Sustainable Transport Interchanges Program (STIP) -Part 1: Freight transportation"	TTI
16:30 - 16:45	Feedback from tutors from 1st Summer School	UTH/ Fraunhofer
16:45 - 17:00	STIP impacts on TTI PhD and MS programs	TTI
17:00 - 17:45	Brief messages regarding STIP course from TTI staff that implement it in the academic programme	TTI
17:45 - 18:00	Round Table	TTI

4 Sustainable Transport Interchange Program Courses

This section presents the courses that compose STIP in the form of tables. The 12 selected transport related courses have been designed and the information collected from the process has been inserted in the following tables. D2.2 presented the 12 courses as these were formed before the organization of the 1st Summer school. D2.5 presents an updated version of all courses following knowledge feedback from organized events within the frame of ALLIANCE project. More specifically, this section presents the updated course material for courses that have been selected to address freight and passenger topics; these courses refer to the "Freight" and "Passenger" courses (section 2.2). In the following tables, "Freight" and "Passenger" course titles are supplemented with the year of implementation (i.e. 2017 or 2018) to indicate for which Summer school program are part of. Remaining courses compose the "core" courses that are delivered in both Summer schools; their material is updated and presented by a single course material table.

Course: C0	
Title	**Research methodology and teamwork setup**
Thematic area	NA
Responsible Institutes	Transport and Telecommunication Institute - TTI, Latvia University of Thessaly - UTH, Greece
Lecturers	Prof. Irina Yatskiv (Jackiva) (TTI) Prof. Eftihia Nathanail (UTH)
Aim	• Present techniques of conducting literature review • Guide how to use databases, search engines and electronic libraries • Explain how to write a scientific report • Explain how to prepare and present research work • Organize teams for conducting the summer school project.
Learning outcomes	
On successful completion of the course, students will: attain knowledge on how • to work with databases, search engines and electronic libraries to retrieve information about a topic • to prepare a research paper, literature review, monograph, dissertation and poster be able to • plan a program of research • conduct state-of-the-art in research direction • document methodology and results • work as a team member • communicate with colleagues about their research	
Prerequisites (if any)	
-	
Language	English
Hours	1

Key words	Research, paper, presentation, literature review, dissertation, report, citation, references, ethics, team
Syllabus	Course material will be presented to facilitate students' conceptual understanding of scientific work which is necessary part of master or PhD thesis, and to help them choosing their research topic, as well as to improve their presentation skills. In the course students acquire basic principles of analysis and overview of scientific publications which are necessary for the development of thesis. The student will be become familiar with scholarly resources in particular fields of science and technology and be able to critically analyze and evaluate sources sufficient to develop an annotated bibliography and literature review for their chosen topic. **Course topics:** • Research Methodology 1. Research process: definition, phases, methods 2. Scientific document types • Review Paper • Thesis • Technical Report • Case Study • Scientific Article • Scientific Proposal 3. Guidelines for good research work 4. Disseminating your research 5. Citations and references 6. Research ethics • Teamwork setup
Bibliography	• The Writing Lab & The OWL at Purdue and Purdue University (1995-2011) • A Guide for Writing Research Papers Based on Modern Language Association, documentation prepared by the Humanities Department as part of The Guide to Grammar and Writing and the Arthur C. Banks Jr. Library Capital Community College Hartford, Connecticut. • Bates College, How to Write a Paper in Scientific Journal Style and Format, http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWgeneral.html • Alan Stevens, "Preparing the scientific paper, or: Confessions of a Journal Editor". • Kate L. Turabian, "A Manual for Writers of Research Papers, Theses, and Dissertations", Seventh Edition. • Richard Pears and Graham Shields, (2005), "Cite them right: the essential guide to referencing and plagiarism". Pear Tree Books, Newcastle upon Tyne, http:www.citethmright.co.uk. • Elsevier. Publishing Ethics Resource Kit (PERK). Available at: http://www.elsevier.com/wps/find/editorshome.editors/Introduction.Accessed: June 11, 2012 • Gustavii, B. (2008). How to Write and Illustrate a Scientific Paper. Second Edition. Cambridge: Cambridge University Press. 178 p.

	• Jonker J. Pennink, B. (2010). The Essence of Research Methodology. A Concise Guide for Master and PhD Students in Management Science. Berlin. Heidelberg: Springer–Verlag. 250 p. • The University of Wisconsin-Madison Writing Center, 2007: The Writer's Handbook: Scientific Reports. Internet: <http://www.wisc.edu/writing/Handbook/ScienceReport.html> • Comrie, A.C., 2007: Scientific Report Writing. Internet: <http://www.geog.arizona.edu/~comrie/geog230/report.htm>. • Latham, J. R. (2014). Research design canvas: A framework for designing and aligning the "DNA" of your research study (Version 2.0 ed.). Colorado Springs, Colorado: Organization Design Studio™ Ltd. • Nancarrow, S., Booth, A., Ariss, S., Smith, T., Enderby, P. and Roots, A. (2017). Ten principles of good interdisciplinary team work.Internet: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3662612	
Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	
	Visits at facilities	
	Other (describe): Case studies	
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) …….	
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Number of topics	8	

Course: C1	
Title	**The European policy on intermodal transportation**
Thematic area	Governance
Responsible Institute	University of Thessaly, Greece
Lecturer	Dr. Giannis Adamos
Aim	• Present and analyse the basic concepts on intermodality • Identify stakeholders that play an important role in intermodal transport • Identify trends, challenges and emerging schemes that will influence the shaping of future European Transport Policy • Review the European legislation and policies in terms of transport modes (road, rail, waterborne, air), transport system environment, intermodality and financing • Review, analyse and assess the planning and financing schemes developed in the representative European countries addressing intermodal transport.
Learning outcomes	
• Provide an understanding of the basic concepts on intermodality • Possess an understanding of the complexity of decision-making processes, mainly addressed by the involvement of several entities and the conflict of interests of the involved stakeholders • Acquire knowledge of the European Union's policies and legislation on intermodality • Ensure that students are capable of investigating and identifying key drivers that provide coherence in the regulatory framework, and the planning and financing schemes affecting intermodality within decision-making.	
Prerequisites (if any)	
-	
Language	English
Hours	2
Key words	Interchanges, stakeholders, EU policies, legislation, institutional frameworks, planning schemes, financing schemes
Syllabus	This course introduces the basic concepts that are met in intermodal transport, such as intermodality, co-modality, passenger urban interchanges, freight urban interchanges, long-short distance interconnection, urban/interurban interconnection, sustainable transport. The main focus of the course is to present the European policies and legislation on intermodality, to identify the degree of flexibility provided by EU legal instruments, to illustrate how this flexibility is adopted by representative European countries, e.g. Italy, Norway, Czech Republic and Greece, and to investigate the role that other regulatory actors may have. Also, it analyses the complexity of the decision-making processes followed in intermodal transport, mainly affected by the involvement of different entities in all stages and the absence of a strict hierarchical flow chart of responsibilities, resulting to complicated procedures. **Course topics:**

	• Background • Basic concepts • Future trends and emerging schemes in European Transport Policy • Transportation in an era of change • Obstacles and problems • Decision-making framework • Stakeholders and interrelations • European institutional framework • EU policies and strategies • Regulatory frameworks • Indicative legislation • Planning and financing schemes • Case studies • Suggested literature • List of indicative legislation
Bibliography	• Adamos, G., Tsami, M. & Nathanail, E., 2015. "Urban interchanges: Moving towards a seamless transportation solution". 5th International Conference on Environmental Management, Engineering, Planning and Economics (CEMEPE) and SECOTOX Conference. Mykonos Island, Greece, June 14-18, 2015. • Adamos, G. & Nathanail, E., 2013. "Recommendations on the development and implementation of a coherent decision making process in the short-long transport interconnection". 13th World Conference on Transport Research, Rio de Janeiro, Brazil, July 15-18, 2013. • Adamos, G., Nathanail, E. & Zacharaki, E., 2012. "Developing a Decision-Making Framework for collaborative practices in long-short distance transport interconnection". Procedia – Social and Behavioral Sciences, Volume 48, 2012, Pages 2849-2859. • CLOSER, 2011. CLOSER Deliverable D4.1. Analysis of the decision-making framework. CLOSER Project. • CLOSER, 2012. CLOSER Deliverable D4.2. Policy Advisory Group recommendations. CLOSER Project. • European Commission, 2001. White Paper " European transport policy for 2010: Time to decide (CEC, 2001). • European Commission, 2004. Towards passenger intermodality in the European Union. Brussels. • European Commission, 2006. Keep Europe Moving. Sustainable mobility for our continent. Mid-term review of the European Commission's 2001 transport White Paper. ISBN 92-79-02312-8. Luxemburg: Office for Official Publications of the European Communities, 2006. • European Commission, 2007. "GREEN PAPER - Towards a new culture for urban mobility", Brussels, 25.9.2007 COM (2007) 551 final. • European Commission, 2009. A sustainable future for transport — Towards an integrated, technology-led and user-friendly system Luxembourg: Publications Office of the European Union 2009 — 26 pp. — 21 x 29.7 cm ISBN 978-92-79-13114-1.

