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Good practices of research, educational and training programs on smart solutions for the interconnection of transportation networks

alliance

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LIST OF ABBREVIATIONS

Abbreviation	Description
BSR	Baltic Sea Region
BSc.	Bachelor of Science
CADSES	Central European Adriatic Danubian South-Eastern European Space
CART	Classification and Regression Trees
CIS	Commonwealth of Independent States
EC	European Commission
EE	Estonia
EMA	Emerging Market Airports
ERTMS	European Rail Traffic Management System
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HDTV	Heavy-Duty Transport Vehicles
ICT	Information and Communication Technologies
iLiM	Institute of Logistics and Warehousing
IPA	Importance Performance Analysis
IS	Information System
IoT	Internet-of-Things
KPI	Key Performance Indicator
LMTT	Linear Motor based Technology Transfer
LT	Lithuania
LTD	Limited Company
LV	Latvia
MSc	Master of Science
NAP	National Development Plan
NNVT	Noord Natie Ventspils Terminals
PL	Poland
PLC	Public Logistics Center
PPP	Public-Private-Partnership

Abbreviation	Description
RICT	Riga International Coach Terminal
RIFD	Radio-Frequency Identification
RO-PAX	Roll-on/roll-off passenger
SJSC	Latvian State Road
STSE	Short Term Staff Exchange
SUMP	Sustainable Urban Mobility Plan
SWOT	Strengths-Weaknesses-Opportunities-Threats
TENT-T	Trans-European Transport Network
TLT	Transport and Logistics Terminal
UCC	Urban Consolidation Centre
UIC	The International Union of Railways
UK	United Kingdom
VIP	Very Important Person
WC	Water Closet
WP	Work Package

Executive summary

During the last decade, the European Union has introduced a common transport policy framework as an overall strategy, integrating sustainable development in urban transportation, and addressing aspects such as economy, competition, land-use planning and research policy. Transporting people and goods is a key catalyst in economy, but at the same time, increased traffic volumes significantly affect the quality of life in the urban-interurban environment. Digital society, combined with strategies that promote sustainability, enhance the promotion of soft modes of transport, public transportation and green logistics. However it is obvious that cities and stakeholders need to identify new strategies to improve quality of life of citizens, setting up their planning according to economic competitiveness and business needs, but also to emerging travelling and consuming trends.

ALLIANCE addresses the topic of intermodal interconnections, through interchanges for passenger mobility and freight transportation, taking into consideration legal and organizational issues, mobility needs and patterns of transport usage, interaction with other domains, such as spatial planning and economic development, smart and sustainable solutions for achieving smooth and seamless transportation, and decision-making strategies, methodologies and techniques for assessing and evaluating the impact of these solutions on the transportation domain, as well as the economy and society.

The scope of this deliverable is the identification of existing gaps between the transport industry and the research, education and training programs in Latvia which constitutes the basis for subsequent tasks. The analysis focuses on in-depth investigation of the current situation and trends that exist in Latvia, about the planning and operation of intermodal terminals. These trends will be compared to the current state of good practices of intermodal terminals and the smart solutions at EU level. In parallel, an in depth analysis of existing educational programs in Latvia is conducted.

The methodological approach adopted comprises five parts, as follows:

- Identification of areas of research
- Identification of data sources
- Selection of good practices or indicative cases
- Tool development for data collection
- Development of gap analysis methodology.

Especially regarding the gap analysis, ALLIANCE identified existing gaps between the transport industry and practice, and the research, education and training programs in Latvia. The analysis focused on in-depth investigation of the current situation and trends that exist in EU and the Latvia, about the planning and operation of intermodal terminals and the related educational and training transport programs. The two levels gap analysis that was developed and implemented in the scope of ALLIANCE project with respect to the three thematic areas of 1) *Governance and policy development*, 2) *Smart solutions, and* 3) *Decision-making,* and the validation process that followed, has revealed several gaps and requirements that currently exist for passenger and freight interchanges and educational programs for the Latvia and the region.

The first level gap analysis that was performed between the interconnecting networks in EU and the Latvia and the region showed that Latvia and the region cover most of the thematic areas in terms of practices for both passenger and freight interchanges. Latvia and the region corresponds adequately to basic needs and requirements; however, compared to EU practices it performs poorer mainly due to limited incorporation of sustainability principles into planning and

operation of terminals and limited integration of technological advances with new transport trends as well as business and management plans. Regarding the passenger interchanges, the identified gaps impose in terms of governance and development a faster harmonization with EU legal framework on interchanges and promotion of operational integration to improve coordination among modes and operators. Regarding the area of smart solutions it was noted a rather limited integration of technological and policy solutions in the transport system which is complemented by the need of improving interchange design to accommodate the needs of all users. Although freight interchange policy challenges were found to be similar to passenger interchanges, other identified gaps for freight based interchanges focus to ownership, management and operation of interchanges in Latvia and the region that require the enhancement of administrative and cooperative schemes between public and private sector as well as the development of business models. Regarding smart solutions the individually planned urban consolidation centers and the limited business and transport operation planning led to the need to develop a more rational strategic plan of urban consolidation/distribution centers by considering the market demand.

The second level gap analysis used as input the results from the first level and data for existing educational, research and training programs in Latvia and the region to converse practice related requirements into educational gaps and requirements. On balance, the analysis showed that although several transport related programs in Latvia and region offer a wide variety of courses there is not a common integrated approach for the development of transport programs and transport courses content. Based on the analysis that was conducted, the transport courses that cover smart solutions (20%) in Latvia and region is lower relative to the other two thematic areas of 1) Governance and policy development (55%), and 2) Decision making (56%), which highlights the need for developing well integrated transport courses that mix smart solutions with the other two thematic areas for interconnecting networks. Smart solutions based courses should benefit by the development of courses that integrate public transport with smart solutions, and interchange and terminal design with accessibility and sustainability impacts.

To maintain a competitive educational program, innovative methods of data collection and exploitation of big data opportunities in decision making and analytics of transport freight should be considered to provide a competitive and sustainable transport strategy for interconnecting networks. Decision making based courses are ranked first in terms of number of courses, nevertheless there is a need to develop integrated course material that will focus on assessment practices with focus on interchanges and life cycle impacts (society, environment and economy). Educational based requirements showed the need to create a transport program that corresponds to forthcoming challenges and that will incorporate courses that cover more than thematic area simultaneously to enable a holistic education of graduates. The importance to develop educational programs which are adapted to local and Baltic region environment is highlighted by the presence of Baltic Transport Network as Gateway between East and West.

Given the projected infrastructural developments for Latvia and region, port interconnections, rail upgrade and connections with international transport corridors and networks there is a necessity to increase the competence of its educational system in the area of international transport by creating an educational program that adopts its content based to regional needs and European best practices.

1 Introduction

1.1 Background

During the last decade, the European Union has introduced a common transport policy framework as an overall strategy, integrating sustainable development in urban transportation, and addressing aspects such as economy, competition, land-use planning and research policy.

Economical, technological and social transformations, in combination with reclassifications in the urban land uses and the environmental effects of road based transport systems, resulted in important changes in the archetypes of passenger and freight movements. Currently, a contradictory situation is met in decision making and planning, where, even if there is a variety of new technological instruments and solutions, still, economic, managerial and regulatory barriers restrict the coherent introduction of these instruments and solutions to the sustainable dimension of the overall management.

Transporting people and goods is a key catalyst in economy, but at the same time, increased traffic volumes significantly affect the quality of life in the urban-interurban environment. Digital society, combined with strategies that promote sustainability, enhance the promotion of soft modes of transport, public transportation and green logistics. However it is obvious that cities and stakeholders need to identify new strategies to improve quality of life of citizens, setting up their planning according to economic competitiveness and business needs, but also to emerging travelling and consuming trends. At a glance, statistics are revealing (Grimm et al., 2008; European Commission, 2014; Figliozzi, 2010; Russo & Comi, 2012):

- More than 100 million people have mitigated to cities globally since the beginning of this decade.
- Over 50% of the world population is living in cities.
- In Europe, approximately 75% of the population lives in urban areas.
- Urban freight vehicles account for 6-18% of total urban travel.
- Urban freight transport accounts for 19% of energy use and 21% of CO_2 emissions.

The detailed understanding of the aforementioned environment and trends requires targeted actions that aim at organizing an educational and training program, which involves the participation of today's and tomorrow's researchers, decision makers and practitioners, provoking raise of scientific excellence and innovation in the domain and ensuring life-long endurance. This will generate sustainable collaborations in intermodal transportation and efficient and appropriate interactions between research and practice with view to stimulate changes of the current organizational and behavioral patterns.

ALLIANCE addresses the topic of intermodal interconnections, through interchanges for passenger mobility and freight transportation, taking into consideration legal and organizational issues, mobility needs and patterns of transport usage, interaction with other domains, such as spatial planning and economic development, smart and sustainable solutions for achieving smooth and seamless transportation, and decision-making strategies, methodologies and techniques for assessing and evaluating the impact of these solutions on the transportation domain, as well as the economy and society.

1.2 Project overview

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 will enable 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 educational programme for graduate and post-graduate students
- Development of training programme for trainers and practitioners
- Provision of grants for participation as authors of peer reviewed publications in conferences
- Facilitation of Short-Term Staff Exchanges (STSE's) with the aim of international collaboration, mainly publications
- Establishment of a guidance strategy for preparing scientific publications
- Creation of an educational forum as online 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 transportation networks and the development of the tools to attain this knowledge, providing at the same time excellence and innovation capacity. The analysis to be conducted during the first stages of the project, steps on the overarching relations among policy makers (e.g. government, city authorities), industry (e.g. transport operators, service providers) and education/research.

Structured around three main pillars, organizational/governance, operational/services and 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 transportation 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.

1.3 Deliverable scope and structure

The scope of Deliverable 2.1, the first deliverable of WP2 (Work Package 2) is the identification of existing gaps between the transport industry and the research, education and training programs in Latvia which constitutes the basis for subsequent tasks. We present research within the course of the educational programs and the requirements for the successful completion of the respective course. The analysis focuses on in-depth investigation of the current situation and trends that exist in Latvia, about the planning and operation of intermodal terminals. These trends will be compared to the current state of good practices of intermodal terminals and the smart solutions at EU level. In parallel, an in-depth analysis of existing educational programs in Latvia is conducted.

The document presents the methodology, the data collection process and analysis that took place since the beginning of the project. The outcome of the work presented in the remaining chapters provides a basis for the detailed gap analysis and subsequently for the development of the educational program that will be presented in subsequent deliverables.

Following the introductory chapter, the subsequent sections of this deliverable include: Chapter 2, which presents the methodological approach of this deliverable; Chapter 3, which presents the state-of-the-art in interconnecting transportation networks in Europe; Chapter 4, which presents the state-of-practice in interconnecting transportation networks in Latvia and the region; Chapter 5, which presents research, educational and training transport programs in Latvia and the region; Chapter 6, which presents research, educational and training transport programs in EU; Chapter 7 that presents the gap analysis which is based on collected information from Chapters 3,4,5, and 6; and Chapter 8 that summarizes conclusions of the deliverable, which will be used in the development of the educational program and will be detailed in Deliverable 2.2.

2 Methodology

2.1 Basic concepts

2.1.1 Intermodality and transport interchanges

The European Commission has defined intermodality as a policy under which "*different transportation modes are being combined in a trip, in order to achieve a seamless journey*", with the aim of providing the means for better mobility and impact minimization (European Commission, 2007). Legal and institutional structures, decision-making schemes, infrastructural and technological solutions are other dimensions concerning intermodality (Adamos et al., 2012).

The network components, which enable intermodal operations are transport interchanges. From the view of passengers, transport interchanges can be defined as "*transportation nodal points that enable seamless mobility, increase travelling efficiency, achieve user satisfaction and ensure system performance for door-to-door journey by making optimal use of combinations of modes in a sustainable way*" (Adamos et al., 2015). Adjusting this definition to freight transport, freight interchanges can be introduced as "*network nodes enabling logistics operations, which are required for the transshipment of goods along a corridor".*

In physical terms, transport interchanges constitute the field of intermodal activities. This can take the meaning of transferring from a long to a short distance network, from interurban transport to urban distribution, referred to as "last mile" and the change of transportation modes and/or vehicles.

2.1.2 Typology of passenger transport interchanges

Properly designed and managed transport interchanges present significant benefits, among which, time saving, better use of waiting time and urban integration. The European project City-HUB, based on qualitative surveys conducted in 21 interchanges, discussions with stakeholders and detailed analysis and evaluation of 5 pilot case studies and 6 validation case studies, identified key dimensions and features that can be applied when developing a typology for passenger transport interchanges (City-HUB, 2015).

The dimensions identified can be classified into two groups: the first one refers to the physical size and includes demand, modes of transport, services and facilities, and location in the city. The second group regards those dimensions which are related to the local impacts, including the consideration of the economic and land use effects in the vicinity of the interchange place, and refer to nearby shopping, integrated development plan, new housing and new offices, and jobs' creation. These two groups of dimensions define the key features that characterize an interchange thus, building design, i.e. small, medium or city landmark, stakeholders' categories and respective involvement, and business models, classified as hot or cold interchanges, partially integrated and fully integrated (City-HUB, 2015).

In terms of their role in the transportation network, an interchange typology was proposed by the CLOSER project, resulting in three categories of passenger interchanges: national hubs, national city terminals, and other city or local terminals. The characteristics of these categories, in terms of long-distance modes, main authority levels, orientation, type (level) of interconnection and ownership, are presented in Table 2.1 (CLOSER, 2011b).

Table 2.1: Passenger transport typology (CLOSER, 2011b)

Characteristics	National hub: Airports and passenger/ferry ports	National city terminal	Other city or local terminals
Long-distance modes	Air, high-speed rail, conventional rail, interurban bus, ferry	High-speed rail, conventional rail, interurban bus	Conventional rail, interurban bus, ferry
Main authority levels	National/regional	National/regional/local	Local/regional
Orientation	National/international	Regional/local/city	City
Type (level) of interconnection	International/national ↔ Local/regional/national	National/regional ↔ Regional/local	Regional ↔ Local
Ownership	National authorities or their representatives, varying private influence	National/regional/local authorities or their representatives, sometimes private influence	Usually local/regional authorities, but also national, not much private influence

2.1.3 Typology of freight transport interchanges

Freight transport interchanges are fully geographically determined areas, managed by one public and/or private body. All activities including transport, handling and distribution of cargo are operated by several enterprises, i.e. transport and logistics providers or users, established in the interchanges (Gogas & Nathanail, 2014).

In literature, several efforts and approaches for the definition of the types of freight terminals/interchanges are met. Based on the geographical coverage, volume and capacity, Wiegmans et al. (1998) identified five characteristic types: mainport terminals, international European terminals, national terminals, regional terminals and local terminals (Wiegmans et al., 1998). Another approach was made by Rodrigue and Hatch (2009), who identified three types of intermodal terminals, including port terminals, rail terminals and distribution centers (Rodrigue & Hatch, 2009). The European project REFORM, identified four categories of transport and logistics terminals (TLTs), the types and characteristics of which are presented in Table 2.2 (Nathanail, 2007).

Table 2.2: Types of TLTs and their characteristics (Nathanail, 2007)

Category	City terminal	Freight village	Industrial and logistic park	Special logistic area
Transport modes	Road-road Road-rail	Road-rail (barge)	Road-road Road-rail	Road-sea/air Road-rail-sea/air
Main aims	Traffic reduction in the city	Model shift and urban traffic reduction	Regional economic growth and modal shift	Regional economic growth
Operator	Huge forwarder or retailer	Operating company (public influence)	No operator	Airport or harbor authorities
Company	Huge forwarder	Small companies, also large transport	Large industrial companies and	Large companies

Category	City terminal	Freight village	Industrial and logistic park	Special logistic area
structure	or retailer	companies	transport companies	
Land use	Small areas in the city	Large areas in outskirts	Large areas in the outskirts or at old industrial areas	Extension to existing sites in the city or in the outskirts
Land price	Very high price	Relatively low	Relatively low	High
Quality of infrastructure	Good access to the city	Direct links to main infrastructure and access to the city	Direct connections to main infrastructure	Very good access to the international infrastructure
Orientation	City	Regional / interregional	Regional / interregional	International / intercontinental

Lastly, the European project CLOSER, proposed a simpler version of the REFORM typology, using fewer characteristics and adding one more category thus, rural terminal (CLOSER, 2011b).

2.2 Methodological approach and data collection

As presented above, Deliverable 2.1 focuses on the identification of existing status for and gaps between the transport industry and the research, education and training programs in Latvia. Identified gaps are anticipated to constitute the basis for subsequent tasks in ALLIANCE, namely the formulation of a research, education and training program in Latvia, to fill in the revealed gaps. The methodological approach adopted in the context of Deliverable 2.1 comprises five parts, as follows:

1. Identification of areas of research. Adapting the deliverable's scope to the purpose of the ALLIANCE project, two areas of research were identified as of high relevance to the development of the educational program in Latvia; "Interconnecting transport networks" and "Research, educational and training programs". For each of the two areas, research is conducted for current practices in EU on one hand, and Latvia and the region, on the other.

2. Identification of data sources. The data sources that were used to collect the necessary information and data include: (a) for the area "Interconnecting transport networks": 1) EU policy on intermodality, 2) EU research projects on interchanges from the EU database CORDIS and partners' finalized projects which are relative to the scope of the project (desk review), 3) Data on the current state of the interchanges in Latvia and the region, 4) Strategic planning for Latvia (National Development Plan 2014-2020); (b) for the area "Research, educational and training programs": 1) Graduate educational programs relevant to transportation in European institutions, 2) Educational programs for all levels relevant to transportation in Latvia and the region. The latter have been based on online information, institute prospectus and personal communication. The purpose of data collection through online sources is to use the most recent information available for each of the programs in the sample to fill data templates.

3. Selection of good practices or indicative cases. Based on information accessibility and availability, and predefined selection criteria, being presented in the relevant chapters of the document, this part led to the selection of good practices or indicative cases in each of the two

areas of research: “Interconnecting transport networks” and “Research, educational and training programs”.

4. Tool development for data collection. For the facilitating the data collection activities, two templates were developed, one for “Interconnecting transport networks” and the other “Research, educational and training programs” and used for both Latvia and the region and the EU. Each template comprised a series of standardized questions, some of which with multiple-parts, allowing, also, for multiple-responses.

The “Interconnecting transport networks” template aimed to collect information about existing transportation systems that accommodate transfer for passengers and transhipment for freight. Each case/good practice was described in a way that it combined all four interchange dimensions, i.e. physical, institutional, services, and information. In cases that this was not possible, the physical dimension was described, as a minimum. A SWOT (strengths, weaknesses, opportunities and threats) analysis was also included in the reporting.