- European Commission, 2011. Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. White Paper of the European Commission. COM (2011) 144 final.
- Eurostat (population and social conditions), Statistics in Focus No 72/2008; and European Commission, 'Demography report 2008: Meeting social needs in an ageing society'. SEC(2008) 2911.
- Nathanail E. and Adamos, G. 2013. "Planning and financing schemes linked to the decision-making for the interconnection of long-short distance transport". Transport and Telecommunication. Volume 14, Issue 1, Pages 20–28, ISSN (Online) 1407-6179, ISSN (Print) 1407-6160, DOI: 10.2478/ttj-2013-000, February 2013.
- United Nations Population Division (2009), 'World population prospects — The 2008 revision'.

List of Indicative legislation

- Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions of 25 June 2008: "Single European Sky II: towards more sustainable and better performing aviation".
- Communication from the Commission of 28 February 2013: EU Space industrial policy: Releasing the potential for economic growth in the space sector.
- Council Regulation (EC) No 12/98 of 11 December 1997, laying down the conditions under which non-resident carriers may operate national road passenger transport services within a Member State.
- Council Regulation (EEC) No 684.92 of 16 March 1992 on common rules for the internal carriage of passengers by coach.
- Council Directive 95/64/EC of 8 December 1995 on statistical returns in respect of carriage of goods and passengers by sea.
- Council Directive 96/48/EC of 23 July 1996 on the interoperability of the trans-European high-speed rail system.
- Council Regulation (EC) No 2236/95 of 18 September 1995 laying down general rules for the granting of Community financial aid in the field of trans-European networks.
- Decision No 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community guidelines for the development of the trans-European transport network.
- Directive 2004/49/EC of the European Parliament and of the Council of 29 April 2004 on safety on the Community´s railways and amending Council Directive 95/18/EC on the licensing of railway undertakings.
- Directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification.
- Directive 2012/34/EU of the European Parliament and of the Council of 21 November 2012 "Establishing a single European railway".
- Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of intelligent transport systems in the field of road transport and for interfaces with other modes of transport.
- Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the single European sky.

	• Regulation (EC) No 552/2004 of the European Parliament and of the Council of 10 March 2004 on the interoperability of the European Air Traffic Management network. • Regulation (EC) No 550/2004 of the European Parliament and of the Council of 10 March 2004 on the provision of air navigation services in the single European sky.	
Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	
	Visits at facilities	
	Other (describe): Case studies	x
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) ……	
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Number of topics	15	

Course: C2	
Title	**Building business models for intermodal transport interchanges**
Thematic area	Governance
Responsible Institute	Fraunhofer Institute for Factory Operation and Automation IFF, Otto-von-Guericke-University Magdeburg, Germany
Lecturer	Dr.-Ing. Henning Strubelt
Aim	• Get introduced to business models and the development thereof • Get enabled to analyse the options for and limitations to logistics implementation concepts concerning intermodal transport aspects • Develop a thorough understanding of the physical and monetary aspects and processes of material flow technology in intermodal transport networks • Get enabled to evaluate business models for intermodal transport
Learning outcomes	
• Acquire basic knowledge of intermodal transport interchanges and business models • Acquire knowledge about the processual importance of intermodal transport interchanges in efficient supply chains • Develop skills for logistical evaluations required for the selection of intermodal transport concepts and to assess economic conditions of service and functionality • Enable the analysis and definition of complex intermodal transport networks	
Prerequisites (if any)	
-	
Language	English
Hours	2
Key words	Logistics, business models, intermodal interchanges, modal split, transport modes
Syllabus	This course is composed of two parts, a lecture style introduction to the topic of business models in intermodal transport, in particular intermodal interchanges and an exercise section. The lecture includes the topics of creation and analysis of business models, an introduction to intermodal transport chains, possible transport mode interchanges and their relevant business models and the fundamental principles of technological means and infrastructure in logistics. Further it gives a summary of recent research findings and current applications of intermodal transport. The exercise section is divided into three parts itself. The first part is the assessment of intermodal transport modes, to understand their specific advantages and disadvantages from a technological, economic, and ecological point of view. The second part of the exercise section involves an exemplary shipment, which is to be realized by intermodal transport. The aspects of sustainability and costs are evaluated and a business model for the participants' preferred variant is to be developed. The last exercise section is concerned with the evaluation of a business model using the bm canvas. The objectives of the exercise are deepening the understanding of application fields of intermodal transport, assessing intermodal transport modes on their technological and monetary soundness (which is facilitated by the discussion of possibilities and their pros and cons) and gaining practical knowledge on the analysis of business

	models. The first exercise section is done individually, while the second and third are intended to be done in small groups. The course will conclude with a presentation of the developed business models and preferred intermodal transport solutions for the discussed case. This is followed by a short summary of the workshop, and an evaluation of intermodal interchanges based on a critical discussion.	
Bibliography	• Brinkmann, B. (2005): Seehäfen, Planung und Entwurf, Springer, Berlin. • Fielt, E. (2011): Business Model Definition. Business Service Management, Smart Services CRC Pty Ltd., Vol. 3. • Gleissner, H., Femerling, J. C. (2013): Logistics : Basics - Exercises - Case Studies, Springer, Cham. • Osterwalder, A., Pigneur, Y. (2010): Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, Wiley & Sons, Hoboken, NJ. • Pfohl, H.C. (2010): Logistiksysteme, Betriebswirtschaftliche Grundlagen, Springer, Cham. • Rodrigue, J.-P., Slack, B., Comtois, C. (2013): Transportation Modes, Modal Competition and Modal Shift, In: The Geography of Transport Systems, 3rd ed., New York: Routledge. • Trapp, M. (2014): Realizing Business Model Innovation - A Strategic Approach for Business Unit Managers, Springer Fachmedien, Wiesbaden.	
Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	x
	Visits at facilities	
	Other (describe) …summary and critical discussion…….	x
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) …….	
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Number of topics	3	

Course: C3 (2017)	
Title	**Sustainable development and transportation planning for freight**
Thematic area	Governance
Responsible Institute	University of Thessaly, Greece
Lecturer	Dr. Lambros Mitropoulos, Prof. Eftihia Nathanail
Aim	The course aims to provide an understanding of transportation planning at a National, regional and local context through outlining transport strategies, policies and smarter choices for increasing sustainability. Methods and approaches for analysing intermodal transport and sustainable transport interchanges are presented, such as scenarios, forecasting, environmental impact and safety analysis and strategic environmental assessment. The course will provide knowledge on planning and operations of intermodal transport systems and their analysis and evaluation through various measures of performance.
Learning outcomes	
• Implement the basic concepts of transportation modelling, scenario development and forecasting • Identify the challenges and elements for creating sustainable transport systems • Develop relevant policy measures, strategies and select smart solutions to address transport oriented problems • Account for sustainability indicators, implement indicators to different transport systems and compare scenarios with present transport systems • Identify different stakeholder groups and factors influencing transport development • Embed environmental impact and safety assessment approach of transport interchanges	
Prerequisites (if any)	
-	
Language	English
Hours	2
Keywords	Sustainable assessment, freight modelling, forecasting, indicators
Syllabus	This course will focus on integrated development plans with reference to sustainable development and the environment. During the entire course attention is paid to a sustainable development of the transport interchanges for freight in the European Union. First the course will present essential transportation forecasting methodologies that are used at EU level and the importance of forecasting towards estimating transport impacts and successfully delivering transport plans. The components which affect traveling and transportation system performance will be identified. The sustainability principles will be covered. Sustainability Urban Logistics Plans will be analysed. Indicators being estimated by impact assessment of transportation interchanges will be discussed and explained. Students will get exposed to software packages dealing with transportation planning and impact assessment. **Course topics:** • Background