The “Research, educational and training program” template aimed to collect standardized information that is provided on the websites and prospectus of educational institutes for their transport programs. To maintain a balance between the effort required to collect and review educational organization websites and the quality of the review, the fields that required completion in the templates were kept to a reasonable number, which was necessary to describe a transport program. Thus, the principal fields that were required are the following:

- Program type, title, institution, country and level
- Program entry requirements, number of courses and language
- List of courses that are related to the scope of the ALLIANCE project
- Course aims, objectives and learning results
- Course syllabus, material and suggested bibliography
- Course teaching and evaluation methods

In addition, the required fields for completion ensured that the review of existing transport programs will lead to:

1. A concrete analysis based on the scope of ALLIANCE project, and
2. The development of an educational and training program which suits the objectives of the ALLIANCE, and thus help strengthening TTI in the field of intermodal transport, and in particular enhancing knowledge on smart solutions for interconnecting sustainable transportation networks.

Data collection templates are presented in Annex A.

5. Development of gap analysis methodology. The data should be used in an in-depth analysis of the current situation and future plans that exist in Latvia, about intermodal terminals, and comparison to the current state of good practices of intermodal terminals at EU level. To support trends of the domain, the gaps and requirements for an educational program in Latvia should be revealed. For this purpose, a gap analysis methodology was formulated and presented in the next paragraph.

2.3 GAP analysis methodology

Different gap analysis strategies have been developed and applied in order to assess the steps that need to be taken to achieve future goals and objectives (Mineraud et al 2016). The McKinsey 7S Framework is applied at business level to examine its characteristics through seven people-centric groupings: strategy, structure, systems, staff, style, skills and shared values (Techtarget 2014). The SWOT ("Strengths," "Weaknesses," "Opportunities," and "Threats.") has also been used in gap analysis to maximize strengths while minimizing weaknesses and avoiding threats. The Nadler-Tushman model or congruence model is a dynamic model that suggests that for identifying potential gaps in a system, the way that key organizational components of the system fit together should be studied; thus components' interactions are more important than the components itself (MDC 2004). Apart from business based applications, gap analysis has been used in a service quality study to identify specific service attributes that are significantly important for improving customer loyalty (McCain et al. 2005). Gap analysis was also used to identify multiple gaps between Internet-of-Things (IoT) platforms, both proprietary and open-source along several dimensions, on the basis of their ability to meet the expectations of different IoT users (Mineraud et al 2016).

For making recommendations and suggestions and developing actions towards improving performance of an educational transport program in Latvia the following methodological steps were taken to support the gap analysis (Figure 2.3):

Step 1: Data collection and analysis for 1) The state of practice in interconnecting transportation networks in Latvia and the region (in Chapter 4), and 2) Research, educational and training programs in Latvia and the region (in Chapter 5).

Step 2: Data collection and analysis for 1) The state of art in interconnecting transportation networks in Europe (in Chapter 3), and 2) Research, educational and training programs EU (in Chapter 6).

Step 3: Assessment of present situation by comparing the state of art in EU and the state of practice in Latvia and the region in terms of interconnecting transportation networks. The first level gap analysis outlined the features and differences between Latvia and the region and EU (Gap analysis 1).

Step 4: Step 3 results are assessed against Latvia's current research, educational and training programs. The second level gap analysis outlines the educational deficiencies in Latvia and the region as compared to the requirements of the domain of transportation network interconnections (Gap analysis 2).

Step 5: The planned development of Latvian transportation networks interconnections are described to define the trends in Latvia regarding the planning and operation of intermodal terminals.

Step 6: Based on the two level gap analyses and outputs from step 5, the knowledge requirements for intermodal terminal development for Latvia and the region are identified.

Step 7: Step 6 results and knowledge of educational programs in the EU (step 2) are used as input towards validating the educational and training requirements for the Latvian Institutions and TTI in particular.

Step 8: Formulation of a plan of action to bridge identified gaps and developing an educational program for Latvia and the region that addresses identified deficiencies/requirements, complying with applying educational standards.

Deliverable 2.1 describes in detail Steps 1 through 7 of the above methodology. Step 8 constitutes the research, educational and training program to be developed for TTI, and comprises Deliverable 2.2.

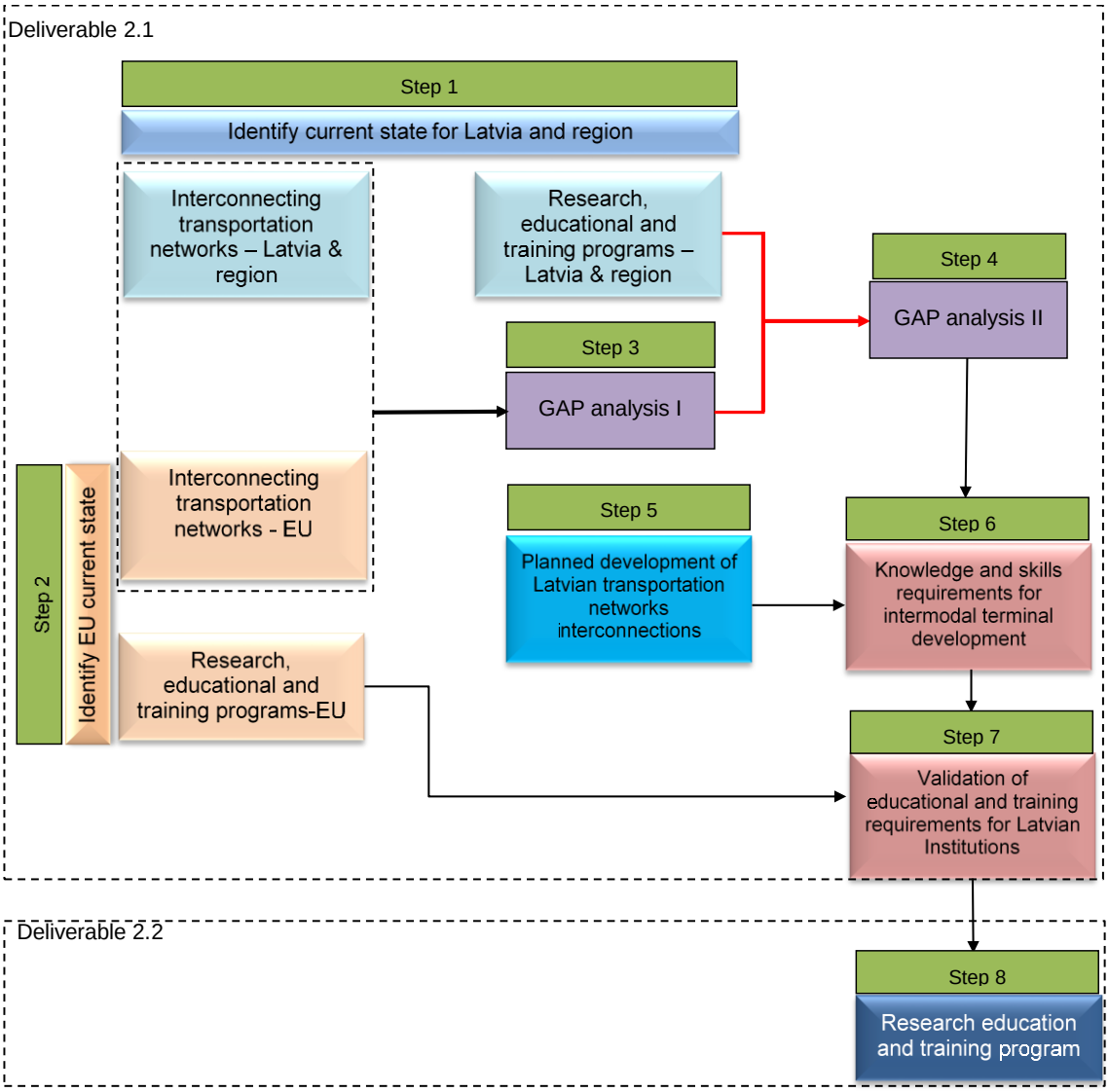

Figure 2.1: Methodological structure

3 State-of-the-art in interconnecting transportation networks in Europe

3.1 The European Union context

3.1.1 European Union policies

The White Paper *"European transport policy for 2010: Time to decide"* (European Commission, 2001) emphasized the need that common transport policy should be integrated into an overall strategy addressing sustainable development and including economic, land-use planning, social education and urban transport policies. In 2006, the Mid-term review of White Paper, and the Communication *"A sustainable future for transport: Towards an integrated, technology led and user friendly system"* (European Commission, 2006) addressed the same transport policy objectives, and argued for comprehensive approach to transport policy, assuming that mutually complementary action is required at national, regional and local levels of governance.

In 2009, the *"Action Plan on Urban Mobility"* was communicated by the European Commission, where urbanization and its impact on transport were recognized as key challenges for the provision of a more sustainable transportation system through actions that integrate urban mobility, promote partnerships and enhance the wide involvement of stakeholders (European Commission, 2009). In addition, the European Commission White Paper *"Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system"* identified three pillars of priorities including people, integration and technology. The Paper contains objectives, actions and initiatives for the realisation of a more sustainable transport system till 2050 and indicates intermodal integration as one of the most important characteristics of future transport systems (European Commission, 2011).

After the "Smart Cities and Communities Initiative", which was launched by the European Commission in 2011, the European Innovation Partnership for Smart Cities and Communities collaboration came up on July 2012, aiming at introducing new and innovative solutions for the confronting of the most challenging issues that European cities face, including environmental, societal and health concerns (http://ec.europa.eu/eip/smartcities/).

As a follow-up to the 2011 White Paper, the European Commission came up in 2013 with the "Urban Mobility Package", which introduced the concept of "Sustainable Urban Mobility Plans" (SUMPs), as a result of the broad exchange of knowledge and experience between stakeholders and planning experts across the European Union (European Commission, 2013a).Towards this direction, the European Territorial Cooperation Programme "URBACT" enables cities to work together for the development of solutions to major urban challenges (http://www.urbact.eu/).

A recent European Commission's document entitled "Thematic Research Summary on Passenger Transport" also pays special attention to the provision of integrated transport services, encompassing intermodal mobility concepts, such as integrated passenger information and platforms for intermodal coordination. The report foresees that intermodal mobility concepts should aim at increasing flexibility and efficiency through the combination of transport means and the concurrent assurance of reliability and comfort (European Commission, 2013b).

Traditionally, urban planning has been focused on passenger transport, and this, over the years, led to serious problems that cities and stakeholders had to deal with, since freight transportation

represents one of the greatest challenges in urban areas, both in terms of goods distribution and service allocation performance, and environmental impacts, including air emission, traffic congestion, road safety, accident and noise.

Co-modality was proposed by the European Transport Policy as an essential instrument for the improvement of the effectiveness of freight transportation towards efficient goods movements and environmental protection (European Commission, 2006). Also, the Green Paper “Towards a new culture for urban mobility”, introduced in 2007, contained several topics addressed to stakeholders and citizens, in order to indicate the most serious problems on urban mobility and possible solutions to these problems (European Commission, 2007).

Lastly in 2007, the European Commission presented a Freight Logistics Action Plan, which promoted the further development of e-freight and Intelligent Transport Systems (ITS), the improvement of the sustainable quality and efficiency, the simplification of transport chains, the reinforcement of green corridors in Trans-European Transport Network (TEN-T) and Marco Polo priorities, the promotion of the establishment of Motorways of the Sea, the exchange of best practices in urban freight transport logistics, etc. (European Communities, 2007).

3.1.2 European research projects

In the past years, a number of projects have developed knowledge in the scope of ALLIANCE. A shortlist of such projects is presented in Table 3.1.

Table 3.1: Shortlist of European research projects related to ALLIANCE

No.	Acronym	Title	Scope	Website
Passenger transport				
1	CityMobil	Towards advanced road transport for the urban environment	Integration of automated transport systems in the urban environment.	http://www.citymobil-project.eu/
2	HERMES	High efficient and reliable arrangements for crossmodal transport	Analysis of mobility schemes and associated organizational patterns at the interface between long distance transport networks and local/regional transport services.	http://ec.europa.eu/research/transport/projects/items/hermes_en.htm
3	INTERCONNECT	Interconnection between short and long-distance transport networks	Investigation of the function of local, regional and intermodal transport interconnections.	http://www.interconnect-project.eu/
4	KITE	A knowledge base for intermodal passenger travel in Europe	Establishment of a knowledge base for intermodal trips enabling stakeholders to develop and evaluate intermodality-related measures.	http://www.transport-research.info/project/knowledge-base-intermodal-passenger-travel-europe
5	CIVITAS	CIVITAS Initiative	Redefinition of transport measures and policies for the creation of cleaner and better transport in cities.	http://www.civitas.eu/
6	City-HUB	City-hub	Development of a business model to support seamless mobility and proper interchange design and operation.	http://www.cityhub-project.eu/
7	NODES	New tools for design and operation of urban transport interchanges	Development of guidance on how to improve and assess the interchange performance towards intermodality and information and telecommunication technology solutions.	http://www.nodes-interchanges.eu/
Freight transport				
8	TRAILBALZER	Transport and innovation logistics by local authorities with a zest for efficiency and realization	Knowledge and experience transfer to less experienced groups, and especially authorities.	http://www.trailblazer.eu/content.php

No.	Acronym	Title	Scope	Website
9	IMONODE	Efficient integration of cargo transport modes and nodes in CADSES area	Investigation of options, solutions and actions for the enhancement of the greater use of, and the accessibility to the transportation axes no V and X for freight transport priority on rail.	http://www.cadses.net/
10	PROMIT	Promote innovative intermodal freight transport	Collection of best practice solutions and development of Best Practice Handbook.	http://www.transport-research.info/project/promote-innovative-intermodal-freight-transport
11	SUGAR	Sustainable urban goods logistics achieved by regional and local policies	Exchange, discussion and transfer of policy experience, knowledge and good practices in urban freight management.	www.sugarlogistics.eu
12	BESTUFS	Best urban freight solutions	Urban freight transportation and promotion of best practices for city logistics solutions.	http://www.bestufs.net/
13	STRAIGHTSOL	Strategies and measures for smarter urban freight solutions	Demonstration of a multi-actor evaluation framework for the assessment of the impact of smart technologies in urban-interurban transport interfacing.	http://www.straightsol.eu/
14	NOVELOG	New cooperative business models and guidance for sustainable city logistics	Enabling of knowledge and understanding of urban freight distribution and service trips, in order for cities to implement effective and sustainable policies and measures.	http://novelog.eu/
Passenger and freight transport				
15	CLOSER	Connecting long and short-distance networks for efficient transport	Guidance on stakeholders' collaborations in the interfaces between long and short-distance transport networks.	http://www.closer-project.eu/

3.2 Good practices in Europe

The objective of this chapter is to present the findings of an extended review in passenger and freight interchanges in Europe, from which good practices were revealed, under the three thematic areas that ALLIANCE addresses: governance and policy, smart solutions and decision-making (Figure 3.1).

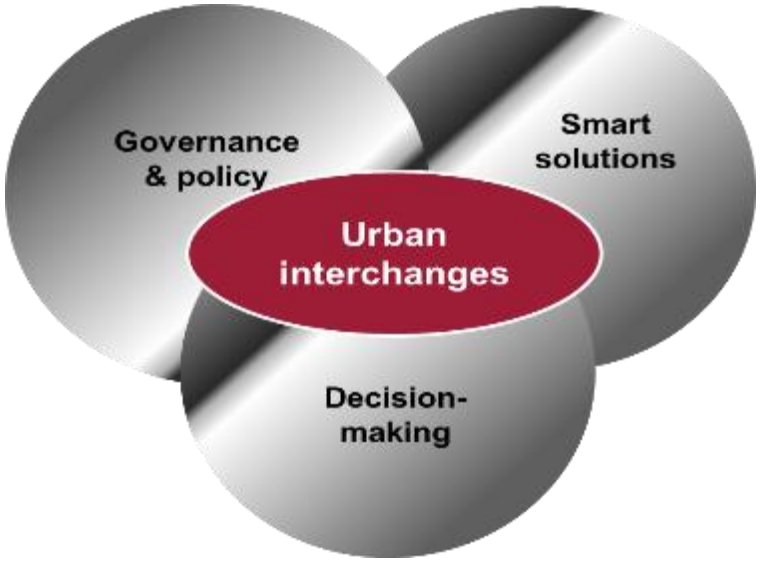

Figure 3.1: Thematic areas of urban interchanges review

The presentation and discussion of the trends and practices is based on the analysis conducted in representative passenger and freight interchanges, selected from cases described and reviewed in the projects CLOSER, City-HUB, KITE, IMONODE, STRAIGHTSOL and NOVELOG.

The overview is distinguished into passenger and freight transport, and for the presentation of the interchanges the typologies of CLOSER and REFORM projects are adopted for passenger and freight interchanges, respectively (see paragraphs 2.1.2 and 2.1.3).

3.2.1 Passenger interchanges

In the framework of ALLIANCE, 41 passenger interchanges were reviewed, covering a wide range of the European Union, including 17 countries: France, Norway, Greece, Lithuania, Spain, United Kingdom, Finland, Hungary, Czech Republic, The Netherlands, Germany, Switzerland, Austria, Denmark, Estonia, Belgium and Portugal. The 32% of the interchanges are identified as national hubs, and the rest 68% of the interchanges can either be considered as national city terminals or other city/local terminals. An overview of these interchanges is presented in Table 3.2.

Table 3.2: Overview of passenger interchanges

Code	Interchange name	Country	Interchange type		
			National hub	National city terminal	Other city or local terminals
P1	Vienna international airport	Austria	X		
P2	Linz central station	Austria		X	X
P3	Brussels airport	Belgium	X		
P4	Antwerp central station	Belgium		X	X
P5	Liege Guillemins train station	Belgium		X	X
P6	Brussels South	Belgium		X	X
P7	Praha Ruzyně international aiport	Czech Republic	X		
P8	Prague terminus Dejvicka	Czech Republic		X	X
P9	Copenhagen airport	Denmark	X		
P10	Port of Tallinn	Estonia	X		
P11	Kamppi terminal	Finland		X	X
P12	Armentiéres station	France		X	X
P13	Gare Lille Frandres-Europe	France		X	X
P14	Charles de Gaulle airport	France	X		
P15	Port of Calais	France	X		
P16	Frankfurt airport	Germany	X		
P17	Berlin central station	Germany		X	X
P18	Karlsruhe central station	Germany		X	X
P19	Thessaloniki port	Greece	X		
P20	New railway station of Thessaloniki	Greece		X	X
P21	Intercity Coaches of Magnesia	Greece		X	X
P22	Macedonia Coach Terminal	Greece		X	X
P23	Railway station of Volos	Greece		X	X
P24	KTEL Kifisou	Greece		X	X

Code	Interchange name	Country	Interchange type		
			National hub	National city terminal	Other city or local terminals
P25	Kőbánya-Kispest intermodal terminal	Hungary		X	X
P26	Intermodal terminal of Miskolc	Hungary		X	X
P27	Vilnius airport	Lithuania	X		
P28	Oslo bus terminal Vaterland	Norway		X	X
P29	Gare De Oriente	Portugal		X	X
P30	Moncloa interchange	Spain		X	X
P31	Paseo de Gracia	Spain		X	X
P32	Plaza Castilla Interchange	Spain		X	X
P33	Madrid Airport Barajas T4	Spain	X		
P34	Zurich central station	Switzerland		X	X
P35	Zurich airport	Switzerland	X		
P36	Den Bosch train station	The Netherlands		X	X
P37	Utrecht Central	The Netherlands		X	X
P38	Birmingham New Street Station	United Kingdom		X	X
P39	King's Cross St Pancras Underground Station	United Kingdom		X	X
P40	Ilford railway station	United Kingdom		X	X
P41	London Stansted Airport	United Kingdom	X		

The interconnected modes in each interchange, are presented in Table 3.3, where, in each connection, the code of the interchange is added to state the availability of the connection at the interchange.

Table 3.3: Transportation modes connections at passenger interchanges

Transportation mode	Bus/ Trolley	Tram	Rail	Bicycle	Boat/ Ferry	Air
Bus/ Trolley	P2, P4, P6, P11, P23, P24, P25, P26, P28, P29, P34, P36, P37, P38, P39, P40					
Tram	P4					
Rail	P30, P31, P32, P34, P36, P37,P40, P41	P6				
Bicycle	P2, P23, P24, P25, P26, P28, P29, P34, P36, P37, P38, P39, P40					
Boat/ Ferry	P10, P15, P19		P15	P10, P15, P19		
Air	P1, P3, P7, P9, P14, P16, P27, P33, P35, P41	P11	P1, P3, P7, P9, P14, P16	P11, P34, P35		

Figure 3.2 is used to illustrate how the performance of a passenger interchange can be assessed under four main dimensions: institutional, physical, service and information.

The first dimension is formed by the organisational and institutional structure that appears in the interchange, and includes the definition of the roles and responsibilities among the involved stakeholders, regarding issues such as regulations, financing, ownership and split of responsibilities on infrastructure and operational structures. It is expected that policy objectives and measures, covering the entire transportation system, also affect this dimension in terms of economy, legislation, environmental concerns, etc. The physical dimension is addressed by the supply side performance and the interchange properties. Energy use, investments, socioeconomic parameters, traffic volumes and passengers flows formulate the supply side performance, while design, location, accessibility, space and capacity and equipment are considered as crucial properties that a successful interchange should meet. Information and fare are strongly related to the level of service provided to travelers, which is further based on factors such as comfort, costs, safety and security, integrated ticketing, flexibility, frequency and reliability of services, and quality of information availability.

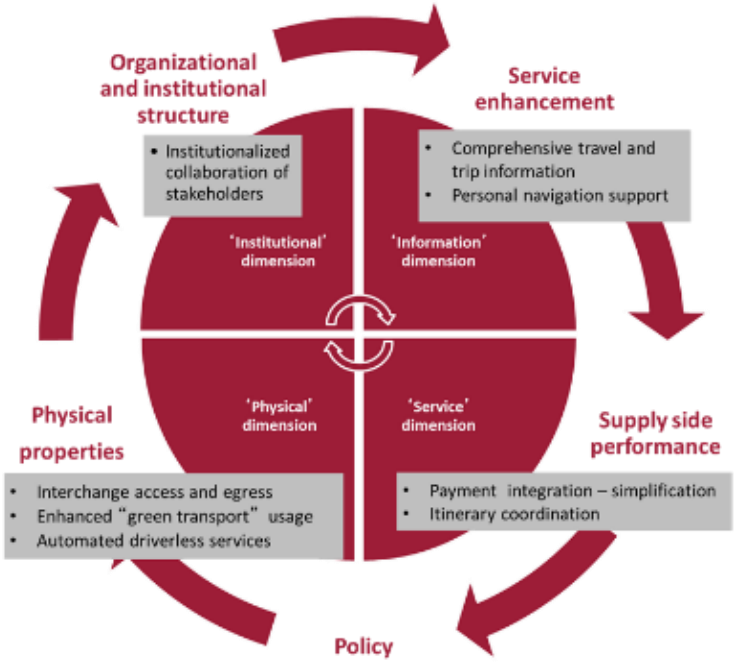

Figure 3.2: Key factors for pursuing successful interchanges

Taking the four interchange dimensions into account as key factors for pursuing successful interchanges, the following paragraphs present and discuss, good practices revealed by the analysis of the above 41 interchanges. The presentation is done separated into three topics: governance and policy, smart solutions and decision making. Where reference to specific interchanges is made, the interchange code is used as presented in Table 3.2.

3.2.1.1 Governance and policy

Governance and policy cover issues related to the interconnection of transportation with land use planning, legislative, institutional and organizational frameworks. Currently, there are few examples of policies, regulations and guidance that incorporate the design, construction, management and operation of interchanges as a whole. In many cases, the interchange facility and its catchment area are not considered satisfactory in transport planning, and the roles and responsibilities of stakeholders involved in the interchange are often addressed by the regulatory framework of each mode. In addition, research has shown that the link between urban interchanges and their impacts on land use are not direct, if there is not a strong development plan associated to the involvement of policy makers (Banister & Berechman, 2001).

In the following paragraphs, good practices indicated in governance are presented, separated into: stakeholders, policy, ownership, sustainable development, management and operation.

Stakeholders

It is important that the manager of an interchange identifies his own stakes, but also the stakes of the relevant stakeholders, which need to be engaged for the successful achievement of the defined policy goals and objectives.

The Gare Lille Frandres-Europe *(P13)* Interchanges in France are two good examples, where

the process of identifying multiple stakeholders, their roles and responsibilities was clear and consequently successful. In this case, the interchanges operate under an efficient partnership with all involved stakeholders and regular meetings among them take place for the coordination of the different functions of the interchanges (City-HUB, 2015).

Moncloa interchange *(P30)* in Spain organizes the operation of the station through a concession contract, which transfers the management and maintenance responsibilities to the concessionaire consortium. This process reveals the need for establishing clear responsibilities, and ensuring that operation specifications are maintained throughout the concessionaire period (City-HUB, 2013a). On the other hand, in the Vaterland bus station *(P28)* in Norway, the regional public authorities own the interchange, in order to secure effective and accountable competition (CLOSER, 2012a).

The analysis of the Den Bosch train station *(P36)* in the Netherlands showed that the municipality, acting as the manager of the interchange, should clearly define goals and needs for actions, identifying and involving, at the same time, relevant stakeholders. A lesson learnt, was that, when the city has clearly set roles and responsibilities, then, in case that an external stakeholder fails to fulfil the goals of the municipality, the municipality itself should lead the process, and bring in, for example, funding sources, if needed (City-HUB, 2015).

Policy

Nowadays, an interchange does not operate only as a node in the network, but there is a need to cover and provide a number of benefits to passengers, including time savings, better use of waiting times, urban integration, enhanced operational business models, efficient accessibility etc. (Di Ciommo, 2012).

A successful example is the Vilnius airport *(P27)* in Lithuania, where national and regional authorities make efforts to familiarize transport and terminal operators with the relevant policies, aiming at the understanding of how important it is to achieve goals at national and European level, and to accept the adoption of emerging trend and practices. In Thessaloniki port in Greece *(P19)*, a Port Development Council is assembled, which makes decisions on how to encounter problems that appear, but also, provides advice to the managing authority of the port to launch policies, which may be helpful for the port's customers on their business operations (CLOSER, 2012a).

Ownership

Ownership at interchanges is directly associated with the financing scheme and the arrangements of the initial investments and operations. The most common structures met at interchanges are: public, private and joint venture (e.g. public-private). Public ownership regards those interchanges that are owned by state, regional or local governments and operate to offer public services (City-HUB, 2013c).

In Norway and the Vaterland station *(P28)* the ownership of the interchanges is separated from operation, and this has resulted in the establishment of trust among actors and the security of fair and equal access of operators to the interchange. In Greece, and the case of Thessaloniki port *(P19)*, the land and infrastructure are owned by the national government, however they have been conceded to the Thessaloniki Port Authority S.A., which is a private entity, for operation, management and exploitation until 2041. Technologies and maintenance are also under the responsibility of the Port Authority (CLOSER, 2012a).

Sustainable development

Interchanges can generate significant economic impacts and revenues, and can affect the economic and land use development in the neighboring areas (Banister & Berechman, 2001).

In Moncloa interchange *(P30)*, for example, the interchange development included a crucial part of an overall plan for larger refurbishment. In Lille, a development plan has been introduced for the city integration, while, there is also a steering committee and technical committees, responsible for the documentation of transport, urban and development policies. Among the issues that these policies address are new shopping facilities, new housing and offices, which are important parameters to improve the interchange's attractiveness (City-HUB, 2015).

Management

It is very important that an Interchange Management Plan is developed, in which a comprehensive strategy can be documented, analyzing public transport, accessibility and land use issues, and the functionality of the interchange. In addition, the Plan should clearly define the roles and responsibilities of all involved stakeholders, and preferably, in each stage, i.e. design, planning, construction and operation of the interchange (City-HUB, 2015).

Such a successful attempt has been made in Madrid *(P30)*, where public administrations have developed a plan for transport interchanges, addressing functionality across different modes and efficiency improvement. Agreements have been made among the regional government, the city council and the Madrid transport authority, which have permitted the development of interchanges for each access corridor to Madrid (City-HUB, 2015).

The Port of Tallinn *(P10)* in Estonia, has also made an effort during the last years to explicate a development plan, feasibility studies and needs' analyses of the clients, aiming at providing high quality and environmental standards and ensuring the well-being of all its stakeholders (KITE, 2008).

Operation

Good examples of successful operation are met in Berlin Central Station *(P17)*, where there are short transfer times between long distance modes, ensured by the successful coordination between transport operators and the dynamic schedule synchronization, and in the Zurich Airport *(P35)*, which provides very dense connections to the local, inter-regio and long-distance train network through an own train station, located very close to the Zurich main station. Also, in Brussels airport *(P3)*, the connection between different modes are coordinated, while the Madrid Airport Barajas T4 *(P33)* provides a high frequency connection of the city centre to the airport by metro, and the centre is easily and cheap accessible by only one transfer (KITE, 2008).

Moncloa interchange *(P30)* also appears to be rather successful in this issue, since buses and metro trains depart every 5-10 minutes in peak hours, providing short transfer times to passengers. Similar situation is met in Kamppi and Kőbánya-Kispest interchanges, where there are approximately five departures every hour (City-HUB, 2013a).

3.2.1.2 Smart solutions

Smart solutions include technological measures and other innovative tools, which enable the efficient operation of intermodal interchanges, and provide services of high quality, environmental and energy protection, and sustainability. Good practices referring to smart solutions are presented in the following paragraphs, organized under three dimensions:

- Information, further distinguished into trip information and wayfinding
- Services, addressed by ticketing, coordination and safety/security
- Physical properties, including location, access/egress, facilities and accessibility

Information

At Ilford railway station *(P40)*, there is a good level of information provision within the train station, including timetables and real time information. Passengers can also receive real time information online via the National Rail website or mobile phone application. At Moncloa interchange *(P30)*, a number of web-based applications for local and long-distance public transport pre-trip planning are available, as well as respective applications for smartphones. Similarly, at the New Railway Station of Thessaloniki, a web application for trip planning is available. At Kamppi interchange *(11)*, timetable information is available on several displays, while the different transport operators share the same information screens. At Köbánya-Kispest *(P25)*, both static and dynamic information is available to travelers on displays, by speakers and via internet (City-HUB, 2013a).

Moncloa interchange *(P30)* can be considered as a good practice in terms of wayfinding design. Despite the large number of travelers using the station every day (more than 260.000), it is easy to move around and make the necessary connections, since the interchange is never overcrowded. Its design is such that the interchange provides four different levels without physical interruptions, and the clear color strategy with consequent signage and symbols allows logical passenger movements. In addition, the Moncloa interchange has dedicated access tunnels for buses that allow quick access to and from the interchange for those users traveling by bus (City-HUB, 2013a).

Services

The potential of providing integrated ticketing for various transportation modes makes an interchange more appealing to travelers. Electronic ticketing offers this opportunity, since it reduces possible barriers related to buying tickets, and offers saving time, when for example users board on public transport or transfer between modes.

At Ilford interchange *(P40)*, integrated ticketing is available, and passengers are able to use a smart ticket for both rail and bus journeys originated from the interchange. In Madrid and Moncloa station *(P30)*, a new smart public transport travel card was introduced in 2012, based on RFID technology, and offering various benefits to users. At Kamppi interchange *(P11)*, travelers can purchase travel cards and use them for Helsinki local transport (City-HUB, 2013a).

Other good examples are met at the Charles de Gaulle airport *(P14)*, where combined tickets are available for high speed trains and aircrafts, at the Zurich Central Station *(P35)*, in which travelers may purchase integrated tickets with nearly all skiing areas in Switzerland and at Gare De Oriente *(P29)* in Portugal, where there is good fare integration between train-rent-a-car, train-parking space, and contactless smartcard for last mile travel, e.g. metro, bus (KITE, 2008).

In addition, it is essential that an interchange is designed and operated against any potential threat that may be risky for travelers, e.g. fire, floor hazards, obstructions, poor visibility, conflicts with vehicles, etc. Personal security is also an important parameter that should be taken into account in the design and operation of the interchanges, e.g. measures to avoid terrorism, crimes, etc.

In general, the analysis of the reviewed interchanges showed that there are good practices related to safety and security. For example, an important aspect to reduce accident risk is to

keep the flow of vehicles and passengers separated. This practice is met in the Moncloa station *(P30)*, where bus bays ensure that passengers do not use areas where the buses operate, and in Kamppi *(P11)* and Vaterland *(P28)* interchanges, where doors open only when it is time for the buses to depart. In addition, at the Moncloa interchange *(P30)*, exclusive facilities for the police are met, as well firemen presence, to ensure fire safety and evacuations. At the New Railway of Thessaloniki *(P20)*, there is intense presence of police officers and private security, while a central police department is located very close to the station. Closet-Circuit Systems are installed in almost all interchanges, e.g. Moncloa, New Railway Station, all airports, etc. (City-HUB, 2013a).

Physical properties

The quality and location of a transport interchange affects its accessibility. The majority of the reviewed interchanges seem to cover this requirement and enhance the use of public transportation. For example, the Moncloa interchange *(P30)* is located at an entrance point to Madrid in an area, where many historic monuments are met, and the station is directly connected to the Metro line 6, the Circular line that operates around the center of the city and has links to all key points of the metro network. Ilford railway station *(P40)* is situated on the Great Eastern Main line, providing regular local train services from Essex to Liverpool Street station in Central London, while, additionally, more than 10 bus stops are located within walking distance of the station. The New Railway Station of Thessaloniki *(P20)* is situated very close to the centre business district, close to the port of Thessaloniki, and also a bus line connecting the railway station to the International Airport of the city, is available right outside the main building of the station. Kamppi interchange *(P11)* is also located in a very central area in downtown of Helsinki (City-HUB, 2013a).

The degree that interchanges fit to their surrounding environment and the appropriate design that allows passengers to access and use the interchanges, are also very important parameters improving their appeal. An integrated interchange should provide multiple access/egress points for any different mode that is facilitated, keeping straight routes where possible, and using appropriate symbols and signs for easy navigation throughout the routes. It is also important that conflicts between bus/coach routes with other modes, including walking, are avoided. Such a good example is met at the Moncloa interchange *(P30)*, where passengers waiting for bus transport are segregated from the moving traffic (City-HUB, 2015).

The more the facilities at an interchange, the better the opportunity offered to users is to spend more productively their time while waiting to travel. Especially for those travelers who have to spend much time at an interchange, due for example to long transfer time, it is important for them to be able to arrange some personal issues by using e.g. the interchange's Wi-Fi network, or to do shopping, etc. A good practice is met in Kamppi interchange *(P11)*, which is centrally located in the center of Helsinki, developed in approximately four hectares. The interchange includes a shopping mall, and accommodates offices and flats in the same building complex, where someone could find 106 stores, 35 restaurants and cafeterias, and 29 additional services, like banks, gym, laundry and beauty salons. In Moncloa interchange, a variety of shops and other commercial services is available, including restaurants and cafeterias, cash machines, book and newspapers' stores, etc. At the New Railway Station of Thessaloniki *(P19)*, a similar situation is met, where a mall is located in the central building of the station offering various stores and kiosks, as well as a Citizen Service Center and a post office (City-HUB, 2013a).

Apart from positive environmental impacts, sustainable interchange design and energy efficiency has also significant impacts on society and economy. In Kamppi interchange *(P11)* in Finland, there have been realized strategies, which improve the environmental impacts, like: use of the

exhaust air from the passenger areas to warm up the bus platform, addition of air filters to the roof of the terminal area to improve air quality, development of system for monitoring air quality and regulates the idling of buses, existence of doors to the bus platforms which open only when buses depart reducing in this way the leakage of heat, etc. In Oslo, and the bus terminal Vaterland *(P28)*, the movement of current bus terminal above the rail tracks is being considered, while it is also planned to adopt the "Building Research Establishment's Environmental Assessment Method – BREEAM" for the classification of the interchange towards environmental considerations (City-HUB, 2015).

Other good examples and implementation of energy efficiency measures are met in the Intercity Coaches of Magnesia interchange *(P21)*, where natural gas is used in the building, in KTEL Kifisou interchange *(P24)*, which uses coaches fleet with lower emissions, and in the New Railway Station of Thessaloniki *(P19)*, where there have been considered lighting and air-conditioning measures, the bus fleet is greener, and an energy strategy plan is documented (Adamos et al., 2015).

In terms of accessibility, a successful practice is met at the Köbánya-Kispest interchange *(P25)*, where signs and information are accessible for people with visual impairments, e.g. boarding buttons emit a low frequency sound which indicates that the bus is ready to load passengers. The station also offers bike and ride facilities, which are covered and have signs along cycle paths (City-HUB, 2013a).

At the Armentiéres station *(P12)* in France, there is a very good intermodal interface among rail, buses, bicycles and private cars, while the surroundings are also designed under a coherent approach. The level of legibility of space and functions is adequate, and the urban and multimodal signaling is considered rather successful (CLOSER, 2012a).

Other good practices are met in Frankfurt airport *(P16)*, where there is ground accessibility and passengers with reduced mobility may use special offers, in Berlin Central Station *(P17)*, which provides barrier-free accessibility for handicapped persons, in Karlsruhe Central Station *(P18)*, where a guidance system in Braille is provided in the terminal for visually impaired people, in Charles de Gaulle airport *(P14)*, which also offers ground access, in the Zurich Central Station *(P34)*, in which all modes are accessible and weather protected, by underground and without conflicts with passengers of other modes, in Vienna International airport *(P1)*, where a transfer service for the elderly and impaired people is offered, in Copenhagen airport *(P9)*, where there is a new connecting pier which offers sidewalks for passengers for their easy movement from the domestic to the international terminals and in Brussels airport *(P6)*, which offers special services to handicapped people, e.g. visually impaired travelers can order a guide dog for their assistance (KITE, 2008).