	• Sustainable transport • Smart solutions in sustainable transportation planning • Sustainable urban development and mobility plans • Transportation planning principles • Modelling freight transport • Transport impacts • Environmental impact assessment • Safety impact assessment
Bibliography	• Banister D. (2002). Transport planning (Transport, Development and Sustainability Series). Second edition. Routledge. • Beckx C, Arentze T, Int Panis L, Janssens D, Vankerkom J, Wets G (2009). An integrated activity-based modelling framework to assess vehicle emissions: approach and application. Environment and Planning B: Planning and Design. 36 (6): 1086–1102. doi:10.1068/b35044. • Cascetta E. (2009). Transportation system analysis: models and applications. 2nd edition. Springer. • Denos C. Gazis. (2002). Traffic theory, Kluwer Academic Publishers. • EUROSTAT, “Methodologies used in surveys of road freight transport in Member States, EFTA and Candidate Countries”, EUROSTAT manuals and guidelines, 2014. • Handbook of Transport Modelling, Handbooks in Transport, Volume 1, Edited by David A. Hensher and Kenneth J. Button, Pergamon, an Imprint of Elsevier Science, 2005. • Hensher D.A., Button K.J. (2000). Handbook of transport modelling, Pergamon. • Lincoln MPO. (2006). Travel demand model. Loma and associates. http://www.princeton.edu/~alaink/Orf467F12/LincolnTravelDemandModel.pdf • Meyer M., Miller E. (2000). Urban transportation planning, 2nd Edition, McGraw-Hill Series in Transportation. • Model validation, Final report revised for TransCAD 4.8. (2008). Alliance Transportation Group, Inc. CARTS TRAVEL DEMAND MODEL IMPROVEMENT PROGRAM (PHASE II) (S) METROPLAN. LITTLE ROCK ARKANSAS. • Moshe E. Ben-Akiva, Steven R. Lerman. (1985). Discrete choice analysis: Theory and application to travel demand. The MIT Press. • Oppenheim, N. (1995). Urban travel demand modeling, from individual choices to general equilibrium, J. Wiley & Sons. • Richardson E.A, and A. Meyburg. (1995). Survey methods for transport planning. Eucalyptus Press. • Stopher P. and M.Lee-Gosselin. (1997). Understanding travel behaviour in an era of change. Pergamon. • Trip generation manual. (2014). 9th edition, Institute of Transportation Engineers ITE. • Weidner T.J., Donnelly R., Freedman J., Abraham J.E., Hunt J.D. (2007). A summary of the oregon TLUMIP model microsimulation modules. Presented at the 86th Annual Meeting of the Transportation Research Board, Washington D.C. • Willumsen L. (2014). Better traffic and revenue forecasting. Maida Vale Press.

Teaching methods	Lectures	x
	Demonstrations	
	Hands on/gaming	
	Exercises	
	Visits at facilities	
	Other (please describe):	
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) ……	
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Number of topics	9	

Course: C3 (2018)	
Title	**Sustainable development and transportation planning for passengers**
Thematic area	Governance
Responsible Institute	University of Thessaly, Greece
Lecturer	Dr. Lambros Mitropoulos, Prof. Eftihia Nathanail
Aim	The course aims to provide an understanding of transportation planning at a National, regional and local context through outlining transport strategies, policies and smarter choices for increasing sustainability. Methods and approaches for analysing intermodal transport and sustainable transport interchanges are presented, such as scenarios, forecasting, environmental impact and safety analysis and strategic environmental assessment. The course will provide knowledge on planning and operations of intermodal transport systems and their analysis and evaluation through various measures of performance.
Learning outcomes	
• Implement the basic concepts of transportation modelling, scenario development and forecasting • Identify the challenges and elements for creating sustainable transport systems • Develop relevant policy measures, strategies and select smart solutions to address transport oriented problems • Account for sustainability indicators, implement indicators to different transport systems and compare scenarios with present transport systems • Identify different stakeholder groups and factors influencing transport development • Embed environmental impact and safety assessment approach of transport interchanges	
Prerequisites (if any)	
-	
Language	English
Hours	2
Keywords	Sustainability, modelling, forecasting, software, transportation impact.
Syllabus	This course will focus on integrated development plans with reference to sustainable development and the environment. During the entire course attention is paid to a sustainable development of the transport interchanges for freight in the European Union. First the course will present essential transportation forecasting methodologies that are used at EU level and the importance of forecasting towards estimating transport impacts and successfully delivering transport plans. The components which affect traveling and transportation system performance will be identified. The sustainability principles will be covered. Sustainability Urban Mobility Plans will be analysed. Indicators being estimated by impact assessment of transportation interchanges will be discussed and explained. Students will get exposed to software packages dealing with transportation planning and impact assessment. **Course topics:** • Sustainable transport • Smart solutions in sustainable transportation planning

	• Sustainable urban development and mobility plans • Transportation planning principles • Transportation planning models • Transport impacts • Environmental impact assessment • Safety impact assessment	
Bibliography	• Banister D. (2002). Transport Planning (Transport, Development and Sustainability Series). Second edition. Routledge. • Beckx C, Arentze T, Int Panis L, Janssens D, Vankerkom J, Wets G (2009). "An integrated activity-based modelling framework to assess vehicle emissions: approach and application". Environment and Planning B: Planning and Design. 36 (6): 1086–1102. doi:10.1068/b35044. • Cascetta (2009). Transportation System Analysis: models and applications. 2nd edition. Springer. • Denos C. Gazis, (2002). Traffic Theory, Kluwer Academic Publishers. • Hensher D.A., Button K.J., Handbook of Transport Modelling, Pergamon, 2000. • Lincoln MPO, Travel demand model, (2006). Loma and associates. http://www.princeton.edu/~alaink/Orf467F12/LincolnTravelDemandModel.pdf • Meyer M. and E.Miller (2000). Urban Transportation Planning 2nd Edition, McGraw-Hill Series in Transportation. • Model validation, Final report revised for TransCAD 4.8, (2008). Alliance Transportation Group, Inc. CARTS TRAVEL DEMAND MODEL IMPROVEMENT PROGRAM (PHASE II) (S) METROPOLITAN. LITTLE ROCK ARKANSAS • Moshe E. Ben-Akiva, Steven R. Lerman (1985). Discrete Choice Analysis: Theory and Application to Travel Demand, The MIT Press. • Oppenheim, N. Urban Travel Demand Modeling, From Individual Choices to General Equilibrium, J. Wiley & Sons, 1995. • Ortuzar, J. D. and L. G. Willumsen, Modelling Transport, (2011). J. Wiley & Sons. • Richardson, E. Ampt, and A. Meyburg (1995). Survey Methods for Transport Planning, Eucalyptus Press. • Stopher P. and M.Lee-Gosselin, (1997). Understanding travel behaviour in an era of change, Pergamon. • Trip generation manual, (2014). 9th edition, Institute of Transportation Engineers ITE. • Weidner, T.J., Donnelly, R., Freedman, J., Abraham, J.E., and J.D. Hunt (2007). A Summary of the Oregon TLUMIP Model Microsimulation Modules, presented at the 86th Annual Meeting of the Transportation Research Board, Washington D.C. • Willumsen, L. (2014). Better Traffic and Revenue Forecasting. Maida Vale Press.	
Teaching methods	Lectures	x
	Demonstrations	
	Hands on/gaming	
	Exercises	

	Visits at facilities	
	Other (please describe):	
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) ……	
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Number of topics	9	

Course: C4 (2017)	
Title	**Operation and management of intermodal transport systems: freight interchanges**
Thematic area	Governance
Responsible Institute	University of Thessaly, Greece
Lecturers	Dr. Giannis Adamos, Prof. Eftihia Nathanail
Aim	• This course is oriented to the operation and management of freight interchanges • It analyses the organization of interchanges regarding operational functionality, management and efficiency of services.
Learning outcomes	
• Provide an understanding of how stakeholder engagement and management works • Conduct an operational analysis, with the use of integrated management and operation practices, which are based on structures met in several European countries and case studies • Recognize and assess implications revealing from different regulatory, operational and managerial structures • Analyse the impacts of interchanges on local economy and the role they have in land use planning.	
Prerequisites (if any)	
-	
Language	English
Hours	2
Key words	Interchange, operation, management, stakeholders, transhipment, information and communication technologies.
Syllabus	The course analyses the involvement of stakeholders and stakes, and respective questions are answered, such as: “Why, when and which stakeholders to involve?”, “What is public involvement, and what kind of public should be involved within the interchange decision-making process”, etc. In addition, the course analyses the organization of interchanges in terms of operational functionality, management, practicalities, services and efficiency, while the impacts on local economy and land use planning are also introduced. **Course topics:** • Background • Stakeholders • Interchange types • Aspects of interchange typology • Development • Operation • Management • Information and Communications Technologies • Main principles for management and operational structures • Case studies • Suggested literature