3.2.1.3 Decision-making

Public participation is considered as an essential component for establishing a coherent decision making framework, directly affected by the frequency and the quality of the framework under which the discussion among stakeholders take place (Adamos et al., 2012). The analysis of the reviewed interchanges revealed that the majority of them do not seek to receive users' feedback, since the proportion of surveys oriented to travelers' needs are few. However, some good examples can be mentioned.

In Madrid and the Moncloa interchange *(P30)*, a user perceived quality and satisfaction survey was conducted, before the beginning of construction. The survey aimed at developing a quality assurance plan and set actions for the interchange. In Lille *(P13)*, regular surveys testing the

satisfaction level among the clients are conducted. In Helsinki *(P11)*, a number of regular surveys take place, addressing however the whole regional and local public transport system, and not particularly the interchanges (City-HUB, 2015).

In the Port of Tallinn *(P10)*, the findings of customer satisfaction and competitive position surveys confirmed that the implemented process and the client-centered management model adopted in the port, increased the company's competitiveness and ensured the high level quality in customer services (KITE, 2008).

In the framework of City-HUB, a travelers' satisfaction survey took place in five interchanges: Moncloa *(P30)*, Ilford *(P40)*, Thessaloniki *(P30)*, Kamppi *(P11)* and Köbánya-Kispest *(P25)*. The survey took into account the overall satisfaction of users at the different locations, as well as looked in more detail which were the most important aspects for users: information, waiting areas, safety and security, services, shops and cafes, transfer communication and access (City-HUB, 2013b).

Additionally, based on the results of the surveys conducted at the five interchanges, a useful tool was developed by Hernandez et al. (2014), which apart from the analysis of the users' satisfaction regarding different elements and aspects of an urban transport interchange, the tool also identifies the "derived importance" of each of them, meaning that it identifies the potential strengths and weaknesses of an urban transport interchange. This tool was based on two-step analytical procedure, combining two methodologies: Classification and Regression Trees Model (CART model), and Importance-Performance Analysis (IPA) (Hernandez et al., 2014).

Adamos et al. (2014) implemented the methodology developed in the framework of City-HUB in two interchanges in Volos, Greece, in order to capture the viewpoint and preferences of travelers on different elements for defining a "smart" and efficient interchange. An on-site face to face questionnaire survey was conducted at the Intercity Bus Station *(P21)* and the Railway Station *(P23)*, and useful information was gathered about travelers' habits, preferences and satisfaction, and in total thirty indicators were rated by respondents, including issues such as travel information, wayfinding information, access, time and movement, image and attractiveness, comfort and convenience, and emergency situations. For the data analysis, both descriptive and inferential statistics were used; specifically in order to record users' satisfaction and assess potential statistically significant differences in the values of the items between the two interchanges, the statistical analysis of the responses was carried out using non-parametric tests, i.e. Mann-Whitney-Wilcoxon test (Adamos et al., 2014).

Tsami et.al. (2013) investigated the accessibility level in Thessaloniki's Railway Station urban interchange under seven different accessibility scenarios. In this case, for the data analysis, apart from the implementation of descriptive statistics for the analysis of users' characteristics, hypothesis testing and one-way and two-way ANOVA testing was also used for the evaluation of scenarios (Tsami et al., 2013).

3.2.2 Freight interchanges

For the needs of ALLIANCE, 13 freight interchanges were also reviewed. An overview of these interchanges and their classification, according to the REFORM typology is presented in Table 3.4.

Table 3.4: Overview of freight interchanges

Code	Interchange name	Country	Interchange type			
			Special logistic area	Industrial and logistic park	Freight village	City terminal
F1	HøjeTaastrup rail freight terminal	Denmark	X			
F2	Port of Helsinki Vuosaari	Finland	X			
F3	Sogaris freght centers	France			X	
F4	Garonor freight centers	France			X	
F5	Leipzig-Halle airport	Germany	X			
F6	GVD freight centers	Germany			X	
F7	Thessaloniki port	Greece	X	X		
F8	Thriassio consolidation center	Greece	X			
F9	Trigono consolidation center	Greece	X			
F10	Kuehne & Nagel freight terminal	Greece	X			
F11	Interporto Bologna S.p.A.	Italy			X	
F12	Constantza port	Romania	X			
F13	DHL Urban Consolidation Center	Spain	X			

Regarding the availability of different transportation modes in each interchange, a summary of the modes connections is presented in Table 3.5, where, in each connection, the code of the interchange is added to state the availability of the connection at the interchange.

Table 3.5: Transportation modes connections at freight interchanges

Transportation mode	Road	Rail	Short Sea Shipping	Maritime	Inland Waterways	Air
Road	F1, F3, F4, F6, F8, F9, F10, F11, F13					
Rail	F1, F3, F4, F6, F8, F9, F10, F11, F13					

Transportation mode	Road	Rail	Short Sea Shipping	Maritime	Inland Waterways	Air
Short Sea Shipping	F2, F7, F12	F2, F7, F12				
Maritime	F2, F7, F12	F2, F7, F12				
Inland Waterways	F12	F12				
Air	F5					

In the following sections, good practices revealed by the analysis of the above 15 case studies are presented and discussed, separated into three topics: governance and policy, smart solutions and decision making. Similarly to passenger transport, where reference to specific interchanges is made, the interchange code is used as presented in Table 3.4.

3.2.2.1 Governance and policy

In the following paragraphs, good practices indicated in governance are presented, separated into: stakeholders, policy, ownership, sustainable development, management and operation.

Stakeholders

In Italy, almost all freight centers (interporti) are located in the northern part of the country, and the investment for their development was mainly made by public bodies and the Italian Railways. Based on the relative legislation, the interporti can either be considered as public companies or Public Private Partnerships (PPPs), meaning that about 30% of the investment capital needs to be covered by public funding and the 20% of these capitals should derive from private funding. The interporti are “open” to any transport or transshipment company, and almost each of them includes an intermodal transport station, customs service and other local authorities. Such a successful scheme is the company “Interporto Bologna S.p.A.” *(F11)*, which was established in order to build Bologna Freight Village. The company was initially constituted of the public authorities in Bologna and progressively joined by other organizations and institutions, including the Italian Railways, which have direct and indirect interests in the development of the center. National authorities support the implementation of transport infrastructures, intermodality and freight villages, under the framework of special laws. The stakeholder model realized in this case foresees that public authorities, thus Bologna Municipality, Bologna District Council, Bologna Chamber of Commerce and the Italian Railways, are the main stakeholder and own 52% of the stock capital (IMONODE, 2005).

In Germany, the development of freight centers (GVZ) *(F6)* was motivated by the need for identifying and implementing calming measures, in order to encounter serious problems caused by congestion, e.g. big delays and environmental impacts. The development companies implemented their projects using public funding, while the management was under the responsibility of local partners, e.g. PPPs with minority privileges to public. In the United Kingdom, British Rail had initially the initiative to develop freight centers, and then local communities and the private sector were also involved (IMONODE, 2005).

In France, Sogaris *(F3)* and Garonor *(F4)* are representative good examples of successful and beneficial freight centers. Sogaris started its operation as a private company, funded by various private institutions, including insurance companies, construction firms, banks and oil companies. However, financial problems affected its financing scheme, resulting to become a mixed organization with capitals from private companies and public bodies. The 80% of the shares is now under the control of local authorities and the rest 20% belongs to private or public-private bodies. On the other hand, Garonor, property of Prologis, remains a private industrial logistic operator and constitutes a member of the Novalliance association since 1990. Both Sogaris and Garonor-Prologis have been involved in the design and administration of other freight centers and special usage areas in France and other European countries (IMONODE, 2005).

Lastly, in Greece, a successful case is the private freight terminal of Kuehne & Nagel freight terminal *(F10)*. Due to the private status of the terminal, private actors are mainly responsible in all stages of the planning process. There is an exception in the regulatory framework and the evaluation/selection, in which national authorities are in charge. In addition, national authorities are involved in the stage of initiative for investments and procurement. Regarding financing issues, responsible actors are either national authorities (in land acquisition, engineering/design and construction) or PPPs (in all stages). Direct investments are developed in all stages of the financial process, and European funds are, also, used for land acquisition, engineering/design and construction. An interesting issue is that the selection of the property on which the terminal finally developed was done according to existing land uses, established by the national regulations (i.e. industrial zone), and the specific site was selected so that to have a direct access to the national highway network and the main railway network, which had to be expanded by the developers (CLOSER, 2011a).

Policy

National policy and regulations, governed to some extend by the European Commission, define the operation of freight interchanges. The surveillance of the compliance of legislation, and the planning and financing of the interchanges' development is mainly under the supervision of the transport ministries of each European country. Additionally, other ministries, e.g. ministries of economy and environment are also involved, covering aspects such as the financing of a transport project and the environmental protection. At a local and regional level, it is common that this level of administration affects the interconnection of modes and the respective services at a local or regional scale.

With regards to European policy, focused legislation on freight interchanges is limited, however there is a number of laws, communications and directives that address relevant issues. For example, in the Transport White Paper "European transport policy for 2010: time to decide" (European Commission, 2001), the integrated organization of the interface of long distance and last mile freight transport was proposed, while the Commission Green Paper "Towards a new culture for urban mobility" referred to the encouragement of co-modality, the integration of follow-on connection with public transport, the integration of existing infrastructures and the improvement of the integration of freight distribution in urban areas through local policy-making and institutional settings (European Commission, 2007).

An important directive for freight terminals was Directive 91/440/EEC (Directive 91/440/EEC), which granted the right of access to railway infrastructure for undertakings that aim at providing international combined services. This option requires the organizational independency of the infrastructure management from the transportation operations, meaning that basic functions, e.g. rail capacity allocation, infrastructure charging and licensing have to be separated from transportation operations to enable new rail operators fair access to the rail market.

In Leipzig-Halle airport *(F5)*, due to a special legislation framework, which promoted the development of the Eastern part of Germany the sooner possible, the planning processes in the airport were shortened and only one level of jurisdiction was needed for a decision to be made. In Greece, the Port of Thessaloniki *(F7)* has documented an Environmental Impact Study, based on national specifications for environmental performance surveillance. In addition, the port, outlined environmental policies for handling of different cargo types and implemented a ship's waste reception and management plan (CLOSER, 2012a).

Ownership

A successful example of ownership model is met at the HøjeTaastrup rail freight terminal *(F1)* in Denmark, in which the Danish State railways own the terminal, while DB Schenker, the dominant rail freight carrier, operates the terminal on a time-restricted contract. However it is foreseen that the ownership will be transferred to Bane Danmark, which is the rail infrastructure manager, and this will result to the facilitation of fair and equal access to the terminal for all rail freight operators in Denmark (CLOSER, 2011a).

In the case of the Leipzig-Halle airport *(F5)*, the interchange is led by a holding company, which is responsible for all subsidiaries and for both airports in Saxony. The holding company and all subsidiaries are under public ownership and strongly connected to the authorities involved. In this case, the competition is rather reduced, and cooperative schemes are encouraged. The Port of Helsinki Vuosaari *(F2)* is completely independent of transport operators and local actors, meaning that all companies have access to a terminal under equal conditions of ownership. A successful practice is also met in the Constantza port *(F12)* in Romania, where there is a strong collaboration among different public and private stakeholders, and, in addition, the landlord model that is implemented for the administration and management of the port and its operations, has been proved to be a very good application, enhancing the expandability of business and the further development (CLOSER, 2012a).

Sustainable development

The review and analysis of the freight interchanges has made clear that the development of an interchange is significantly affected by the financing potentiality. Due to the growing inability of national and regional governments to support the management and funding of the deployment of an interchange, the last decades, deregulation and active private contribution and participation are recorded.

For example, in Greece, the Port of Thessaloniki *(F7)* is a self-financed private body and all funding sources are internal. There are some special cases, where the port managing body would require external bank loans for costly projects' investments, or, rarely however, there is public subsiding, when a project is identified as of high importance for the national infrastructure development. The Port of Helsinki *(F2)* was completely in charge for the financing of Vuosaari harbor and the logistics are surrounding it. In this case, the construction of the harbor was done with a loan taken from the city of Helsinki, while the construction of the transport connections to the harbor were equally financed by the Port of Helsinki and the state of Finland (CLOSER, 2012a).

In Romania, and in the case of Constantza port *(F12)*, the terminal was initially financed by the Romanian state along with the contribution of some private investors, under a PPP scheme. However, although till now the scheme lacks of any public subsidy, still, it seems to be a very attractive opportunity for private investors to lease land, infrastructure and equipment, and also to have leading responsibilities of their own provided services and operations (CLOSER, 2012a).

Management

Similarly to passenger interchanges, freight managers have to face a number of challenges, which are mainly formed by the demanding organizational and operational schemes met in the interchange, where several stakeholders and companies are located and involved in the processes. For this reason, it is of high importance that the interchange develops and implements a strategical management plan.

Such a successful practice is met in the Constantza port *(F12)* in Romania, which is both a maritime and a river port, located at the crossroads of the trade routes (TEN-T Paneuropean Transport Networks) and links the markets of the landlocked European countries to Transcaucasus, Central Asia and the Far East. In 2001-2002, the Constantza Port Master Plan was developed, documenting the constitutional map, according to which any project or activity associated to the port operation and development, is clearly defined, planned, scheduled and processed. The context of the plan, defines the role, jurisdiction and responsibilities of all involved bodies, and additionally determines the communication code amongst them, so as to prevent any potential conflicts or misunderstandings (CLOSER, 2012a).

Operation

Location, infrastructure, geographical coverage, cargo profile, modes and services are key factors that form the operational profile of a freight interchange, which, in order to be competitive, it is important to differentiate from other interchanges (CLOSER, 2012b).

A successful example is this case is the Port of Helsinki Vuosaari *(F2)*, which is located in the main business area of Finland and very close to the main airport handling freight, a situation that enables significantly the combination of transport flows. Also, the port has a pricing system, which promotes the chosen cargo profile. The Leipzig-Halle airport *(F5)* in Germany, is located in an area, where there is little industry for large scale freight flows that would be beneficial from the combination of transport volumes, the area has invested on air-air freight hub, which does not depend on other transportation in the area. In Romania and the case of Constantza, the interchange serves river transportation, which is an ecological and low cost alternative in comparison to road transportation (CLOSER, 2012a).

3.2.2.2 Smart solutions

Smart solutions include both technologies and smart schemes which facilitate operation of the interchanges. Such solutions are presented below.

New consolidation/distribution and logistics cooperative concepts

Establishing an Urban Consolidation Center (UCC) has been proved that affects positively mobility and traffic conditions associated with the UCC's neighbouring area, including metropolitan areas, municipalities and urban regions. The better organization of the transport chain and the optimization of traffic conditions are among the advantages of an UCC, which result in significant reduction of the number of trips, quantified in vehicle kilometres, better vehicle and driver utilization and improvement in volume/weight utilization rates for vehicles on deliveries from the center and inward flows from suppliers (STRAIGHTSOL, 2013).

Such a successful case is the Urban Consolidation Centre in L'Hospitalet de Llobregat *(F13)* in the metropolitan area of Barcelona, built by DHL SUPPLY CHAIN, in order to serve a large shopping mall, smaller retailers nearby and parts of the City Council in the city. Within the scope of the European project STRAIGHTSOL, DHL SUPPLY CHAIN, operated the UCC, aiming at

reducing the number of vehicles entering the defined area, while maintaining service levels. The most "smart" concept in this case was based on consolidating the demand and the adaptation of regulations in a flexible scheme, depending on full-truckload or less-than-truckload carriers (STRAIGHTSOL, 2013).

In Italy, and the Reggio Emilia, which is a medium-size city of the Emilia-Romagna region, an attempt will be made, in the framework of the European project NOVELOG, to develop and evaluate a business and transport operational plan for the use of an existing parking area as urban distribution center, served by electric vehicles. Taking into account the city's objectives, which are the increase of the efficiency of urban freight transport and the reduction of CO_2 emissions and congestion, this case study is expected to have significant positive impacts, such as increase of load factor, reduction of vehicle kilometres, traffic and noise reduction, increase of reliability and increase in the use of renewable sources (NOVELOG, 2016).

Another practice that will be studied in the framework of NOVELOG is the case of Athens, and specifically the cargo deliveries from Thessaloniki to Athens with the use of rail for long haul transport to Athens and then truck for the last mile delivery. The cargo is containerized so as to be transported from Thessaloniki to Athens by train, and then is transhipped to trucks in Thriassio consolidation center, which is located in the suburban area of Athens. In this case, the focus is on the consolidation of cargo and the upgrade of the vehicle/truck routing with the implementation of Intelligent Transport Systems applications and relevant information exchange platforms. The improvement of the communication and collaboration of the involved stakeholders thus TRAINOSE, KUEHNE+NAGEL and Development Agency of the Municipality of Athens is considered as crucial for the success of this attempt. In addition, the background experience is significant, since TRAINOSE already runs an intermodal "door-to-door" container transport service between Athens and Thessaloniki, based on daily regular rail connection consisting of a pair of railway itineraries, which start simultaneously by the two cities early in the evening with arrivals early in the next morning, and eventually transport the cargo directly to the customer facilities. The transhipment process takes place in the freight centres of Thriassio (Athens) *(F8)* and Trigono (Thessaloniki) *(F9)* (NOVELOG, 2016).

Information technologies

The use of Information and Communication Technologies (ICT) is also of high importance in freight transport, as they improve the efficient movement of goods influencing time, costs, reliability, safety, security, fleet management, tracking, tracing, etc. Successful applications of ICT include monitoring and management systems, information exchange systems, etc.

Such a successful example is met in KUENHE+NAGEL interchange *(F10)* in Sindos area, close to the city of Thessaloniki in Greece. The interchange works as the connection point of two legs: the first leg regards rail operations of the company, including transfer of goods from Austria, through Balkan countries to Greece and the interchange in Sindos, while the second leg refers to the freight which is unloaded and is either transferred through its cross-docking area to the warehouse or loaded to trucks to be directed towards other logistics centers within Greece or distributed to the final customer. In the framework of STRAIGHTSOL project, KUEHNE+NAGEL tested provision of real time information addressing cut-off wagons and their shipments, updated estimated time of freight arrival, reporting of problems, delivery date and time and cargo status during the rail part, aiming at facilitating better planning of the next leg, either in the warehouse (Warehouse Management System-WMS) or via truck (Truck Management System-TMS). Upon train arrival and load decomposition, information is communicated to the recipients (STRAIGHTSOL, 2013).

Smart transshipment

The facilitation of interconnection at freight interchanges is based on equipment which is used for loading-unloading operations and movements within the facility. Such equipment is presented is in detail in Annex B of this document. The Annex contains illustrated explanation of the following smart transhipment solutions: compact terminals, quick handling facility, platform vehicle, roller container, rolling road, CargoBeamer system, WB mobile, combi-lifters, ModaLohr, Flexi-wagon, Translifter Cassette System, linear motor technology, wagon tipping system, yard trucks and water trucks.