Bibliography	• Ballis, A., 2004. Introducing Level of Service Standards for Intermodal Freight Terminals. Transportation Research Record: Journal of the Transportation Research Board, Vol 1873, Washington DC, pp. 79-88. • Banister, D. & Berechman, Y., 2001. Transport investment and the promotion of economic growth. Journal of Transport Geography, 9(2001) 209-218. • Bask, A. 1999. Third Party Relationships in Logistics Services, Helsinki School of Economics and Business Administration, Licentiate Thesis, Helsinki. 140 p. • European Commission, 2001. White Paper " European transport policy for 2010: Time to decide (CEC, 2001). • European Commission, 2006. Keep Europe Moving. Sustainable mobility for our continent. Mid-term review of the European Commission's 2001 transport White Paper. ISBN 92-79-02312-8. Luxemburg: Office for Official Publications of the European Communities, 2006. • European Communities, 2009. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Action Plan of Urban Mobility. COM (2009) 490 final. Brussels, Belgium. • European Commission, 2011. Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. White Paper. COM (2011) 144 final. European Commission. Brussels, Belgium. • Gogas, M., Papoutsis, K., Nathanail, E., Adamos, G. & Kapetanopoulou, P., 2012. A comparison study on urban-interurban interfaces on ports – The Constantza and Thessaloniki ports case studies. 2nd International Conference on Supply Chains, Katerini, Greece, October 5-6, 2012. • Harris, I., Wang, Y. & Wang, H., 2015. ICT in multimodal transport and technological trends: Unleashing potential for the future. Int. J. Production Economics 159 (2015) 88-103. • IMONODE, 2005. WP3: Supply side – Intermodal network analysis. IMONODE – Efficient Integration of Cargo Transport Modes & Nodes in CADSES area. • Monzon, A. & Di Ciommo, F. (Editors), 2015. CITY-HUBs: Sustainable and Efficient Interchange Stations. Taylor and Francis Group. • Nathanail, E., 2007. "Developing an integrated logistics terminal network in the CADSES area", Transition Studies Review, issue 45. • NOVELOG, 2016a. NOVELOG Deliverable D2.2. Urban freight and service transport in European cities. • Papoutsis, E. Nathanail, 2016. Facilitating the Selection of City Logistics Measures through a Concrete Measures Package: A Generic Approach Transportation Research Procedia 12, 679-691. • NOVELOG, 2016b. NOVELOG Deliverable D5.1. City cases implementation. • STRAIGHTSOL, 2014a. STRAIGHTSOL Deliverable D5.1. Demonstration assessments. • STRAIGHTSOL, 2014b. STRAIGHTSOL Deliverable D5.3. Business models for innovative and sustainable urban-interurban transport.	
Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	

	Visits at facilities	
	Other (describe): Case studies	x
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) ……	
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Number of topics	11	

Course: C4 (2018)	
Title	**Operation and management of intermodal transport systems – passenger interchanges**
Thematic area	Governance
Responsible Institute	University of Thessaly, Greece
Lecturers	Dr. Giannis Adamos
Aim	• This course is oriented to the operation and management of passenger interchanges • It analyses the organization of interchanges regarding operational functionality, management and efficiency of services • The impacts of the interchanges operation on local economy and land use planning are also addressed.
Learning outcomes	
• Provide an understanding of how stakeholder engagement and management works • Conduct an operational analysis, with the use of integrated management and operation practices, which are based on structures met in several European countries and case studies • Recognize and assess implications revealing from different regulatory, operational and managerial structures • Analyze the impacts of interchanges on local economy and the role they have in land use planning, in terms of revenues for local enterprises, new start-up businesses, new jobs, etc.	
Prerequisites (if any)	
-	
Language	English
Hours	2
Key words	Interchange, operation, management, stakeholders, accessibility, urban planning, integrated information systems, ticketing.
Syllabus	The course analyses the involvement of stakeholders and stakes, and respective questions are answered, such as: “Why, when and which stakeholders to involve?”, “What is public involvement, and what kind of public should be involved within the interchange decision-making process”, etc. In addition, the course analyses the organization of interchanges in terms of operational functionality, management, practicalities, services and efficiency, while the impacts on local economy and land use planning are also introduced. **Course topics:** • Background • Stakeholders • Interchange types • Operation key factors • Operation • Management • Interchange management plan

	• Special definition plan • User feedback • Integrated information systems and ticketing • Accessibility • Main principles for management and operational structures • The role of interchanges in urban planning • Case studies • Suggested literature	
Bibliography	• Banister, D. & Berechman, Y., 2001. Transport investment and the promotion of economic growth. Journal of Transport Geography, 9(2001) 209-218. • City-HUB, 2013. City-HUB Deliverable D2.3. Lessons from descriptive case studies – recommendations for City-HUB model. • City-HUB, 2013. City-HUB Deliverable D4.1. Integrated management of efficient urban interchanges. • City-HUB, 2015. City-HUB Deliverable D5.2. City-HUB Handbook. • European Commission, 2001. White Paper " European transport policy for 2010: Time to decide (CEC, 2001). • European Commission, 2006. Keep Europe Moving. Sustainable mobility for our continent. Mid-term review of the European Commission's 2001 transport White Paper. ISBN 92-79-02312-8. Luxemburg: Office for Official Publications of the European Communities, 2006. • European Communities, 2009. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Action Plan of Urban Mobility. COM (2009) 490 final. Brussels, Belgium. • European Commission, 2011. Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. White Paper. COM (2011) 144 final. European Commission. Brussels, Belgium. • GUIDE Terzis, G., Last, An. GUIDE – Urban Interchanges – A Good Practice Guide – Final Report prepared for EC DG VII. April, 2000. • Grotenhuis, J.W., W.W. Bart and P. Rietveld, 2007. "The desired quality of integrated multimodal travel information in public transport: Customer needs for time and effort saving". Transport Policy, Vol. 14, pp. 27-38. • Monzon, A. & Di Ciommo, F. (Editors), 2015. CITY-HUBs: Sustainable and Efficient Interchange Stations. Taylor and Francis Group. • PIRATE project, 2001. Final report. Accessed by http://www.transport-research.info/web/projects/project_details.cfm?ID=593 on 11/03/2013.	
Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	
	Visits at facilities	
	Other (describe): Case studies	x
Evaluation methods	Homework	
	Class project	

	Interim examination	
	Final examinations	
	Other (describe) ……	
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Number of topics	15	

Course: C5	
Title	**Optimization of intermodal transport systems**
Thematic area	Governance
Responsible Institute	University of Thessaly, Greece
Lecturer	Prof. Eftihia Nathanail
Aim	The aim of this course is to introduce students with the principle of optimization, and the mathematical models that are built to facilitate decisions, in the context of reaching the optimum taking into account applying restrictions.
Learning outcomes	
• Identifying variables and relationships that govern in an optimization problem. • Develop mathematical formulations that take into account the optimization of the objective function, safeguarding the satisfaction of constraints and limitations. • Use computer programs that solve optimization problems.	
Prerequisites (if any)	
-	
Language	English
Hours	3
Key words	Optimization, mathematical formulations, linear programming technique, integer lineal programming technique.
Syllabus	The course identifies the components that formulate a problem and the decision variables that need to be estimated for its solution. Firstly, it introduces the student to the network structure of the problem, and the conversion in mathematical terms of the decision variables and the constraints that apply. It presents the concept of linear programming, and the alternative ways to formulate an optimization problem, depending on the variables to be defined by the analyst. The linear programming technique is explained in depth and presented through the solution of examples. A more specific category of linear programming, integer linear programming is also studied. In this case, the variables may only obtain integer values, which restricts the number of possible solutions. Finally, the transportation problem is described and solved, as well as other specific applications that deal with vehicle routing, resource allocation and facility location. **Course topics:** • Basic concepts • Basic elements • Optimization Rules • Optimization Techniques • Software and applications • Guidance to further knowledge acquisition
Bibliography	• Anjos, M. F. and Vieira V.C.M. (2016). Mathematical optimization approaches for facility layout problems: The state-of-the-art and future