3.2.2.3 Decision-making

A good practice in this topic is revealed by the investigation of Thessaloniki Port *(F7)* in Greece, where an integrated process, documented in a detailed study, was realized for the development of the freight centre, established in the port's area. The step-by-step methodological approach of the study is briefly presented below (CLOSER, 2012a):

- Deep analysis of the business objectives of the port in accordance to the construction and operation of the freight centre.
- Assessment of the potential workflow. Potential interests can be defined, arising from those interests that the port managed the previous years, and from possible interests that could be generated in future.
- Definition of services, addressing services that should be provided in order to cover the organizational and operational needs of potential users of the freight centre.
- Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis, which can highlight the strengths of the freight centre towards providing the potentiality of intermodal transhipment of goods and ensuring significant freight movements from the first day of its operation.
- Strategic choice of the location of the centre. Evaluating any strategic roles that the centre could have, its functional incorporation into the supply chain of its customers can be proposed, and directions for service provision and organizational preparation are defined.
- Dimensioning and design of the centre. In this step, the appropriate facilities are defined and dimensioned according to the foreseen workflow per service and per development phase.
- Ownership and organizational status. This step is further organized into sub-steps:
  - Critical review of sustainable development and management schemes that are met in existing European freight centers, and understanding of the success criteria.
  - Definition of the conditions that should be fulfilled for the successful development and operation of a freight centre, and identification of potential shareholders.
  - Identification and evaluation of the main alternative development and operational models.
  - Based on the above models, the potential participation of each identified shareholder into ownership can be determined.
  - Definition of the organizational status of the centre, in terms of indicating the interrelationships among the potential shareholders in operation and management.
- Investigation of the economic sustainability of the freight center.

The above methodological approach can be adopted or amended respectively, and be implemented in similar situations related to the development of a freight interchange.

4 State-in-practice in interconnecting transportation networks in Latvia and the region

4.1 General

Latvia and other Eastern Baltic Sea Region (BSR) countries (Poland, Lithuania and Estonia) have developed transportation networks according to the national needs and continue to evolve in line with the common European transport network development objectives. Transportation networks include railways, roads, maritime and aviation, and are widely used by domestic and transit passengers and freight carriers. Disparities in availability and quality of infrastructure, transportation services and interconnection can be seen among countries.

Well-functioning interconnected transportation networks stimulates economic development. There is a substantial flow of freight traffic in East-West direction already from Russia and other Eastern countries to Western Europe using roads, railways and ports in BSR countries, and it is expected that following the increasing integration of the Baltic States into the EU, traffic flows in North-South direction will increase as well. Characteristics of transportation networks in BSR countries are given in Table 4.1.

Table 4.1: Key transportation networks and terminals in Eastern Baltic Sea Region

Networks	Latvia	Lithuania	Estonia	Poland
Ports	3 seaports (Riga, Ventspils, Liepaja)	3 seaports (Klaipeda, Butinge, Sventoji)	6 large seaports (Tallinn, Muuga and others)	6 seaports (3 have ferry terminals)
Airports	1 international airport (5 million passengers annually) 3 regional airports (planned to be developed as international)	4 international airports (Vilnius, Kaunas, Palanga, Saulia)	4 international airports (Tallinn airport the largest)	12 international 3 domestic
Railways	2,347 km of railway lines (Russian gauge) Main cargo: oil, oil products, coal 57 million tons of cargo transported in 2014 16.886 million passengers in 2015	1,998 km of railway lines 49.0 million tonnes transported in 2014 4.6 million passengers in 2014	900 km of railway lines 132 km of which electrified 61 stations and 129 passenger platforms. 4.1 million passengers on national lines (2014)	18,533 km of railway lines 1435 mm track – 21.8 km high speed rail Intermodal terminals operated by ten carriers 270.4 million passengers in 2013
Roads	68 944 km of public roads of which 1651 km highways	21 252 km of public roads or which 309 km motorways	57 565 km of public roads	412,264 km public roads of which: 1330 km motorways 1144 km

Networks	Latvia	Lithuania	Estonia	Poland
				expressways
Municipal public transport	Bus, tram, trolleybus	Bus, trolleybus	Bus, tram, trolleybus, ferry	Bus, tram, metro, trolleybus
Electric vehicle network	Poorly developed	Poorly developed	Well developed 165 charging stations	Poorly developed

4.1.1 Latvia

Latvia is located next to the Baltic Sea and shares borders with Estonia, Lithuania, Russia and Belarus. Its territory covers 64,589 sq km and is composed of low-lying plains with vast forests.

Over time, a relatively balanced transport network has been developed in Latvia for both freight and passenger traffic. Latvia is an important centre connecting the Baltic states. Vilnius and Tallinn, the capital cities of Lithuania and Estonia are easily accessible by car, rail or air. The location of Latvia serves as the main transport route connecting Russia with Western Europe. The ports of Riga, Liepaja and Ventspils are active with shipments from throughout the region and remain navigable during the winter. Latvia's transport system is shown in Figure 4.1.

Figure 4.1: Transport system of Latvia (Source: www.liaa.gov.lv)

Geographical location of Latvia along the East coast of the Baltic Sea with its ice-free ports and infrastructure of roads and railway, which has been largely created for the export needs of the resources of Russia and other CIS states and for the import needs of other goods, as well as the modern logistical tendencies in the space of Eurasia, serve as a precondition for the provision of

efficient transit services and the increase in export of services of Latvia, contributing largely to the balancing of the external trade balance of the State.

The range of transit services comprises services of ports, railway, road carriers, customs warehouses and brokers, as well as ship agents, forwarding agents and operators of oil product pipelines. They all operate under the conditions of international competition and mainly compete with other Baltic States, Finland and Russia. Moreover, they significantly depend on the foreign policy framework of the State, relationships with neighbouring countries, tax norms and norms of customs law, as well as actions of other services working in the border control. In transit services, each 10 million tons give at least 1% GDP. Therefore, it is within the interests of Latvia to recover the lost amounts of freights and to attract new ones.

The dominant modes of freight transport in Latvia are rail (30% in 2014), maritime (38% in 2014) and roads (32% in 2014). Maritime transport plays a major role in international trade. Majority of transported cargo on the territory of Latvia is transit coming from East to West, and it uses interconnected transportation network (maritime and rail) successfully.

Waterways are a great supplement mode of transport for railway where the infrastructure of the sea port allows it. All three major Latvian ports (Riga, Ventspils and Liepaja) are fully equipped to transfer almost all kinds of cargo from sea onto rail. A state owned company “LDZ Cargo Logistika”, one of the leading railway freight carrier in the Baltic States, works closely with 9 major terminals in the Baltic region and thus provides efficient transportation of containerized cargo from sea to rail (Source: www.logistika.ldz.lv).

Roads are mainly used for international freight transportation (80%). The road transportation market in Latvia is highly fragmented, consisting of a number of subsidiaries of international players and a large number of small local players (KPMG, 2011).

The dominant mode of passenger transport is bus (56% of passengers used it in 2014). Railway accounts only for 7% of the total number of passengers. Although Latvian transport policy guidelines suggest that railway is to be considered as a backbone of passenger transportation in Latvia, in reality, current railway infrastructure and services do not stimulate modal shift from road to rail.

4.1.1.1 Seaports

There are three large ports operating in Latvia (Ventspils, Rīga and Liepāja), the proportion of which in the total turnover of freight was 98.8% (2014), and seven small ports (Engure, Lielupe, Mersrags, Pavilosta, Roja, Salacgriva, Skulte). Also the territory of the Port of Ainazi was determined, however, it was not developed and hitherto the movement of ships was not possible. All three largest ports of Latvia, particularly the Port of Ventspils, are explicit export ports – the amount of the freight consigned (mainly transit freight from Russia, Belarus and other states of the Commonwealth of CIS) exceeded several times the amount of the freight received.

Riga port is located on both banks of the River Daugava, covering 15 km in length. It is a transit port and one of the most important sea corridors connecting Russia, Middle Asia and China with the countries of West and North Europe through the Baltic Sea. The seaway is the most advantageous regarding delivery time and financial cost in comparison with other routes.

The port of Ventspils is ice-free the entire year which is a great advantage. The maximum depth of the waters is 17.5 m and the draught is 15 m and is therefore able to accommodate the largest vessels able to enter the Baltic Sea. In Ventspils, terminals are divided into liquid, dry bulk and general cargo. Ventspils Nafta Terminal LTD is the largest Baltic Sea Region oil and

petroleum product transhipment terminal operating in the port's liquid cargo area. Noord Natie Ventspils Teminal is the most up-to-date terminal of the region in terms of equipment. This Belgian-Latvian joint venture is equipped with state-of-the-art loading/unloading and terminal facilities.

Although the total freight turnover at the largest ports of Latvia keep increasing, negative tendencies are observed in individual freight groups. It is related to the increased competition among the ports of the Baltic Sea Region. Particularly the amount of freights of higher value (general cargoes, oil etc.) is reducing, which attests to negative tendencies in the development of ports.

Among small ports of Latvia commercial freight is handled at the ports of Skulte, Mērsrags, Salacgrīva and Roja. The ports of Engure, Pāvilosta and Lielupe operate only as fishing and yacht ports.

In order to involve Latvia more successfully in international trade and transit circulation, to promote the attraction of investments and the development of production, as well as the creation of new working places, the large ports are granted the status of special regime with tax relief. The ports of Ventspils and Rīga have the status of free port, but the Port of Liepaja is a part of the special economic zone of Liepaja.

Connections to all other transport infrastructure elements, along with attractive tax-free zone incentives, have resulted in the ports becoming regional centres of industrial activity. Latvian ports are highly export-oriented, with the proportion of loaded-oncargo being about 95% of all cargo throughput, mostly shipping cargo for transit and export from Latvia. The leading port in terms of unloaded cargo volume is Riga. RO-PAX transport connections with Germany and Sweden are important logistics services available at all three free ports. Additionally, as a sign of sustainable growth the Liepaja port has established a direct ferry line in 2013 from Liepaja to Russia. The route of the ferry line is as follows: Baltiysk-Liepaja-UstLuga.

The Port of Riga is the main passenger port in Latvia. However, the Port of Riga has not sufficiently used the possibilities of passenger servicing. Passenger traffic from Rīga is not sufficient to the possibilities of Riga as metropolis and the centre of the Baltic States. The number of passengers is significantly lower than in the ports of Tallinn and Klaipeda.

4.1.1.2 Roads

The Latvian road system (Figure 4.2) provides direct access to destinations in the east (Russia/CIS), the southwest (central/western Europe) and is well connected to Northern Europe via other countries and RO-PAX capable ports.

Generally, all roads are fully public and toll-free. Total length of roads and streets is 73 592 km. Motorways are absent in Latvia. The density of the motor road network of Latvia is 1.077 km per 1 km2, which may be considered as sufficient, taking into account the number of inhabitants and the size of the territory.

Figure 4.2: Latvian road network (Source: Latvian State Roads)

4.1.1.3 Railway network

Latvia possesses a dense railway network (Figure 4.3) connecting the country to destinations as distant as the Russian Far East. Russia and Latvia share a common railway gauge, easing rail transportation. Currently, Latvian railways mostly serve as a transit trunk line with as much as 76% of total freight volumes being transit connected to Latvian ports and more than 60% of freight rolling-stock being tanker-wagons.

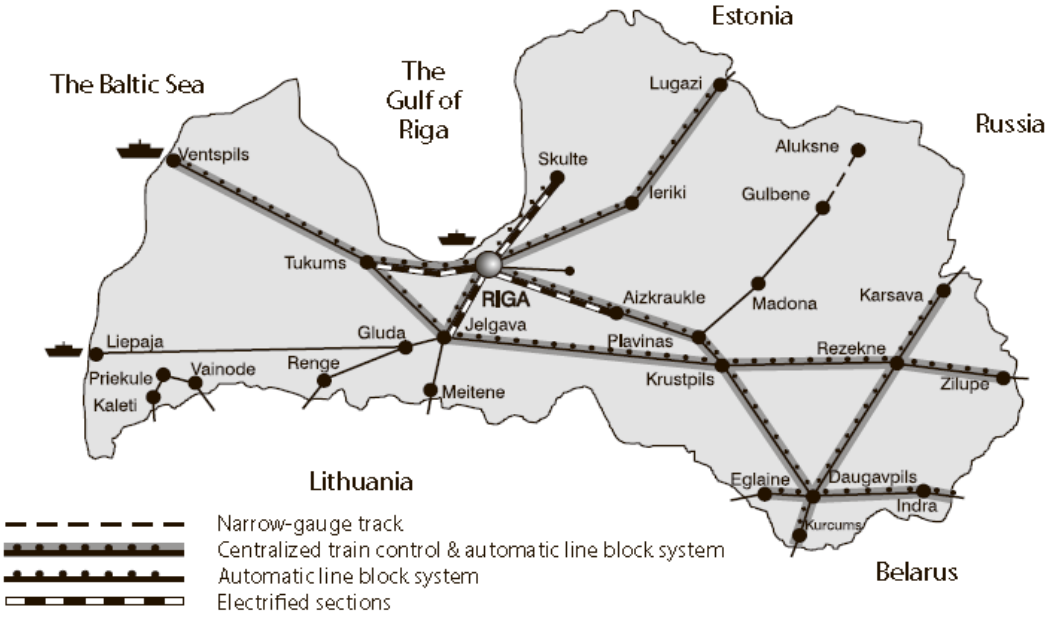

Figure 4.3: Latvian railway network (Source: http://www.ldz.lv)

To facilitate trade flows in the north-south direction, a pan-Baltic railway route with Estonia and Lithuania, connecting Finland to Central Europe is planned (RailBaltica project). This project

would also serve as the first step in Latvia's transition to the European railway gauge technical standards.

Latvian Railways (LDz) is the main state-owned railway company in Latvia with more than 12,400 employees. It owns 1,933.8 kilometres of 1,520 mm Russian gauge railway lines and 33.4 kilometres of 750 mm narrow gauge railway lines in Latvia. Passenger services are operated by the company "Pasazieru vilciens". There are many local passenger lines and some international rail links with Russia, Lithuania, Belarus, and Estonia.

4.1.1.4 Air transport

There are four operating airports in Latvia: Riga International Airport, Liepaja International Airport, Ventspils Airport and Jurmala Airport. The airport in Daugavpils (southern part of Latvia) is currently in the development stage.

Currently, nearly 99% of all air passenger and freight transport in Latvia moves through Riga International Airport while the smaller airports serve charter flights. Riga International Airport is the leading air transport and transit centre in the Baltic states. It provides both aviation (airplane, passenger and cargo attendance) and non-aviation services (lease, parking spaces, VIP centre services, etc.).The airport currently serves 19 airlines, including Latvian national airline airBaltic, low-fare carrier Ryanair, and European leaders like Lufthansa, Czech Airlines, and Finnair. It handles up to five million passengers per year. The above companies and others ensure fast and reliable direct travel from Riga International Airport to more than 80 destinations in Asia and Europe, including Helsinki, Stockholm, Copenhagen, Berlin, Frankfurt, Paris, Rome, and London, all of which provide further connections to transcontinental air routes (Figure 4.4).

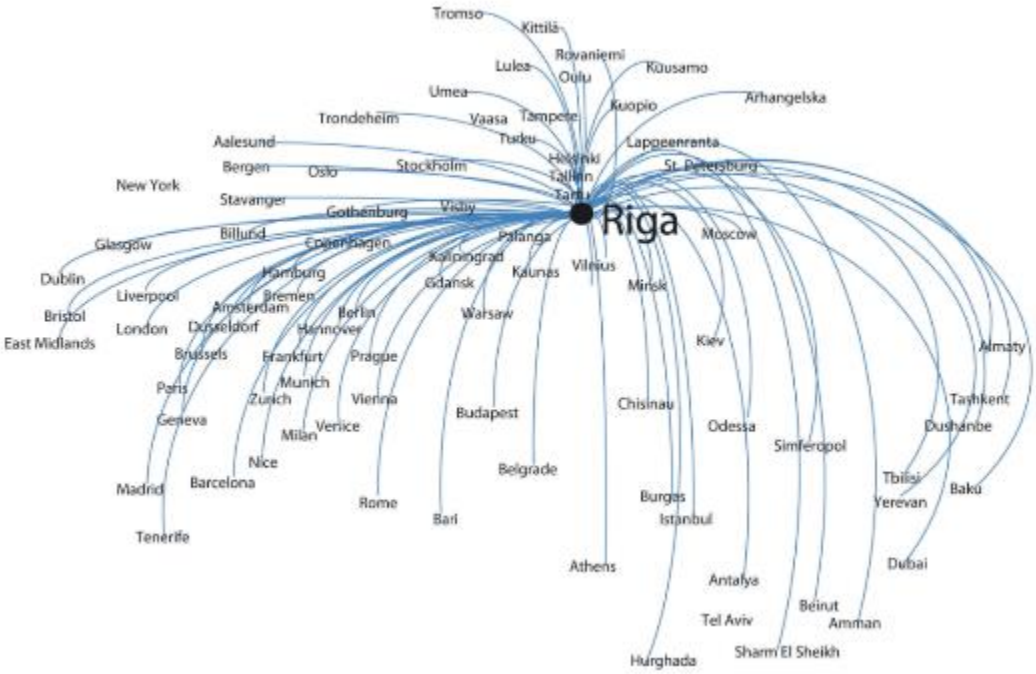

Figure 4.4: Direct flights from Riga International Airport (Source: www.liaa.gov.lv)

The number of flights continue to increase. This makes Riga International Airport one of the most rapidly developing airport hub in all of Europe. Riga International Airport is planning the construction of new terminals to continue its current growth and increase passenger-handling capacity, although it already serves approximately half of all Baltic airports passengers.

4.1.2 Lithuania

Lithuania shares borders with Latvia to the north, Belarus to the southeast, Poland to the south and the Russian exclave of the Kaliningrad Oblast to the southwest.

Due to Lithuania's geographic location, the transport sector, particularly freight transit, plays a key role in the economy of the country. Freight shipments between Russia and the CIS and the West, are the core of the transit industry in Lithuania. Lithuania has one major seaport, the Port of Klaipeda, which is the hub of the transport transit industry.

Lithuania provides transit services in movement of freight along two main corridors:

- East-West (to/from Russia and other CIS countries, via Belarus through Vilnius and Kaunas to the Port of Klaipeda, and from there to Scandinavia, Western Europe and Kaliningrad);
- North-South (to/from Finland, via Estonia and Latvia, through Kaunas and Sastokai, to Poland, Germany and Central Europe.

North-South corridor is also known as Via Baltica for road transport and Rail Baltica in future for rail transport. There are four lane highways linking major industrial cities, main roads and regional roads serving smaller cities, international airports located close to industrial cities, an ice-free port and well developed rail network.

The density of Lithuanian rail network is 27 km / 1000 km^2. It consists of nearly 2000 km of railway lines (Figure 4.5).