	research directions, European Journal of Operational Research, Volume 261, Issue 1, 16 August 2017, Pages 1-16. • Arnone, M., Mancini, S. and Rosa, A. (2014). Formulating a Mathematical Model for Container Assignment Optimization on an Intermodal Network Procedia - Social and Behavioral Sciences, Volume 111, 5 February 2014, Pages 1063-1072. • D. W. Wang, J. W. Wang, R. Y. Zhang and Z. Guo, (2007). Ed. Intelligent Optimization Methods. Higher Education Press, Beijing, 2007. • Daskin MS, "Networks and discrete location", Wiley, New York, NY, 1995. • Flötteröd, G. (2017). A search acceleration method for optimization problems with transport simulation constraints, Transportation Research Part B: Methodological, Volume 98, April 2017, Pages 239-260. • Gambardella, L.M., Mastrolilli, M., Rizzoli, A.E. and Zaffalon, M. (2001). An optimization methodology for intermodal terminal management. Journal of intelligent manufacturing 12:521:534. • Hao, C. and Yue, Y. (2016). Optimization on Combination of Transport Routes and Modes on Dynamic Programming for a Container Multimodal Transport System, Procedia Engineering, Volume 137, 2016, Pages 382-390. • Pedersen, M. B., Madsen, O. B. G., & Nielsen, O. A. (2005). Optimization models and solution methods for intermodal transportation. • Sörensen, K. and Vanovermeire, C. (2013). Bi-objective optimization of the intermodal terminal location problem as a policy-support tool Computers in Industry, Volume 64, Issue 2, February 2013, Pages 128-135. • Sun, Y., Lang, M., and Wang, D., (2015). Optimization Models and Solution Algorithms for Freight Routing Planning Problem in the Multi-Modal Transportation Networks: A Review of the State-of-the-Art. The Open Civil Engineering Journal, 2015, 9, 714-723. • Taha Hamdy (2011). Operations Research: An introduction. Prendice Hall. • Yang, K., Yang, L., Gao, Z. (2016). Planning and optimization of intermodal hub-and-spoke network under mixed uncertainty, Transportation Research Part E: Logistics and Transportation Review, Volume 95, November 2016, Pages 248–266. • Wang, Q. B. and Z. X. Han (2010). "The optimal routes and modes selection in container multimodal transportation networks," Int. Conf. Optoelectron. Image Process., vol. 2, pp. 573-576, 2010.	
Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	
	Visits at facilities	
	Other (describe): Case studies	
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) ……	

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Number of topics	6

Course: C6	
Title	**Intelligent services for passenger transportation**
Thematic area	Smart solutions
Responsible Institute	Fraunhofer Institute for Factory Operation and Automation IFF, Otto-von-Guericke-University Magdeburg, Germany
Lecturer	Dr.-Ing. Henning Strubelt
Aim	• Get introduced to public transport management and its technical services • Get a research summary covering passenger transport (modes) and an overview of information technology for the passenger transport market • Understand the use of telematics to manage public transport networks and the development and implementation of flexible, reliable, and efficient multimodal transport concepts • Gain an overview of possible IT application fields for passenger transport (e.g. ticketing, routing, etc.).
Learning outcomes	
• Acquire knowledge about smart information systems for multimodal travel and platforms to coordinate integrated transport services • Understand the levels of ITS deployment and their possibilities for passenger networks • Introduction to the use of essential tools to conduct strategic analyses for network planning and optimization • Understand the aim and scope of Transport Demand Management • Understand the combination of strengths of different transport modes (multimodal concepts).	
Prerequisites (if any)	
-	
Language	English
Hours	2
Key words	Logistics, Intelligent transport services, multimodal transport, passenger transport
Syllabus	This course is composed of two parts, a lecture style introduction to the topic of intelligent services for passenger transport and an exercise section. The lecture includes the topics of intermodal and multimodal passenger concepts, the analysis and summary of research findings and recommendations concerning IT-services to improve passenger transport, general ideas of smart information systems for intermodal travel and platforms to coordinate integrated transport services, as well as the use of real time information and smart combination of transport modes facilitates more efficient use of existing infrastructure. The exercise section is divided into two parts itself. The assessment of a case study with the objective of deepening the understanding of application fields and assessing applied intelligent services and two exercises. The first exercise aims to facilitate the understanding of Transport Demand Management while the second aims at evaluating and subsequently discussing current and future application fields in the students' local environment. The first exercise section is done individually, while the second is intended to be done in small groups.

	The course will conclude with a presentation of local application fields, a summary of the workshop, and an evaluation of intelligent services for passenger transport based on a critical discussion. **Course topics:** • Mobility goals • Public transport management • Passenger transport modes • Information technology for passenger transport market • Telematics for public transport network • IT application fields for passenger transport (ticketing, real-time information service, transport demand management)
Bibliography	• Austin, J. (2016): Passenger Transport Operations, Transport Demand Management, World Road Association, available online at: http://rno-its.piarc.org/en/user-services/passenger-transport (accessed on 28 Sep. 2016). • Berg Insight (2013): ITS in Public Transport, Berg Insight, 3rd ed., available online at: www.berginsight.com/reportpdf/productsheet/bi-its3-ps.pdf (accessed on 7 Oct. 2016). • BMVI (2014/2015): Verkehr in Zahlen 2014/2015, Ed.: Bundesministerium für Verkehr und digitale Infrastruktur, available online at: http://www.umweltbundesamt.de/daten/verkehr/modal-split-des-personen-gueterverkehrs (accessed 11 Oct. 2016). • Broaddus, A., Litman, T., Menon, G. (2009): Transportation Demand Management, Training Document, Division 44, Water, Energy and Transport, Sustainable Urban Transport Project (SUTP), gtz, Federal Ministry for Economic Cooperation and Development, available online at: http://www.sutp.org/files/contents/documents/resources/H_Training-Material/GIZ_SUTP_TM_Transportation-Demand-Management_EN.pdf (accessed 23 Jan. 2017). • Gnap, J., et al. (n.d.): Improving of information for passengers of urban public transport in Košice, University of Zilina, Faculty of Operation and Economics of Transport and Communications, Department of Road and Urban Transport, available online at: www.southeast-europe.net/document.cmt?id=848 (accessed on 10 Oct. 2016). • Intertraffic (2016): Intertraffic Amsterdam, Smart Mobility, available online at: http://www.intertraffic.com/amsterdam/innovations/smart-mobility (accessed 10 Oct. 2016). • Litman, T. (2016): Guide to Calculating Mobility Management Benefits, Victoria Transport Policy Institute, 250-360-1560, available online at: http://www.vtpi.org/tdmben.pdf (accessed 23 Jan. 2017). • Nökel, K., Gentile, G. (2016): Modelling Public Transport Passenger Flows in the Era of Intelligent Transport Systems, Springer, Cham. • Passenger Transport (2013): Thematic Research Summary: Passenger Transport, Ed.: Transport Research and Innovation Portal on behalf of DG MOVE, available online at: http://www.kowi.de/Portaldata/2/Resources/fp/trip-passenger-transport.pdf (accessed 10 Oct. 2016). • Rodrigue, J-P et al. (2017): The Geography of Transport Systems, Hofstra University, Department of Global Studies & Geography, available online at: http://people.hofstra.edu/geotrans (accessed 5 Oct. 2016).

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Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	x
	Visits at facilities	
	Other (describe) ……critical discussion and summary……..	x
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) ……	
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Number of topics	6	

Course: C7	
Title	**Smart information technologies in freight transport logistics**
Thematic area	Smart solutions
Responsible Institute	Fraunhofer Institute for Factory Operation and Automation IFF, Otto von Guericke University Magdeburg
Lecturer	Olaf Poenicke, Oliver Meier
Aim	Teaching of basics for ICT for freight relevant applications for • Identification (Auto-ID) • Image Processing and Localization • 3D-Scanning • Tracking and Tracing
Learning outcomes	
• The audience gains basic information and experience (demonstration and hands-on) about modern information and communication technologies that are relevant in logistics processes (transport as also intra logistics). • The overview on the different types of technology is the basis for the future digitalization of logistics processes and the development of new smart services for logistics applications. • Furthermore open fields for R&D can be identified to discuss approaches for future international collaborative R&D projects.	
Prerequisites (if any)	
• Basic knowledge about logistics • Technical understanding	
Language	English
Hours	2
Key words	Information Systems, Smart Logistics, Auto-ID, Image Processing, Localization, 3D-Scanning, Tracking & Tracing
Syllabus	The course will be divided into three modules. **Module 1** – will teach the basics of the different technologies as listed above. Starting from an overview on ICTs relevant for logistics applications, single relevant technologies like RFID, Image processing, 3D scanning and Tracking & Tracing will be explained in detail. The Module 1 will also give a brief overview on typical applications of the ICTs and development trends. Duration approx. 75 mins. **Module 2** – will give short demonstrations and a hands-on for the technologies of RFID, 3D scanning and Tracking & Tracing. The aim of the Module is to deepen the understanding of these technologies – the possible usage as also the limitations of the technologies within different application environments and conditions. Duration approx. 30 mins. **Module 3** – will give the opportunity to discuss and identify possible applications and trends of ICT for Smart Logistics. It is also possible to discuss open questions for single contents of the other two modules. Duration approx. 15 mins.