Figure 4.5: Railway network in Lithuania (Source: www.mapsofworld.com**)**

Rail has a 52% share of the Lithuanian freight market. Most sections of the existing rail network are not interoperable with Western European as most existing rail tracks are of Russian standard gauge. The 7% of track is electrified (Source: www.railjournal.com).

The emphasis of the transport policy is shifted from the mass transportation of freight to complex logistics solutions stressing intermodality. Currently, nearly half of all the freights in Lithuania are transported by railways, meanwhile the European Union aims to reach at least 30 per cent of this kind of transportation by the year 2025.

Lithuanian Railways are looking further east to develop its intermodal business and is eager to tap into the market for transporting containers from central and eastern Asia to western Europe. Lithuanian Railways are already operating container services from China and Kazakhstan to Western Europe in partnership with other railways and logistics companies (Source: Lithuanian Railways).

An important development for Lithuania's links with Western Europe is Rail Baltica project. It will allow freight trains from western Europe to operate directly into the heart of Lithuania and serve a new intermodal terminal at Kaunas, where containers will be transhipped between standard and broad-gauge wagons. The first section of Rail Baltica, completed in 2015, is a 1435 mm gauge line from the Polish border to Kaunas, which has been built alongside the existing 1520 mm gauge line.

There are many inland waterways in Lithuania. Inland waterways serve both cargo and passenger transport. The total length of inland waterways in Lithuania is 843 km; of these 436 km are used for transportation of passengers and goods. The inland waterway along the Nemunas River and the river-port of Kaunas are included into the European Priority Network of Inland waterways of international importance (TEN-T). The role of Lithuanian inland waterways in the overall transport system of Lithuania is limited due to the following reasons: short navigation period, shallow waterways, seasonal change in water level, limited number of navigation routes, obsolete fleet of inland water vessels not adjusted to carry different types of cargo and passengers (ECORYS Nederland BV, 2006).

The port of Klaipeda is the main port in Lithuania and it is part of the TEN-T network serving all types of freight and passenger transport. The port of Klaipeda is the fifth largest in the BSR.

Also, big public logistics centres are being created as intermodal terminals in Vilnius, Klaipeda and Kaunas (see section 4.2.2.1).

4.1.3 Estonia

Estonia is a relatively small country as to its surface (45,227 sq km), yet quite sparsely populated. The Estonian transport system comprises rail, road, maritime, river, and air transport as well as the municipal electrified transport. The infrastructure of national transport is well established.

The operation services are mostly provided by private enterprises - maritime transport, inter-urban coach traffic, air traffic, and most of the rail transport. There are two cargo transport companies operating within the infrastructure of Estonian Railways. In 2014, 19.22 million tonnes of cargo were moved by rail, 14.08 million tonnes of which came from transit, 0.62 tonnes from export and 1.05 million tonnes from import. Local freights were made in the volume of 3.47 million tonnes. Biggest share of cargo was oil and oil products in the volume of 9.83 million tonnes or 51% of total. The volume of oil shale was 2.67 million tonnes and fertilizers 3.35 million tonnes. Estonian railway connections (Figure 4.6) allow delivering cargo to seven ports, biggest of which being the Muuga Harbour owned by Port of Tallinn (Source: Estonian Railways).

The Port of Tallinn serves both goods and passenger traffic. It is deep enough to receive big ocean vessels as well. It is an ice free port and easily navigable all year round. The most eastbound port - port of Sillamäe - is located only 25 km from Russian-Estonian state boarder. (Source: www.evr.ee).

Figure 4.6: Estonian railway network (Source: Estonian Railways)

In 2014, the number of passengers carried by Estonian transport companies by road, rail, sea and air transport amounted to 211 million. 92.7% of these passengers were carried by road, 4.1% by sea, 2.8% by rail and 0.4% used air transport. 4.1 million passengers made domestic trips by rail and 156.3 thousand passengers travelled internationally Tallinn-Moscow, Tallinn-Petersburg (Source: www.stat.ee).

4.1.4 Poland

The transport infrastructure in Poland includes roads, rail, airports, seaports, inland waterways, pipelines and combined transport. There are four main transport corridors running through Poland:

- European route E67 from Helsinki (Finland) to Prague (Czech Republic);
- European route E30 from Cork (Ireland) to Omsk (Russia);
- European route E40 from Calais (France) to Leninogorsk (Kazakhstan);
- European route E75 from Vardo (Norway) to Sitia (Greece).

Currently there are 13 airports operating in Poland. 10 of these are members of the Trans-European Transport Networks (TENT-T). In addition to these, there are also 41 smaller airfields which also develop their infrastructure (Brzeziński, 2015).

There are 3,983 km of navigable waterways in Poland, but only about 40% of the total length are exploited.

In 2013 railway services in Poland were used by more than 270.4 million passengers, and on average each day 5,500 freight and passenger trains travelled on Polish tracks. Currently, passenger transport services are handled by fourteen carriers according to licences issued by the Railway Transport Office.

In addition, Poland has about 60 freight transport carriers. The predominant company is PKP Cargo with a market share (according to the weight of cargo transported in 2013) of about 49%. Other major carriers are: DB Schenker Rail Polska – 19%, CTL Logistic – 8%, PKP LHS – 4% and Lotos Kolej – 4% (Source: www.polish-railways.com).

In May 2014 the European Commission approved the Partnership Agreement with the government concerning a new financial perspective for Poland in 2014-2020. According to its provisions the largest EU funds will be allocated to transport and infrastructure (23.8 billion Euro), with as much as 10.2 billion Euro going to railway transport, that is, nearly 80% more than in 2007-2013. The investments are planned to cover: modernisation of 61 existing railway routes (in particular those forming a part of TEN-T), development of traction supply, railway traffic control and management of passenger and freight transport, improvement of the technical condition of civil engineering structures, modernisation and purchase of rolling stock and special-purpose technical equipment. Works to implement the European Rail Traffic Management System (ERTMS) on major railway routes will continue along with the repair and maintenance of railway stations. In addition, investments in railway infrastructure will be oriented to improving the condition and development of cargo infrastructure, including intermodal transport.

Intermodal terminals in Poland are situated in all major sea harbours (Gdańsk, Gdynia, Szczecin, Świnoujście) and near major cities (Warsaw, Poznań, Kraków, Wrocław, and Łódź). A definite majority are adapted to the transhipment of containers, semi-trailers and swap bodies. However, few of them can handle full trucks (Gdynia, Świnoujście).

The Transport Policy for the years 2006-2025 published by the Ministry of Infrastructure and Development of Poland assumes that intermodal transport could be particularly significant in further development of international trade and handling of land transits through Poland. (Source: www.polish-railways.com)

There are 29 container terminals already established in Poland facilitating transhipment of intermodal transport units (Figure 4.7).

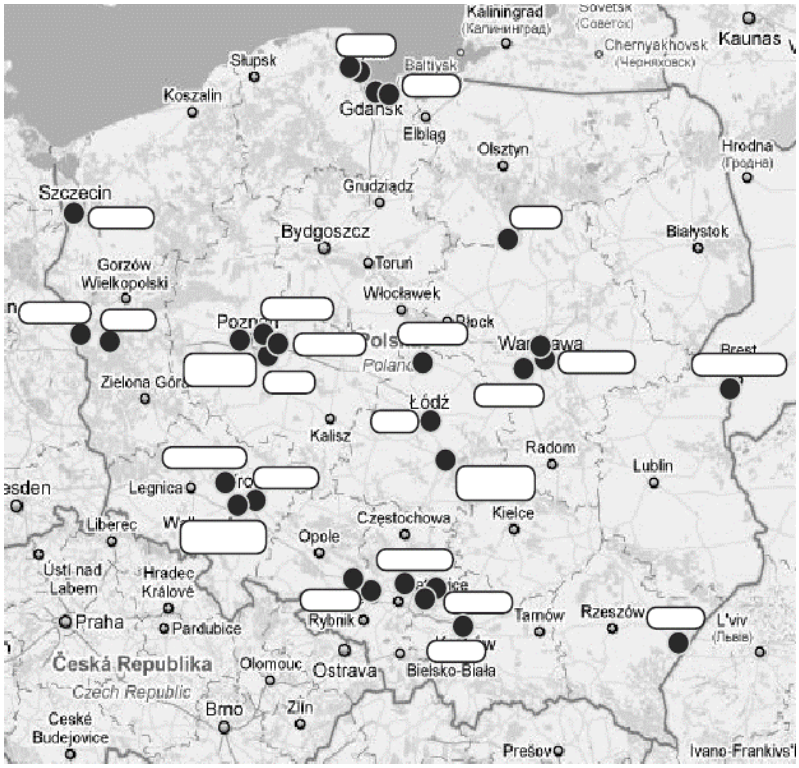

Figure 4.7: The network of container terminals in Poland (Mindur, Haijdul, 2011)

The share of intermodal transport in rail transport based on the data of Central Statistical Office, PKP Cargo and PCC Intermodal accounts for app. 2,5% - 3%. Most of containers from Polish seaports are transported by road (app. 80%).

4.2 Good practices in Latvia and the region

This section provides some practices of passenger and freight terminals in Latvia and region focusing on thematic areas of the project.

4.2.1 Passenger transport

In the framework of ALLIANCE, some existing passenger interchanges in Latvia were chosen as good practices corresponding to the defined thematic areas of the project. Also, the specific interchanges were chosen in order to cover all three types of interchanges, as defined in Table 4.2. In the following paragraphs, where reference to specific interchanges is made, the interchange code is used as presented in Table 4.2.

Table 4.2: Overview of passenger interchanges

Code	Interchange name	Country	Interchange type		
			National hub	National city terminal	Other city or local terminals
PB1	Riga International Coach Terminal (RICT)	Latvia	X		
PB2	Intermodal transport interchange at Alfa shopping center	Latvia		X	X
PB3	Riga International Airport	Latvia	X		
PB4	Noord Natie Ventspils Terminals	Latvia		X	X
PB5	Sigulda bus and train terminal	Latvia			X

The interconnected modes in each interchange are presented in Table 4.3, where, in each connection, the code of the interchange is added to state the availability of the connection at the interchange.

Table 4.3: Transportation modes connections at passenger interchanges

Transportation mode	Bus/ Trolley	Tram	Rail	Bicycle	Boat/ Ferry	Air
Bus/Trolley	**PB1, PB2, PB5**					
Tram	**PB1, PB2**					
Rail	**PB1, PB5**					
Bicycle	**PB2**	**PB2**				
Boat/Ferry	**PB4**					
Air	**PB3**					**PB3**

4.2.1.1 Governance and policy

The types of governance of passenger transport vary country-wide and city-wide. They are linked to institutional legacies, ownership, modes available and others more. Governance determines relationships between the main actors involved in passenger transport system – public authority, transport authority, transport operators and users. In the urban context, public transport services need to be integrated in order to best serve the needs of users and to provide a reliable service. Such integration can be achieved by means of local transport authority coordinating and contracting transport operators and which is furthermore responsible for planning, operations and financing.

Passenger transport policy at national level is aimed at improvement of accessibility of public transport services. As the number of population decreases in Latvia, Lithuania, and Estonia (less

in Poland), the number of passengers decrease as well. New ways for cost effective and good quality public transport service are sought. Latvian National Development Plan 2014-2020 envisage organizing of a single bus and rail route network to provide possibilities for inhabitants of rural areas to access regional significance centers and national significance centers and the capital. National transport development guidelines foresee to look for a compromise between demand, costs and quality of public transport services.

A good practice of governance is seen in the bus terminal and railway station in Sigulda town in Latvia *(PB5)*, which are located in one building since 2012. Previously, the two passenger terminals were separate. The town is located 45 km northeast from Riga, and there is a high number of commuter traffic going to/from Riga every day. Use of intermodal transport in Sigulda is common. People usually get to railway station either by car or by bus, or walking and then switch to train to get to Riga. Creating of intermodal passenger terminal has made a trip by public transport more convenient, has decreased travel time, as well as has allowed to coordinate time tables better.

4.2.1.2 Smart solutions

Technological advancements and other innovative measures and tools, which enable the efficient operation of intermodal terminals, and provide high quality service and environmental and energy protection and sustainability, are widely used in both freight and passenger terminals in Latvia.

A good example of information technologies is Riga's international coach terminal *(PB1)*, which uses integrated system for tickets purchase and trip management on the bases of information system (IS) "Baltic Lines".

Riga International Coach Terminal (RICT) is located in the center of Riga city next to the Riga Central Railway Station's embankment. It gives opportunity for all passengers to travel around Latvia and whole Europe.

RICT is one of the key transport hubs in Latvia and a modern passenger service center and provides services for passengers and road passenger transportation companies that operates on inter-city, regional, national and international routes. Coach terminal location provides easy interfaces to other transport modes, located at the heart of the capital. It is located near the railway station, the passenger port and the city's public transport, which generally provides good connection using various modes of transport. Riga coach terminal as the international passenger transport unit, provides high quality passenger and carrier-class service, information service, high security and land use capabilities, as well as other co-passengers and binding services.

The information services of RICT include:

- coach route schedule and operational information on changes;
- coach traffic information (arrival/departure time, location on platforms, delays etc);
- system of ticket reservation and sale, including:
    - route planning, using services of many carriers and means of transports (multimodal and intermodal principles of transportations);
    - different ways of payments and communications (cashless settlements with credit cards, payments through Internet, using mobile telephone);
- connection with other services (urban transport, luggage transportation, hotel services etc.);
- development of the control system and the coach station services process;
- communication among dispatcher service, ticket sale and information service;

- 24/7/365 service.

The analysis of the activity of a passenger transport terminal shows that in the chain of passenger transport, the terminal is an important part which provides wide possibilities of transfer and instillation of the principle of multimodality into the network of passenger transportations. The transfer from policy of coordination to integration is the next step of the development of the Latvian public transport system on the way to sustainable cities and regions.

Another good example of smart solutions is the national public transport trip planner in Estonia (peatus.ee). According to the information available on Estonian Road administration website, it helps finding public transport connections between departure and arrival points chosen by the user. The portal assists public transport users in planning their travel, be it by bus, trolleybus, streetcar, boat, plane, train or all of them together. The system contains the timetables of all county bus lines, long-distance coaches, international coaches and buses of Tallinn, Tartu, Pärnu, Rakvere and Viljandi. In addition, peatus.ee includes information on ferries, domestic flights and trains. One of the future development goals regarding the portal is to include the timetables of the rest of town and rural municipality bus lines The next step of the PTIS is the development of a ticket sales information system.

So far, similar systems have been city-based or service provider-based, but peatus.ee is unique in providing all public transport information nationwide in one place. The system enables users to plan their trips in both urban and rural areas. It is developed in accordance with the national Transport development plan 2006–2013 and enhances popularity of public transport. (Source: http://www.mnt.ee)

4.2.1.3 Decision-making

The public authorities, transport authorities, transport operators, infrastructure owners and developers are concerned about the impacts of measures planned or implemented. Many different actors are involved in design and operation of passenger transport systems. They make decisions that seek to optimize their own specific objectives. Decision making process connects planning, development, and operational phase.

Customer surveys help to get feedback and show directions for further development. Such surveys have been conducted in the case of Alfa shopping center *(PB2)*, which is the largest shopping center in Riga city. The area of the shopping center is 62000 m², stores area is 56 500 m² for 182 stores. It has a big parking lot adjacent to the building with 1500 parking spaces. Besides, Alfa shopping center has a cinema Cinnamon, which has 8 auditoriums with the total number of 1360 seats.

The developers of the shopping center have chosen a convenient location. It is located along the main city street on the outskirts of Riga which is used as an entrance/exit of the city on the Northeast. It can be easily reached by car, 2 tram lines, 2 trolleybus routes, 4 bus routes and 2 minibuses routes. Nearby is the bicycle lane. Also, the railway line is in a walking distance.

Alfa shopping center can be considered as an inter-modal transport hub, where travellers can easily change modes of transport (car, bus, tram, trolley, train, bike). Alfa can be seen as an unofficial 'park & ride' area, where travellers living outside Riga leave their cars and then use the public transport to travel to the city center. Parking in Alfa shopping center is for free.

Parking lot is equipped with an electric car charging station as well. Exploitation of Alfa parking lot as ‘park&ride’ area reflects travellers’ behaviour - willingness to switch from car to public transport in urban environment. Convenient location, good accessibility, well developed

infrastructure, provided services, and continuous improvements responding on demand attracts customers.

4.2.2 Freight transport

For the needs of ALLIANCE, some existing freight terminals were chosen as good practices corresponding to the defined thematic areas of the project. The list of these terminals is given in Table 4.4. Once again, where reference to specific interchanges is made, the interchange code is used as presented in Table 4.4.

Table 4.4: Overview of freight interchanges

Code	Interchange name	Country	Interchange type			
			Special logistic area	Industrial and logistic park	Freight village	City terminal
FB1	Baltic Coal Terminal	Latvia	X		X	
FB2	Noord Natie Ventspils Terminals	Latvia	X		X	
FB3	Latvian Post sorting complex	Latvia			X	X
FB4	Rimi Latvia distribution center	Latvia	X			
FB5	Vilnius Intermodal Terminal	Lithuania	X			

A summary of available transportation modes connections for each case study is given in Table 4.5. The code of the interchange is added to state the availability of the connection at the interchange.

Table 4.5: Transportation modes connections at freight interchanges

Transportation mode	Road	Rail	Short Sea Shipping	Maritime	Air
Road	**FB3, FB4, FB5**				
Rail	**FB5**				
Short Sea Shipping	**FB1, FB2**	**FB1, FB2**	**FB2**		
Maritime	**FB2**	**FB1, FB2**	**FB2**		
Air	**FB3**				

4.2.2.1 Governance and policy

National transport policies in BSR countries are in line with the EU transport policy aiming at efficient, safe, secure and sustainable transportation systems which can create the conditions for a competitive industry that generates jobs and prosperity. Latvia's Transport development guidelines 2014-2020 outline the economic, institutional and infrastructure development of the national transport system. The key goal is to ensure the coherent development of an efficient transport system. Transport research and consultancy projects conducted for the Ministry of Transport need to follow the directions established by the National Transport Development Programme.

Major challenges for successful freight transport development in all BSR countries are: still poor infrastructure quality, relatively small internal market, and great dependence on freight transit from East.

Development of sustainable transport interchanges is a complex process involving land use planning, institutional and organizational aspects, risk assessment, economic and life cycle analysis. The case of Latvian Post sorting complex *(FB3)* shows the importance of the selection of site location for freight city hub establishment. Postal sorting complex is located next to Riga airport. The location was chosen taking into account both convenient international shipment delivery and transmission (more than 90 per cent of international mail services use air transport), and the fact that a large area with convenient access roads and spacious parking area allows to plan efficient mail traffic flow. It is possible to receive and convey mail much faster than it was possible in Riga city center previously, where mail traffic was interfered with congestion.

The postal sorting complex has significantly improved and facilitated the work of the Latvian Post once moved outside from the Riga city center. Sorting complex including road transport center provides both the company's core functions and improves working conditions. The building complex is located within the airport, which allows to receive and deliver both domestic and international shipments quickly. Postal sorting complex processes 3 million parcels a year and has nearly reached its capacity.

A good example of governance is the Noord Natie Ventspils Terminals (NNVT) *(FB2)*, which is a multi-purpose cargo handling centre; one of the most modern terminal for handling of general cargoes, containers and Ro-Ro cargoes in the Baltic region.

The idea of the terminal was determined by the conception of the Ventspils Free Port authority to develop new projects and attract perspective cargo flows – containerisation services and intermodal solutions are the power of this century's logistics. The terminal comprises the best experience in port management, wide international contacts and high standard technologies. The Terminal provides services for any kind of containerized and unitized general cargo, including heavy-lifts, intermodal solutions, all stevedoring operations etc.

Today Noord Natie Ventspils Terminals strikes for one goal – to strengthen its positions in the global transport network and to become a strategic point within the container and Ro-Ro cargo logistics chain between Western Europe, Russia, CIS countries and Asia. Noord Natie Ventspils. NNVT has well developed railway system: on the territory of loading/unloading simultaneously can be placed 110 rail wagons (2 rail trains).

The case of Noord Natie Ventspils Terminal demonstrates the governance of the Ventspils Free Port authority to develop new projects and attract perspective cargo flows – containerisation services and intermodal solutions.

Seeking to attain a suitable level of integration of Lithuania into the European Union's transportation network, the preconditions for the smooth interoperation of various modes of transportation are being created in Lithuania. Public intermodal terminal has been developed in Vilnius city to reduce roadway usage and transfer a large part of the burden of cargo transportation to railways. The project is being carried out by Lithuanian Railways, making use of support from the EU Cohesion Fund.

Vilnius Intermodal Terminal *(FB5)* ensures the effective integration of different modes of transport, i.e., among sea, road and rail transport, making use of the advantages of each: the energy efficiency of railways, the speed and flexibility of road transport in delivering cargo to the end user's doorstep, and the especially broad geographic reach of cargo delivery by sea. The terminal provides the following services: container warehousing, container loading, container unloading, repair, rental, sales and customs services.

Objectives of the practice:

- permit greater cargo mobility and more effective use of vehicles, improve the quality of cargo transportation and customs services, reduce expenses for cargo transportation, and allow enhanced cooperation among companies;
- connect with international networks: Vilnius Intermodal Terminal and Vilnius Public Logistics Centre operations will increase the competitiveness of Lithuania's transportation and logistics system in the international market;
- more flexible, efficient business processes, reducing air pollution, accidents, and noise (Source: Vilnius Intermodal Terminal).

4.2.2.2 Smart solutions

Use of intelligent systems for operation planning and optimization helps to create effective supply chain management as in case of Rimi Latvia *(FB4)*, one of the leading retailers in Latvia. Information technologies benefit to the following:

- improved data quality;
- shorter product time to market;
- more efficient transportation of goods (fewer trips);
- better communication between suppliers and clients;
- easier administrative data handling;
- more efficient employees (less administrative work);
- easier order tracking and tracing.

RIMI Latvia, one of the leading retailers in Latvia, has its own distribution center (logistic center) located in the outskirts of Riga city and has the necessary space and equipment for transshipment of goods using heavy trucks on middle class freight cars (5 - 7.5 tons) in Riga city and other locations in Latvia (117 stores in total). The distribution center handles more than 30000 tons of goods a month. Movement of goods is provided with 186 devices of 15 different types, of which 18 are lifts and 168 different assembly and handling machines.

Goods delivery area (docks) can serve more than 40 cars at the same time. It operates around the clock, always providing fresh food supply. Logistics service and staff is provided by Havi Logistics, a subsidiary company of an international logistics company Alpha Management Ltd.

Rimi Latvia (also Rimi Baltic) has centralized logistics which means that the products are supplied from a distribution center, thus reducing the heavy vehicle traffic volumes. It allows to

schedule trips with fully loaded vehicles and choose the best driving route contrary to outsourced transportation services. This is particularly important in Riga, where the traffic is very intense. Supply chain has become more efficient. All participants of supply chain jointly manage planning and forecasting processes and share the necessary information. Also, it reduces the amount of paper required for invoices.

A special web-info sharing platform iRimi is created for Rimi suppliers (launched in March, 2014). It is one source of information for assortment, quality, logistics and marketing to suppliers. Centralized database is maintained to store product information (masterdata in a standardized way with common industry rules and standards). Suppliers upload product data and retailers download it from the data pool (process known as Global Data Synchronisation). Pilot project was implemented to test usage of data pool system for exchange of product masterdata with suppliers. After successful pilot project, data pool system was implemented in all three Baltic states (Source: Rimi Latvia).

4.2.2.3 Decision-making

Management and operation of an intermodal terminal is a continuous multi-stakeholder multi-criteria decision making process. Sustainable business and organizational models are sought for collaborative schemes amongst the stakeholders of the intermodal transportation chain.

Baltic Coal terminal *(PB1)* became the first in the Baltic region high technology covered type coal terminal. Environmental impact assessment, traffic forecast, economic analysis, risk assessment and other decision support tools were used before the decision about the major investment project in Ventspils free port was made.

In December 2008 the first turn of the specialized covered coal transshipment terminal was put into operation in the Port of Ventspils. The project was financed by Latvian banks: AS DNB banka, “Nordea Bank Finland”, “UniCredit Bank”. The construction of terminal became one of the major investment projects realized on the territory of a Ventspils free port. The total amount of investments for the construction only of the first turn of a terminal is valued as 77 million Euro. So extensive investments are explained with the opening of the first in the Baltic region high technology covered type coal terminal (Source: Baltic Coal Terminal).

Baltic Coal Terminal has the covered type warehouse which protects the cargo from slacking and direct exposure of weather, therefore it prevents cargo from natural loss and raise the caloric value of coal. The coal placing in the warehouse is made by the conveyor system and the dropping track (stacker) that helps to make coal piles with the capacity 1800 tons per hour. To unload coal from the warehouse is used portal frame reclaimer with nominal capacity 3000 tons per hour. The equipment is controlled and works fully automatically. The conveyor system is equipped with scales to control the amount of cargo during the ship loading operations. The first turn allows to transfer up to 6 million tons per year. The construction of the second turn is also scheduled in the project. With the second turn, total capacity of the specialized coal terminal will reach 10.5 million (Source: Baltic Coal Terminal).

5 Research, educational and training programs in Latvia and the region

This section of the deliverable summarises the analysis of existing transport education and training programs (including logistics and ICT) in Latvia, Lithuania, Estonia and Poland.

5.1 Programs' overview

The analysis was based on the following methodology:

1. Information about available educational programmes was searched on the Internet using main key words, such as "study programme", "smart solutions", "transportation", "logistics", "transport infrastructure", "planning", "urban transport" etc.
2. Information was searched through the web sites of the ministries of education and science, as well as the web sites of the universities and higher schools.
3. 114 programmes were found in Latvia, Lithuania, Estonia and Poland (Table 5.1). Most transport education and training programs in the universities of the Baltic States and Poland are undergraduate and professional programmes. The distribution of the programmes in categories undergraduate, professional and postgraduate programmes is shown in Figure 5.1.
4. The postgraduate programmes were identified for further analysis.
5. Each postgraduate programme was reviewed to see the relevance to the project's scope. 53% of them, thus 19 programmes were identified as relevant to the project's scope (shown as selected in Table 5.1).
6. Relevant programmes were examined in detail in order to collect necessary information for the programme and course review.
7. Most of the information was found in the local language. All programmes identified were translated into the English language.

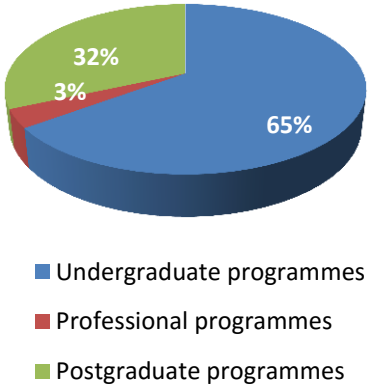

Figure 5.1: Distribution of programmes in categories of degree level

Table 5.1: Transport programs in Baltic Region per education organization and country

No.	Country	University	Program	Selected
1	Latvia	Latvian University	MSc. Spatial Planning	X
2			BSc. E-Business and Logistic Management Systems	
3		Riga Technical University	MSc. Transport Engineering	X
4			BSc. Urban and Regional Engineering Economic	
5			MSc. Logistics and Supply Chain Management	X
6			MSc. Transport Electronics and Telematics	
7			MSc. Transportation Engineering	
8			BSc. Computer Management, Information and Electronic Systems of Transport	
9			MSc. Automobile Transport	
10			BSc. Road Transport	
11			MSc. Aviation Transport	
12			MSc. Railway Transport	
13			MSc. Railway Electrical Systems Transport	
14			MSc. Civil Engineering	
15			MSc. Innovative road and bridge engineering	
16		Transport and Telecommunication Institute	MSc. Transport and Logistics	X
17			BSc. Commercial Transport Operation	
18			BSc. Transport and Business Logistics	
19			BSc. Transport Management	
20			BSc. Technical Maintenance of Aviation Transport	
21			BSc. Aviation Transport	
22		Rezekne University of Applied Sciences	BSc. Environmental Engineering	
23		Latvian Agriculture University	MSc. Agricultural Engineering with specialization Automotive Transport	X
24		Riga Aeronautical Institute	MSc. International Carrier Management	X
25			BSc. International Transport Operation	
26			MSc. Transport System Management	X
27			BSc. Air Traffic Control	
28			BSc. Aircraft Maintenance	
29		Liepaja Maritime College	BSc. Maritime transport	
30			BSc. International Transport Operation	
31		Latvian Maritime Academy	Prof. MSc in Maritime transportation	
32			Prof. BSc. Port and Shipping Management	
33			Prof. BSc. Marine Electrical Automation	
34			Prof. BSc. Marine Engineering	
35		Riga Technical College	BSc. Road Transport	
36			BSc. Telematics and Logistics	
37	Estonia	Tallinn University of Technology	BSc. Logistics	
38			BSc. Transport planning	
39			BSc. Supply chain engineering	

No.	Country	University	Program	Selected
40			MSc. Mechatronics	
41			MSc. European Architecture	X
42		TTK University of Applied Sciences	BSc. Automotive Engineering	
43			BSc. Logistics and Economics	
44			BSc. Railway Engineering	
45		Estonian Aviation Academy	BSc. Aviation Management	
46			BSc. Air Traffic Services	
47			BSc. Management of Aviation	
48			BSc. Communication and Navigation Systems	
49			BSc. Aircraft Piloting	
50			BSc Aircraft Engineering	
51		Valga County Vocational Training Centre	BSc. Transport services	
52			BSc. Construction and civil engineering	
53	Lithuania	Vilnius Business College	BSc. Transport Business Management	
54		Klaipeda State College (Klaipeda State University of Applied Sciences)	BSc. Logistics Management	
55			BSc. Logistics Business Management	
56				
57		Graiciunas School of Management	BSc. Sea Ports Management	
58		Klaipeda University	MSc. Sea Ports Management	X
59			BSc. Sea Ports Engineering	
60			BSc. Transport and Logistics Business	
61		Alytaus Kolegija University of Applied Sciences	BSc. Transport and Logistics	
62		Vilnius Gediminas Technical University	BSc. Business Logistics	
63			BSc Roads and Railways Engineering	
64			BSc. Transport Engineering Economics and Management	
65			BSc. Urban Engineering	
66			MSc. Transport Engineering Economics and Management	X
67			MSc. Urban Planning and Engineering	X
68			MSc. Aviation Mechanics Engineering	
69			MSc. Safety Engineering	

No.	Country	University	Program	Selected
70			MSc. Geodesy and Cartography	
71			MSc. Transport Engineering	X
72			MSc. Civil Engineering	X
73			MSc. Structural Engineering	X
74			MSc. Roads Traffic Safety Engineering	X
75			MSc. Innovative Road and Bridge Engineering	X
76			MSc. Construction Technologies and Management	X
77			MSc. Solar Cell and Modules Engineering	
78			MSc. Architecture	X
79			BSc. Automobile Transport Engineering	
80			BSc. Air Traffic Services	
81			BSc. Aviation Engineering	
82			BSc. Aircraft Piloting	
83			BSc. Business Logistics	
84			BSc. Roads Traffic Safety Engineering	
85		Kaunas University of Technology	BSc. Roads Engineering	
86			BSc. Railways Engineering	
87	Poland	International University of Logistics and Transport in Wroclaw	BSc. Transport	
88			BSc. Production Logistics	
89			BSc. Purchasing Logistics	
90			BSc. Trade and Distribution Logistics	
91			BSc. IT Systems in Supply Chain	
92			MSc. Production Logistics Manager	
93			MSc. Supply Chain Manager	
94			MSc. Transport Manager	
95			MSc. Industrial Systems Engineering	X
96		University of Information Technology and Management	BSc. Logistics in Transport	
97		Maritime University of Szczecin	BSc. Management and Production Engineering	

No.	Country	University	Program	Selected
98		The Collegium Polonicum	BSc. Master International Relations: Regional and Trans-border Cooperation	
99		The Institute of Logistics and Warehousing (ILiM)	BSc. Logistics	
100		Gdynia Maritime University	BSc. Port and Fleet Operation	
101			BSc. Transport and Logistics	
102			BSc. Maritime Transportation	
103			BSc. Logistics Systems	
104		University of Ecology and Management in Warsaw	BSc. Trade and logistics	
105		Warsaw University of Technology	BSc. Transport	
			BSc. Inland Shipping	
107			BSc. Sea Port and Fleet Operations	
108			BSc. Management in European Transport System	
109			BSc. Eco-logistics	
110			BSc. Transport Insurance	
111			BSc. Integrated Transport Logistics	
112			BSc. Company logistics	
113			BSc. IT in Logistics	
114			BSc. Logistics and Management in European Transport System	

5.2 Selected programs and courses

Table 5.2 below, presents an accumulation of all selected programs, the Educational Institution offering the program, the degree gained, the goal, objectives, learning outcomes and courses. Where information was not available, NA was place, for “not available”. To facilitate future reference of transport programme and course throughout ALLIANCE project, the following coding is used for each transport course selected for Latvia and the region.

Course code: $XXY_1.Y_2$

Where:

XX refers to the country where transport program exists:

"LV" - Latvia, "LT" – Lithuanian, "EE" – Estonia and "PL" for Poland.

Y_1 refers to the program's sequence number.

Y_2 refers to the transport course sequence number within each transport program.

For example the course "Logistics and Transport Systems" offered by Riga Technical University is coded as LV1.1*,* referring to *"LV"* for transport programs in Latvia, "1.1*"* for the sequence of the first transport course in the first selected MSc transport program out of the 19 programs in Table 5.2. Similarly, the coding XXY_1 is being used for the program ID.

Table 5.2: Overview of transport programs in Baltic Region per education organization and country

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
LV1	Riga Technical University MSc. Transportation Engineering	To equip specialists with theoretical knowledge, skills and competences necessary for industrial practice and research work in transport infrastructure engineering.	NA	Knowledge and ability to build a transport networks and chains, choose rational delivery routes; to create and use mathematical models of transport system planning and optimization; to make container terminal functioning technological basic scheme analysis, set container park rational structure; to calculate the road transport system element carrying capacity, volume of freight handling live version of vehicle arrival time on uncertain conditions; to define different product distribution management systems.	LV1.1:Logistics and Transport Systems LV1.2:Multimodal and Intermodal Transportation LV1.3:Transport Systems Functioning
LV2	Riga Technical University MSc. Logistics and Supply Chain Management	Study program given current logistics systems and supply chain management aspects, particular focusing on appropriate information technology concerted solutions development and implementation, promoting preparation of highly qualified specialists, who have the knowledge and	To prepare highly skilled professionals who understand and are able to implement a logistics system technology, to identify, analyse and solve problems of logistics system and in the field of supply chains, that are related to the logistics system and supply chain design, implementation, operation and management, including the field of the logistics information technology and systems, as well as to develop the capacity of the program to carry out scientific work, to participate in local and	• Knowledge of the main concepts, models and methods of cargo handling and transportation systems, automation systems and technologies for cargo handling and are able to use this knowledge in their everyday work. • Ability to choose the optimal solution for supply chain processes planning, using special methods; to create model of informational, financial and cargo flow for global market; assume supply chain flows; work out optimization project, systematize modelling results and theoretical information, working in groups and presenting results of works in groups; to identify and analyse different managerial problems in logistics and	LV2.1:Modelling and Simulation in Logistics LV2.2: Materials Handling and Transportation Technologies LV2.3:Supply Chain Network Management Technologies LV2.4: Global Markets and Supply Chains LV2.5:Logistics and Supply Chain Management European Dimension LV2.6: Decision Synthesis Principles and Practice in Logistics

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
		skills to work in an international environment.	international projects, continuing post-graduate studies.	supply chain management; to describe and interpret general concepts and methods of decision synthesis and their application aspects to problem solving in logistics and supply chain management.	
LV3	Transport and Telecommunication Institute MSc. of social sciences in Transport and Logistics	The scope of activities of the "Transport and Logistics" Programme graduates are as follows: public transport, airlines and airports, sea transportation and ports, railroad cargo and passenger transportation, delivery chain control in national and international companies.	• In-depth knowledge in the field of corporate strategies, contemporary information technology, organisation of business processes and new analytical tools. • Training of specialists having marketing skills who know how to conduct economic analysis, statistical simulation and project evaluation for the effective solution of problems in the field of planning, development and control of transport and logistics processes.	• Knowledge of the research methodology, the organizational basis of management and business activities in the area of transport and logistics, market legislation and market regulation tools. • Ability to analyse the main issues related to the organization of passenger transportation, processes organization and management; employ modern computer technologies for managing transport and logistics operations; to use economic theories, the analysis and modelling techniques for decision-making in the working areas of transport and logistics.	LV3.1: Transport Economics LV3.2: Geography of Transport Systems LV3.3: Logistics Systems and Logistics Chains LV3.4: Simulation Modelling in Transport and Logistics LV3.5: Risk Management in Supply Chains LV3.6: Transport Policy of the EU and LR.
LV4	Riga Aeronautical Institute MSc. Transport system management	NA	NA	Knowledge of transport systems management theory, modern management theories and transport process modeling techniques. Skills in business strategy planning and managing, skills in project management of transport business development and skills of the business financial performance management.	LV4.1: Transport Systems LV4.2: Modelling of Transport Processes LV4.3: Management of Transport Systems LV4.4: Global Logistics LV4.5: Economics of Transport Enterprises LV4.6: Organisation of