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Teaching methods	Lecture	x
	Demonstration	x
	Hands on/games	x
	Exercises	
	Visits at facilities	
	Other (describe)	

Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe)	
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Number of topics	3	

Course: C8	
Title	**Design of passenger transport interchanges**
Thematic area	Smart solutions
Responsible Institute	University of Thessaly, Greece
Lecturers	Dr. Giannis Adamos
Aim	• Gain skills to design medium and large scale infrastructure and increase the perception of creating effective and efficient solutions that rely on safety principles • Understand the design requirements and special characteristics of passenger interchanges for designing accessible infrastructure • The course aims at achieving a synergy between substantive technical knowledge and safety consideration knowledge.
Learning outcomes	
• Acquire practical knowledge of design aspects for passenger transport interchanges • Possess a good understanding of passenger interchanges, know design principles of accessibility and acquire basic engineering skills in interchange planning • Provide an understanding of the fundamental relationships involved in the design of passenger interchanges by integrating facilities, retailing, passenger transfer and considering interactions with other sectors and future challenges • Ensure that students have a sound understanding of the key issues affecting the planning, safety and comfort of passenger terminals.	
Prerequisites (if any)	
-	
Language	English
Hours	3
Key words	Interchange, design, users, access/egress, facilities, accessibility, safety, way-finding, permeability, legibility
Syllabus	This course is composed of two educational areas: 1) Design and safety principles of transport terminal infrastructure, and 2) Passenger terminal design. The course covers the access/egress aspects of passenger interchanges as local area, the transport and transfer of passengers for intermodal transport, the development and integration of facilities and retailing within the interchange. Also, attention is paid to safety and security, to aspects that facilitate passengers to understand the facility, such as way-finding, permeability, legibility and inclusivity, and to the physical accessibility aspects of designing transport interchanges. The course is supplemented by a series of case studies to demonstrate the design of the main transport infrastructure in the European Union. Especially, medium to large-scale infrastructure is included, for which all the above aspects are covered with up-to-date and extensive good practices met in specific case studies, such as the Moncloa interchange in Spain, the Kamppi interchange in Finland, the New Railway Station of Thessaloniki in Greece, the Köbánya-Kispest interchange in Hungary and other. **Course topics:** • Background

	• Basic concepts in design • Interchange zones • Key interchange factors • Transport operators and managers viewpoint • Policy and governance viewpoint • Users' viewpoint • Access/egress • Transport and transfer • Design principles • Facilities and retailing • Safety and security • Accessibility • Inclusive information • Comfort • ITS in interchange design • Design typologies and requirements • Case studies • Suggested literature
Bibliography	• Brons, M., Givoni, M., Rietveld, P., 2009. Access to railway stations and its potential in increasing rail use. *Transportation Research Part A: Policy and Practice* 43(2): 136–149. • Di Ciommo, F., J. M. Vassallo, J.M. & Oliver, A., 2009. Private funding of intermodal exchange stations in urban areas. *Transportation Research Record: Journal of the Transportation Research Board* 2115(12): 20–26. • Edwards, B., 2011. *Sustainability and the Design of Transport Interchanges*. Abingdon, UK: Routledge. • FDOT, 2007. Quality/Level of Service Handbook, Florida Department of Transportation (http://www.dot.state.fl.us/planning/systems/sm/los/). • Green, C. and Hall, G., 2009. Better Rail Stations, Department for Transport. • Grotenhuis, J-W., B. W. Wiegmans and P. Rietveld. 2007. The desired quality of integrated multimodal travel information in public transport: Customer needs for time and effort savings. *Transport Policy* 14(1): 27–38. • GUIDE Terzis, G., Last, An. GUIDE – Urban Interchanges –A Good Practice Guide –Final Report prepared for EC DG VII. April, 2000. • Ministry of Transport, NSW, 2008. Guidelines for the Development of Public Transport Interchanges, MoT, NSW. • Monzon, A. & Di Ciommo, F. (Editors), 2015. CITY-HUBs: Sustainable and Efficient Interchange Stations. Taylor and Francis Group. • Network Rail, 2011. Guide to Station Planning and Design, Issue 1, Network Rail, London. • Rail Safety and Standards Board, 2013. Guidance on the implementation of station travel plans. RSSB. • Sintropher Project, 2011. Good Practice in Transport Interchanges, Sinotropher Project, UCL. • Sputnic, 2009. Guidelines in market organisation—Public transport integration. Sputnic project—Strategies for public transport in cities. http://documents.rec.org/publications/SPUTNIC2MO_ptintegration_AUG2009_ENG.pdf.

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Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	
	Visits at facilities	x
	Other (describe): Case studies	x
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) ……	
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Number of topics	19	

Course: C9	
Title	**Design of freight transport interchanges**
Thematic area	Smart Solutions
Responsible Institute	University of Thessaly, Greece
Lecturer	Prof. Eftihia Nathanail
Aim	Gain skills to design intermodal freight infrastructures and increase seamless transhipment and secure interconnections.
Learning outcomes	
• Knowledge of design aspects and main functions of intermodal freight terminals • Good understanding of requirements of freight transport terminals and the complexity introduced by multi-disciplinarity of the associated activities • Integrating freight servicing facilities, with special services, such as 3rd and 4th party logistics, and other facilitations	
Prerequisites (if any)	
-	
Language	English
Hours	3
Key words	European legal framework, accessibility, multimodal transport infrastructure
Syllabus	This course will focus on the components of an intermodal freight terminal and will analyse the parameters that have to be estimated and assessed, in order to provide the input data for designing the terminal. It will present the European regulation framework for designing and interconnecting freight transport interchanges and will reveal the relativeness of transportation planning with regional and urban development procedures. The main modules which comprise these terminals will be presented, and their functionalities and interactions will be explained. **Course topics:** • Introduction • European legal framework – guidelines • Background • Typology of freight transport interchanges • Cases studies • Suggested literature
Bibliography	• Ballis, A. (2006). Freight Villages: Warehouse Design and Rail Link Aspects. Presented at 85th Annual Meeting of the Transportation Research Board, Washington, D.C., p.16. • CEC, Transport Infrastructure Needs Assessment in Central and Eastern Europe - TINA project. • Department of Justice. (2010). 2010 ADA Standards for Accessible Design. Retrieved from http://www.ada.gov/regs2010/2010ADAStandards/2010ADAStandards.pdf.

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Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	
	Visits at facilities	
	Other (describe): Case studies	x
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) ……	
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Number of topics	6	

Course: C10	
Title	**Smart equipment for freight transshipment**
Thematic area	Smart solutions
Responsible Institute	Fraunhofer Institute for Factory Operation and Automation IFF
Lecturer	Dipl.-Wirt.-Inform. Oliver Meier
Aim	• Give a technology and trend overview addressing smart solutions for freight transport • Provide a clear understanding of smart solutions for freight transport applications and services that could be delivered • Explore alternative fuels and propulsion technologies with application to intermodal terminals
Learning outcomes	
• Acquire practical knowledge of smart solutions for freight transport • Possess a good understanding of smart solutions for freight transport, • know design principles of accessibility and acquire basic engineering skills in the transport planning • Provide an understanding of the fundamental relationships involved in the design of freight transport by integrating facilities, retailing, freight transfer and considering interactions with other sectors and future challenges	
Prerequisites (if any)	
• Basic knowledge about logistics • Technical understanding	
Language	English
Hours	2
Key words	Smart Logistics, Transhipment Technologies, Consolidation Center, Alternative Fuels, Last Mile Logistics
Syllabus	The course will be divided into five modules. **Module 1** – against the background of current challenges will give an overview of current transhipment technologies and their advantages and disadvantages within their application area. **Module 2** – against the background of current societal requirements and EU targets, future transhipment technologies and concepts will be presented, by highlighting their improvements in comparison with the current technologies and their disadvantages. **Module 3** – will introduce transhipment places for contextualisation of transhipment technology use. The students should be equipped with necessary analysing and planning instruments and therefore should know the different types of transhipment places. Some innovative examples will be described. **Module 4** – will introduce into eco-friendly solutions by presenting electric cars and cargo bikes for last mile logistics. **Module 5** – will test the gained knowledge of the students by the help of a case study to the topic “International Transport Chain”.
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Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	x
	Visits at facilities	
	Other (describe)	
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe)	
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Number of topics	5	

Course: C11	
Title	**Decision making methodologies**
Thematic area	Decision making
Responsible Institute	University of Thessaly, Greece
Lecturer	Prof. Eftihia Nathanail, Dr. Lambros Mitropoulos
Aim	The course aims to help students to understand the basic decision making methodologies by exploring different characteristics and features of each one and demonstrate how these can be applied in real life problems.
Learning outcomes	
• Apply basic steps of decision making • Understand key methods for supporting logistics decision making • Set goals, objectives and organize alternatives • Understand most important decision making methods and problem building given alternatives and different stakeholders • Evaluate alternatives with different units by considering normalization techniques • Perform analysis, synthesis, and address problem issues and develop critical thinking skills to treat tradeoffs between alternatives • Manage data and build decision support models in spreadsheets • Use available tools for performing decision making.	
Prerequisites (if any)	
-	
Language	English
Hours	3
Keywords	Decision making, social cost benefit analysis, multi-stakeholder multi-criterial analysis.
Syllabus	The students are exposed to (a) social cost benefit analysis and (b) multicriteria assessment methodologies. Social costs and benefits are analysed, through various techniques, such as monetarization, normalization etc. and will guide to the estimation of financial indicators, Net Present Value, Internal Rate of Return, Benefit to Cost ratio. Multicriteria analysis introduces a hierarchical process for analysing complicated systems through the identification of stakeholders, their objectives and criteria, selection of alternative solutions, quantification of the criteria through quantitative and qualitative indicators, identification of weights, estimation of the performance index of the solution. **Course topics:** • Cost benefit and social cost benefit analysis • Multi-stakeholder multi-criteria analysis • Weighing • Normalization

Bibliography	• Beria P., Maltese I., Mariotti I. (2012). Multicriteria versus cost benefit analysis: a comparative perspective in the assessment of sustainable mobility. European Transport Research Review, Volume 4, Issue 3, pp 137–152. • Cascetta E. (2009). Transportation system analysis: models and applications. 2nd edition. Springer. • CE Delft Report (2007). Handbook on estimation of external cost in the transport sector. EC DG Tren. • COM – The European Commission (2007). Greenbook 2007 – Towards a new culture for urban mobility. Commission of the European Communities, Brussels. • Dunn W. N. (2002). Public policy analysis: An introduction, Pearson Prentice Hall, Upper Saddle River. • EVA TREN (2008). Improved decision-aid methods and tools to support evaluation of investment for transport and energy networks in Europe. Deliverable 1. Evaluating the state-of-the-art in investment for transport and energy networks. www.eva-tren.org. • Glenaffric Ltd (2007). Six steps to effective evaluation: A handbook for program and project managers. • HEATCO (2005). Developing harmonised European approaches for transport costing and project assessment. Deliverable 1: current practice in project appraisal in Europe. • HMT. (2003). Green Book: Appraisal and evaluation in central government. London: HMSO. • Litman T. (1999). Evaluating public transit benefits and cost. Victoria, B.C.: Victoria Transport Policy Institute. • Sinha, K.C. and Labi, S. (2007). Transportation decision making. Principles of project evaluation and programming. Wiley.	
Teaching methods	Lectures	x
	Demonstrations	
	Hands on/gaming	
	Exercises	x
	Visits at facilities	
	Other (please describe): Case study	
Evaluation methods	Homework	
	Interim examination	
	Final examinations	
	Other (describe) ……	
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Number of topics	7	

Course: C12 – Part a (2017)	
Title	**Data collection methods: Surveys**
Thematic area	Decision making
Responsible Institute	University of Thessaly, Greece
Lecturer	Prof. Eftihia Nathanail
Aim	The aim of this course is to: • Provide an understanding of qualitative methods in data collection • Present how a qualitative freight transportion survey is organized • Provide an overview of the practical problems of sample design, the collection and application of transport-related data • Introduce the process of surveys' analysis results in order to draw useful conclusions
Learning outcomes	
• Identify appropriate methods for urban freight transport, traffic and spatial data collection. • Understand the role of sampling in data collection • Setting up a transport survey from A to Z	
Prerequisites (if any)	
-	
Language	English
Hours	1
Key words	Data collection, surveys, qualitative methods, sampling
Syllabus	This course will present a step-by-step guidebook for organizing and conducting transport surveys with focus on freight transport surveys. As a first step it will provide the key elements and the principles that should be followed upon the setup of a survey. Sampling, data collection methods and techniques for qualitative data and survey design are introduced and developed as processes in sequence, presenting at the same time their strengths and weaknesses. As a last step the statistical analysis of the qualitative is further explained to the attendants. **Course topics:** • Introduction • Sampling & Statistical analysis • Data collection methods • Strengths and weaknesses of each method • Urban freight transportion survey • Guidance to further knowledge acquisition
Bibliography	• Abdel-Aty M., (2003), "Hybrid Distribution and Response Techniques for an Origin-Destination Travel Survey", ITE Journal, pp. 22-27. • Amekudzi, A., Meyer, M., & Ross, C. (2011). Transportation planning for sustainability guidebook. Washington, D.C.: U.S. Federal Highway Administration.

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Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	
	Visits at facilities	
	Other (describe): Case studies	
	Homework	

Evaluation methods	Class project	
	Interim examination	
	Final examinations	
	Other (describe) ……	
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Number of topics	6	

Course: C12 – Part b (2017)	
Title	**Data collection methods: Historical and observed data**
Thematic area	Decision making
Responsible Institute	Otto von Guericke University Magdeburg, Germany, Fraunhofer Institute for Factory Operation and Automation IFF
Lecturer	M.Sc. David Weigert
Aim	• Participants receive a basic introduction to decision theory and their extensive use in logistics • Main goal is the application of a holistic concept in the field of big data and data mining in logistics from the problem analysis to solution. • Get introduced to Big Data, Data Science and Data Analytics. • Enable participants to give conclusions from theory to practice.
Learning outcomes	
• Understanding of the handling, function and application and use of the currently available data sources in transportation logistics • Acquire basic knowledge of Big Data, Data Science and Data Analytics • Acquire knowledge about using of Big Data and Data Analytics in Transportation • Enable the analysis and definition of complex data analysis	
Prerequisites (if any)	
-	
Language	English
Hours	2
Key words	Data collection, historical data, observed data, sampling, big data, visualization, fusion techniques.
Syllabus	The course is divided into 3 segments. Basic study on decision theory, data acquisition and methods for analysis, collection and evaluation as well as the comprehensive application of a holistic concept for the analysis and modeling of large amounts of data. Always from the aspect of logistics. The goal is to provide the participants with basic content on quantitative methods, tools and terms in order to specifically understand the problem of large amounts of data. The area of logistics, especially transport logistics, emits countless data sets. For this purpose the participants should be informed and, in a real case study, the application of a developed concept for a holistic analysis and modeling of logistical problems. Due to the extensive terminology and the current state of the art, it is important to make targeted delimitations in the world of logistics. It should be clear that there is not only one solution to deal with Big Data within the logistics. The participants should made aware of the facts and be given an extended insight. **Course topics:** • Introduction • Quantitative and Qualitative • Big Data, Data Science and Data Analytics in Transportation • Analysis and Visualization

	• Big Data Example • Case-Study - Freight airport • Summary
Bibliography	• Alvarenga, Carlos A. und R. C. Schoenthaler (2003). A new take on supply chain event management. Supply Chain Management Review • Anwar, A., Nagel, T. & Ratti, C., 2014. Traffic Origins: A Simple Visualization Technique to Support Traffic Incident Analysis.. s.l., IEEE Pacific Visualization Symposium. • Ashbrook, Daniel und T. Starner (2003). Using GPS to learn significant locations and predict movement across multiple users. Personal and Ubiquitous Computing, 7(5):275–286. • Baader, Andraes und S.Montanus (2008). Transparency in Global Supply Chain Networks - Methods and Tools for Integrated Supply Chain Event Management. In: Ijioui, Raschid, H. Emmerich und M. Ceyp, Hrsg.: Strategies and Tactics in Supply Chain Event Management, S. 3–11. Springer-Verlag, Berlin Heidelberg. • Barfus, Katja (2010). Entwicklung eines Vorgehensmodells zur strategischen Planung des logistischen Netzes einer verteilten Produktion. Fraunhofer Verlag, Stuttgart. • Beierle, Christoph und G. Kern-Isberner (2006). Methoden wissensbasierter Systeme - Grundlagen - Algorithmen - Anwendungen. Friedr. Vieweg & Sohn Verlagsgesellschaft | GWV Fachverlage GmbH, Wiesbaden, 3. Aufl. • Bernard, Thomas (2011). Entscheidungsunterstützung durch Data-Mining-Werkzeuge. Automatisierungs-ATLAS 2011, SPS-Magazin, 5:608–610. • P Brandau, Annegret und J. Tolujevs (2013). Modelling and analysis of logistical state data. Transport and Telecommunication, 14(2):102–115. • Brandau, Annegret und J. Tolujew (2011). Logistics Event Management. In: Schenk,Michael, Hrsg.: 9./10. Forschungskolloquium am Fraunhofer IFF 2010 – Forschung vernetzen - Innovationen beschleunigen, S. 47–51, Magdeburg. Fraunhofer Verlag. • Cunha, Catherine da, B. Agard und A. Kusiak (2005). Improving manufacturing quality by re-sequencing assembly operations: a data-mining approach. In: 18th International Conference on Production Research - ICPR 18, Fisciamo, Italy. University of Salerno. • P Dong, Guozhu und J. Pei (2007). Sequence Data Mining. Springer Science+Business Media, LLC. • Düsing, Roland (2006). Knowledge Discovery in Databases - Begri, Forschungsgebiet, Prozess und System. In: Chamoni, Peter und P. Gluchowski, Hrsg.: Analytische Informationssysteme- Business Intelligence-Technologien und -Anwendungen, S. 241–262. Springer, Berlin Heidelberg, 3.Aufl. • Fayyad, Usama, G. Piatetsky-Shapiro und P. Smyth (1996a). From data mining to knowledge discovery in databases. AI Magazine, 17(3):37–54. • Fayyad, Usama M., G. Piatetsky-Shapiro und P. Smyth (1996b). From data mining to knowledge discovery: an overview. In: Fayyad, Usama M., G. Piatetsky-Shapiro, P. Smyth und R. Uthurusamy, Hrsg.: Advances in Knowledge Discovery and Data Mining, Kap. 1, S. 1–34. AAAI Press / The MIT Press, Menlo Park, California. • Ghezzi, Carlo, M. Jazayeri und D. Mandrioli (1991). Fundamentals of Software Engineering. Prentice-Hall, Inc.

	• McKinsey Global Institute (2011). Big data: The next frontier for innovation, competition, and productivity, McKinsey & Company • OECD/ITF (2015). Big Data and Transport: Understanding and assessing options, Study 2015 • Säuberlich, Frank (2000). KDD und Data Mining als Hilfsmittel zur Entscheidungsunterstützung. Peter Lang GmbH Europäischer Verlag der Wissenschaften, Frankfurt a. M. • Windt, Katja, M. Knollmann und M. Meyer (2011). Anwendung von Data Mining Methoden zur Wissensgenerierung in der Logistik - Kritische Reflexion der Analysefähigkeit zur Termintreueverbesserung. In: Spath, Dieter, Hrsg.: Wissensarbeit - zwischen strengen Prozessen und kreativem Spielraum, Schriftenreihe der Hochschulgruppe für Arbeits- und Betriebsorganisation e. V. (HAB), S. 223–249. GITO, Berlin.	
Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	
	Visits at facilities	
	Other (Case-Study)	x
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) ……	
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Number of topics	4	

Course: C12 – Part a (2018)	
Title	**Data collection methods: Surveys**
Thematic area	Decision making
Responsible Institute	University of Thessaly, Greece
Lecturer	Prof. Eftihia Nathanail
Aim	The aim of this course is to: • Provide an understanding of qualitative methods in data collection • Present how a qualitative travel survey is organized • Provide an overview of the practical problems of sample design, the collection and application of transport-related data • Introduce the process of surveys' analysis results in order to draw useful conclusions
Learning outcomes	
• Identify appropriate methods for traffic and spatial data collection. • Understand the role of sampling in data collection • Setting up a transport survey from A to Z	
Prerequisites (if any)	
-	
Language	English
Hours	1
Key words	Data collection, surveys, qualitative methods, sampling
Syllabus	This course will present a step-by-step guidebook for organizing and conducting transport surveys with focus on passenger transport survey. As a first step it will provide the key elements and the principles that should be followed upon the setup of a survey. Sampling, data collection methods and techniques for qualitative data and survey design are introduced and developed as processes in sequence, presenting at the same time their strengths and weaknesses. As a last step the statistical analysis of the qualitative is further explained to the attendants. **Course topics:** • Introduction • Setting up a travel survey • Sampling • Data collection methods • Strengths and weaknesses of each method • Statistical analysis • Guidance to further knowledge acquisition
Bibliography	• Abdel-Aty M., (2003), "Hybrid Distribution and Response Techniques for an Origin-Destination Travel Survey", ITE Journal, pp. 22-27. • Amekudzi, A., Meyer, M., & Ross, C. (2011). Transportation planning for sustainability guidebook. Washington, D.C.: U.S. Federal Highway Administration.

	• Andrés Monzón, Floridea Di Ciommo, Sara Hernández, Eftihia Nathanail, Giannis Adamos, Maria Tsami, Ricardo Poppeliers, Odile Heddebaout, Tuuli Jarvi, Marko Nokkala, Juno Kostiainen, Derek Palmer, Clare Harmer, Katie Millard, Jardar Andersen, Petter Christiansen, Albert Gabor, Adam Pusztai, Almos Virag, Jan Spousta, 2015. CITY-HUBs: Sustainable and Efficient Interchange Stations. Taylor and Francis Group, 2015. • Bayart, C., Bonnel, P., & Morency, C. Survey mode integration and data fusion. • Bonnel, P. (2009). Transport survey methods. Bingley, UK: Emerald. • Cambridge Systematics (1996), "Inc. Travel Survey Manual", Prepared for the U.S. Department of Transportation and the U.S. Environmental Protection Agency. Washington, D.C., USA. • Cascetta E., (1984), "Estimation of trip matrices from traffic counts and survey data: a generalized least squares estimator", Trasportation research, Vol. B, pp. 289-299, USA. • Crevo C., Niedowski R., D. Scott, (1995) "Design and Conduct of a Statewide Household Travel Survey in Vermont", Transportation Research Record 1477, Transportation Research Board, National Research Council, Washington DC, pp 26-30. • Hagen L., Zhou H., Pirinccioglu F., (2006), "Development of Revised Methodology for Collecting Origin-Destination Data", Florida Department of Transportation (FDOT), USA. • Ortuzar J.D., Willumsen L.G., (1990), "Modeling transport", 4th edition (published 2011), Wiley. • Peter Stopher. Collecting, Managing, and Assessing Data Using Sample Surveys. Cambridge University Press, 2012. 246p. • Survey Sampling. Theory and Methods, 2nd edition. Arijit Chaudhuri, Horst Stenger. Charman&Hall, 2005.- 380 p. • Transport Survey Methods: Best Practice for Decision Making Editor(s): Johanna Zmud, Martin Lee-Gosselin, Marcela Munizaga, Juan Antonio Carrasco, ISBN: 978-1-78-190287-5 eISBN: 978-1-78-190288-2 • Travel Survey Methods. Quality and Future Directions. Edited by Peter Stopher, Cheryl Stecher. Elsevier, 2006.706 p. • Yatskiv, A. Grakovski and E. Yurshevich. An overview of different methods available to observe traffic flows using new technologies. In: Proceedings of the international conference NTTS, 5-7 March 2013, Brussels, Belgium, 2013.	
Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	
	Visits at facilities	
	Other (describe): Case studies	
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) ……	

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Number of topics	7

Course: C12 – Part b (2018)	
Title	**Data collection methods: Historical and observed data**
Thematic area	Decision making
Responsible Institute	Otto von Guericke University Magdeburg, Germany Fraunhofer Institute for Factory Operation and Automation IFF
Lecturer	M.Sc. David Weigert
Aim	• Main goal is the application of a holistic concept in the field of data analysis in passenger transportation from the problem analysis to solution. • Get introduced to Big Data, Data Science and Data Analytics. • Enable participants to give conclusions from theory to practice.
Learning outcomes	
• Understanding of the handling, function and application and use of the currently available data sources in passenger transportation • Acquire basic knowledge of Big Data, Data Science and Data Analytics • Acquire knowledge about using of Big Data and Data Analytics in Passenger Transport • Enable the analysis and definition of complex data analysis	
Prerequisites (if any)	
-	
Language	English
Hours	2
Key words	Data collection, historical data, observed data, sampling, big data, visualization, fusion techniques.
Syllabus	The course is divided into 3 segments. Basic study on decision theory, data acquisition and methods for analysis, collection and evaluation as well as the comprehensive application of a holistic concept for the analysis and modeling of large amounts of data. The goal is to provide the participants with basic content on quantitative methods, tools and terms in order to specifically understand the problem of large amounts of data. The area of passenger transportation, emits countless data sets. For this purpose the participants should be informed and, in a real case study, the application of a developed concept for a holistic analysis and modeling of passenger transportation problems. **Course topics:** • Introduction • Quantitative and Qualitative • Big Data, Data Science and Data Analytics in Transportation • Analysis and Visualization • Big Data Example • Case-Study - Big Data in passenger transport: Transport for London • Summary
Bibliography	• Alvarenga, Carlos A. und R. C. Schoenthaler (2003). A new take on supply chain event management. Supply Chain Management Review

- Anwar, A., Nagel, T. & Ratti, C., 2014. Traffic Origins: A Simple Visualization Technique to Support Traffic Incident Analysis. s.l., IEEE Pacific Visualization Symposium.
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Teaching methods	Lecture	x
	Demonstration	
	Hands on/games	
	Exercises	
	Visits at facilities	
	Other (Case-Study)	x
Evaluation methods	Homework	
	Class project	
	Interim examination	
	Final examinations	
	Other (describe) ……	
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Number of topics	4	

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