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
					Transport Production LV4.7: Commercial Management of Transport Systems LV4.8: Risk Management of Transport Systems
LV5	Riga Aeronautical Institute MSc. International Carrier Management	NA	NA	Specialist receives knowledge on methods of analysis and forecasting of the transport operations enterprise development, modern management theories, modelling of transportation processes.	LV5.1: Global Logistics LV5.2: Modelling of Transport Processes LV5.3: Economic and Financial Analyse of International Carrier LV5.4: Transport Risks and Insurance LV5.5: Transport Logistics LV5.6: Management of Transport Enterprises
EE6	Tallinn University of Technology MSc. European Architecture	The programme prepares students for the wide range of international professional requirements: a wide-range canon of multi-disciplinary knowledge about living cultures, social and political conditions of urban planning, the metropolitan society as source and client of spatial genesis – a	After completing their studies, the graduates are capable of independently designing, planning and implementing building tasks in different cultural and economic contexts, as well as developing, communicating or representing architectural and urban concepts or planning processes in international work contexts.	The students will have the opportunity to focus an international career as important leaders in architectural production and research, the formulation of architectural policy or urban development.	EE6.1: Urban Strategies EE6.2: Spatial Strategies

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
		prerequisite for the suitability of the responsible and reflective architect taking the task of a team generalist.			
LT7	Klaipeda University MSc. Sea Ports Management	Sea port engineering with specialization Marine transport logistics specialist, is oriented on persons which can take researcher's or higher skill qualification post, manager's in transport sector, marine industry as well as in various research educational institutions and to continue the third level studies.	Fundamental knowledge about the effectiveness of port infrastructure, assessment of port infrastructure in terms of new construction or reconstruction of the old structures and rationale for the development of port infrastructure and sources of funding; maintain in-depth knowledge of port infrastructure elements and their characteristics, operation and options subject to certain conditions.	• Fundamental knowledge about engineering and its phenomena, comprehension of new and important field of study in maritime ports and transport engineering research and development problems. • The ability to solve unfamiliar or incompletely defined problems; have competing specifications, related to seaports and transport, to use their knowledge and understanding to conceptualise engineering models, systems and processes related to sea ports and transport; to use creativity to develop new and original ideas and methods in sea ports and transport. • The expanded abilities of information research and IT application, such as: information networks and data bases, the ability to investigate the application of new and emerging technologies in sea port and transport	LT7.1: System and analysis concepts LT7.2: Transport system components LT7.3: Sea and land transport interaction LT7.4: Sea transport managing systems LT7.5: European water transport system LT7.6: Lithuanian transport system LT7.7: Intelligent transport systems LT7.8: Intermodal transports and Ro-Ro shipping LT7.9: Multimodal transport International maritime organizations

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
				engineering. • The ability to use professional knowledge in different tasks in known and unknown situations; ability to solve unknown or not defined problems and situations, to identify and analyse new problems.	
LT8	Vilnius Gediminas Technical University MSc. Transport Engineering Economics and Management	The graduates, who acquired knowledge, comprehension and developed special skills, are successfully employed by transport, other enterprises, carrying out research and developing experimental projects, creating and implementing innovations and technologies, allowing to solve the problems associated with the transport system, work and traffic safety, the environment protection.	• To acquire knowledge about the theories of transport and logistics, management and business sciences, market trends, research methodologies, process analysis and problem solution methods applicable to the solution of theoretical and practical issues. • To gain an understanding of the theoretical problems in transport and logistics, practical processes of transport and logistics services and their causes, applicability of the analysis methods of these phenomena, research opportunities by assessing the impact of the decisions being made on the environment, business and society. • To be able to apply the	• To know research methodology and its applicability, to know methods of business models, process analysis and projection methods in the area of transport and logistics. • To be able to apply specialized theoretical and practical knowledge in solving contemporary transport and logistics business issues. • To be able to apply the methods of transport and logistics process management in practice; to plan, organize, control and evaluate their own and team work; to implement life - long learning principle.	LT8.1: Transportation Services of International Trade LT8.2:Warehouse and Inventory Management LT8.3:Quality Management Systems in Transport LT8.4:Transport Policy and Innovations LT8.5:Mathematical Simulation of Transport Systems LT8.6:Economics of Transport Service LT8.7:Reverse Logistics LT8.8:Strategic Supply Chain Management LT8.9:Resource and Operation Management in Logistics

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
			acquired knowledge and specific practical skills, and constantly absorb new knowledge and methodologies in solving the issues of modern transport and logistics business in an ever-changing environment. • To be able to work independently and responsibly, to plan, organise, control and assess one's own work as well as the work of the team, to effectively communicate with colleagues and customers, to think strategically, and learn independently throughout life.		
LT9	Vilnius Gediminas Technical University MSc. Urban Planning and Engineering		• To prepare a specialist of general and special (engineering) urban planning having the second cycle university education, capable to work in the team of specialists which prepare city plans, having skills to solve the tasks of urban, regional and territorial development, taking into consideration the impact of EU integration and	• Knowledge and ability of planning and implementation of scientific research methodologies, methods, organization and innovations; of possibilities for the use modern information systems in urban planning and civil engineering and of the main trends of their development. Special knowledge in the civil engineering study field. • Special skills to plan and implement scientific researches, apply analysis methods, estimate results, determine their reliability and to solve problems in the field of urban engineering	LT9.1: Transportation Infrastructure. LT9.2:Urban Infrastructure LT9.3:Urban Engineering Information Systems LT9.4:Regulation of Urban Planning and Democracy LT9.5:Urban Planning Theory and Methodology LT9.6:Sustainable Development of the City LT9.7:Using GIS for Planning and Modeling

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
			globalization processes on the public, economy and urban development of Lithuania, capable to economically assess and justify rational design, technological and maintenance solutions, to use modern information technologies, having knowledge and skills necessary for the engineering and scientific work, able to effectively communicate with the specialists of other fields and the public, having a creative and critical way of thinking, able to maintain his/her professional competencies by the whole life learning.	systems and urban territorial planning, to solve tasks of the development of engineering systems, to reflect the city, to create subject digital maps with the use of GIS tools, to recognize and critically valuate theoretical and practical innovations in the field of urban planning and engineering.	LT9.8:Architecture of Urban Landscape LT9.9:Urban Engineering Network LT9.10:GIS Based Computer Designing
LT10	Vilnius Gediminas Technical University MSc. Transport Engineering	To provide the newest special knowledge in Technological Science in the area of studies of Land Transport Engineering, to develop special skills of problem solution required for carrying out the research as well as managerial skills	• The graduates, who acquired knowledge, comprehension and developed special skills, are successfully employed by transport, other enterprises, carrying out research and developing experimental projects, creating and implementing innovations and technologies, allowing to solve the	• To know and to understand the methods of research, the principles and methods of modelling machines (vehicles) and physical processes, the principles and methods of production organization and processes associated with economic system's performance. • To be able to investigate, analyse and evaluate physical processes, taking place in technological systems to diagnose, estimate and predict the technical state of machines and	LT10.1:Transport Policy and Innovations LT10.2: Road Traffic Organization and Control LT10.3: Road Vehicle Safety LT10.4: Traffic safety legal regulation LT10.5: Road Building Engineering LT10.6: Integrated Transport Systems LT10.7: Transport Economics

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
		and an innovative approach to apply them to technological problems' solution.	problems associated with the transport system, work and traffic safety, the environment protection.	equipment, their reliability and the remaining service life. • To be able to investigate, analyse and assess the factors influencing the machine performance, efficiency and ergonomic parameters, to investigate, evaluate and improve the effectiveness of traffic and labour safety as well as to solve the problems associated with traffic and labour safety and the environment protection, to develop and apply rational principles of work organization.	LT10.8: Management of the Logistics System Structural Units LT10.9: Interaction Between Transport System Elements LT10.10: Tests and Expertise of Transport Technological Systems LT10.11: Expertise of Road Accidents LT10.12: Total Quality Management in Transport System
LT11	Vilnius Gediminas Technical University MSc. Civil Engineering	To prepare a post-graduate the future professionals who are able to design and to build new and reconstructed buildings with the modern computing and detailing principles and modern construction technology.	• To give knowledge and skills for creative thinking, to train students to apply the acquired knowledge and skills creatively, to do scientific research and to evaluate it, as well as to apply the results in practical applications. • To raise the high quality specialists who are able to develop complex buildings' solutions, taking into account their very close ties, durability, aesthetics and cost-effectiveness considerations. • To raise the high quality building design architectural engineering	• Knowledge about the state, quality evaluation and testing principles and methods of the buildings and their structures, about the energy efficiency of renovated buildings. • The ability to identify and analyse the innovative design and construction methods for renovated buildings, to use the most rational constructional solutions and construction methods for the renovated buildings, to properly understand, assess and adapt renovation methods applicable in world. • Properly to organize their continuous professional development.	LT11.1: Legal Regulation of Urban Planning and Construction LT11.2: Theory of Railway Construction LT11.3: Urban Infrastructure LT11.4: Legal Regulation of Urban Planning and Construction LT11.5: Modern Roads Technologies LT11.6: Road Building Quality LT11.7: Road Information Systems LT11.8: Geographic Information Systems LT11.9: Road Integrated Research LT11.10: Railway

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
			specialists who are able to develop complex buildings' architectural and structural solutions, taking into account their very close ties, durability, aesthetics and cost-effectiveness considerations.		Modernization LT11.11: Urban Transport Systems LT11.12: Theory of Traffic Flow LT11.13: Theory of Territorial Planning LT11.14: Theory of Road Maintenance LT11.15: Railway Management LT11.16: Urban Information Systems LT11.17: Urban Public Transport LT11.18: Traffic Safety Management LT11.19: Train Traffic Organization and Traffic Safety LT11.20: Systemic Analysis of Roads LT11.21: Design of Railway Station LT11.22: Theory of Road Maintenance LT11.23: Mobility Management LT11.24: Planning of Transportation Infrastructure LT11.25: Management of Urban Development LT11.26: Using GIS for

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
					Planning and Modelling
LT12	Vilnius Gediminas Technical University MSc. Structural Engineering	The graduates of this second cycle programme acquire all skills necessary for practical work and they are ready for independent professional activities. They can start practical activities in construction and design companies, expert bureaus, departments of ministries, town and regional municipalities or can continue their doctoral studies.	• To put in readiness the specialist having the second level university education - the master of civil engineering capable to collect, organize, analyse, evaluate and offer the information. • To acquire the researcher capable creatively to think and to fulfil the research work competently assessing the received results and applying them in practice. • Providing ability of highly qualified structural engineer to put in readiness the specialist for engineering activity creatively decision-making complicated problems of designing, behaviour assessing and strengthening of building structures. • To put in readiness the specialist for competitive activity in conditions of European construction market capable to keep his professional competency by studying	• Knowledge of the principles and major dependences in the behaviour analysis, calculation methods, and advanced design software for complex building and building structures and structural members for innovative, rational and optimal structural decision making. • Abilities to understand the behaviour of bridge structures, structural systems and members, to see the problems of development and analysis of bridge structures and to find their solutions, to know the physical and virtual testing methods of structures and constructions; to recognize and analyse data related to design of buildings and their structures, to be able to prepare data analysis results for searching innovative structural solutions; to carry out research and to evaluate the results using information technologies; to evaluate the reliability of special structures and connections, to provide the performance variation trends of special structures.	LT12.1: Reinforced concrete bridge design, evaluation of the archaeological and climatological factors LT12.2: Timber and Polymeric Bridges LT12.3: Composite bridge decks LT12.4: Computer aided design of bridges and special structures LT12.5: Steel fiber reinforced concrete bridge structures LT12.6: Innovative Steel Bridge Structures

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
			through all life.		
LT13	Vilnius Gediminas Technical University MSc. Roads Traffic Safety Engineering	Graduates are competent to work as leading managers and engineers in companies and organizations of road and street design, building and maintenance, in the Lithuanian Road Administration under the Ministry of Transport and Communications of the Republic of Lithuania and its regional enterprises, in city and district municipalities.	To prepare a Master of road engineering having the second cycle university education and capable to understand, analyse and discover road traffic safety problems, to make conceptual and accurate engineering solutions in case of the lack of information and taking into account the certain situation on roads and streets, capable to carry out public educative activities, to be a team leader, to find and figure out the newest tendencies in the field of road traffic safety and to adapt them in Lithuania.	• Knowledge of planning and implementation of research methodologies, of measures to ensure road traffic safety on roads and streets, planning and modelling of traffic flows; of road infrastructure management. • Ability to evaluate the newest information systems, technologies and innovations for ensuring road traffic safety on roads and city streets; to evaluate importance of interaction and integration of different fields and directions when solving problematic questions of road traffic safety engineering; to recognize and critically valuate road traffic safety situation, to give accurate and rational solutions for safety assurance.	LT13.1: System of Traffic Safety on Roads and Streets LT13.2: Traffic Safety Management LT13.3: Vehicle Dynamics and Traffic Accident Expertise LT13.4: Traffic Safety Legal Regulations LT13.5: Engineering Traffic Safety Measures and Their Evaluation LT13.6: Road and Street Network Planning LT13.7: Modern Road Design Methods LT13.8: Urban Transport System LT13.9: Traffic Safety Information Systems LT13.10: Road Safety Audit and Management LT13.11: Theory of Road Maintenance Management LT13.12: Country and Cities Planning LT13.13: Transport Flows Modelling
LT14	Vilnius Gediminas Technical University	Education of civil engineering master degree graduates, who are able to	Graduates may take leading positions at the state or municipal road sector management or maintenance	Knowledge and ability to apply of the research methodology, methods, organization, innovation planning and implementation approaches in dealing	LT14.1: Road Integrated Research LT14.2: Traffic Safety

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
	MSc. Innovative Road and Bridge Engineering	apply the gained innovative road and bridge engineering science and practical knowledge for formulation, verification and independent making of effective engineering solutions, based on systematic, critical and constructive thinking/ consideration and scientific argumentation, and having mastered scientific provisions of quantitative and qualitative cognition and interaction, and dependence of the provisions in question on different conditions. The graduates are expected to be able to integrate and in a complex manner to employ road system management theories, innovative road and bridge design an technology	entities or institutions, road and bridge research, maintenance, technical supervision, design or construction companies and organizations, can take post-graduate studies.	with problems and tasks associated with road network maintenance, development and management; the potential of modern road and bridge information systems and the basic trends of their development in engineering, by application of theoretical knowledge, identification of risk and safety factors in bridge and road engineering; solutions and the related responsibility, management of risk and safety conditions by establishing durability of road and bridge structures, and to justify the conclusions of own researches and reasoning in a substantiated way, to communicate them verbally and in writing in an understandable manner to different area and interest and different reduction background stakeholders.	Management LT14.3: Steel-concrete Composite Bridge LT14.4: Computer Aided Design of Bridges LT14.5: Dimensional Road Design LT14.6: Risk and safety in bridge engineering LT14.7: Innovative Timber and Reinforced Concrete Bridges LT14.8: Durability of Bridge Structures LT14.9: Road and Streets Network Planning LT14.10: Land Use Planning

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
		engineering knowledge, which encompass the progress in construction, economics and other sciences and technologies.			
LT15	Vilnius Gediminas Technical University MSc. Construction Technologies and Management	To introduce the concept of sustainable development and its evolution; to provide knowledge on regional and urban sustainability assessment, and planning for sustainable development.	NA	Concept, evolution and theoretical basis of Sustainable development. The theory of complex regional development; the regional development problems and ways of their solution. Levels and processes of territorial planning. The main urban development trends in the world and Lithuania. The nature and principles of sustainable urban development. Evaluation of urban sustainability and planning of sustainable development. Automation tools for modelling of sustainable city.	L15.1: Sustainable Development of Territories
LT16	Vilnius Gediminas Technical University MSc. Architecture	NA	• To provide up-to-date, specialised knowledge of professional and scientific activities which lays the foundation for original thinking and innovative artistic creation. • To foster the ability to substantiate products of artistic creation with applied studies covering the critical understanding of the interaction of knowledge between	• Knowledge of the new environment, implementing innovations in the process of the design of architecture objects and other professional architectural activities; architecture creation trends, impacts of adjacent scientific and practical fields, modern principles of the balanced architectural design of structures and environment, and the impact of new materials and technologies on structural morphology; principles of the architectural and structural renovation of buildings and complexes and the impact of	LT16.1: Analysis of Architectural and Urban Structures LT16.2: Principles of Urban Design LT16.3: Computer Urban Analysis (of GIS Base) LT16.4: City Urban Structure: Planned and Spatial Development LT16.5: Urban Complex in Redeveloped Town Environment LT16.6: Composition of

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
			various fields and its application in the creative process. • To form the skills of leadership and innovativeness applicable in a working and learning environment that is unusual, complicated, and requiring to address problems involving many interacting factors.	engineering solutions on the architecture of the object being renovated. • Ability to integrate knowledge of various fields of activities in preparing architectural projects in complex situations when sufficient and defined information is not available; to select appropriate methods of multifaceted analysis, to provide and assess alternative project solutions and their environmental impact; to resolve, in the spatial space of cities, complex tasks related to the formation of the architecture of urban complexes and development and protection of the visual identity of cities; to prepare territorial planning documents of the parts of a city.	Urbanizes Landscape LT16.7: City Urban Structure: the Reconstruction of the City Central Part LT16.8: Spatial and Volume Concept of Urban Complex
PL17	International University of Logistics and Transport in Wroclaw Msc. Transport. Industrial Systems Engineering	The major Transport provides students with a broad knowledge on transport and forwarding industry. Students of this major will learn the specifics of transport company management and the issues of efficient organization of international and domestic transport.	NA	• Knowledge and skills for specialties: ○ Shipping and Transport Insurance ○ Transport Company Management ○ Organisation of Special Transport ○ Railway Transport Management • Graduates are prepared to work for: ○ international and domestic transport companies, ○ international and domestic shopping companies, ○ forwarding department in production, retail and service companies, ○ logistics and distribution centres; ○ insurance companies operating in	PL17.1: Transport management PL17.2: Logistics management PL17.3: Design of processes and logistics systems PL17.4: Computer systems in transport PL17.5: Management of logistics project PL17.6: Logistics controlling PL17.7: International logistics PL17.8: Optimization of transport costs PL17.9: Reliability and

ID	Program name and institution	Goal	Objectives	Courses' learning outcomes	Courses that support the learning outcome
				transport, forwarding, logistics sector, ○ companies that organize multimodal transport.	maintenance PL17.10: Models and algorithms for logistics PL17.11: Logistics planning PL17.12: Optimization of logistics processes
LV18	University of Latvia MSc. Spatial Planning	NA	NA	NA	LV18.1: Geographical Information Systems (GIS) LV18.2: Planning of Technical Infrastructure LV18.3: Planning of Spatial Development
LV19	Latvian Agriculture University MSc. Agricultural Engineering with specialization Automotive Transport	NA	NA	NA	LV19.1: Transport Management and Logistics LV19.2: Traffic Management and Modelling LV19.3: Intellectual Technologies and Systems LV19.4: Logistics LV19.5: Computer-aided Management systems LV19.6: Warehouse Management LV19.7: Transport Engineering Service LV19.8: Auto transport and environment

6 Research, educational and training programs in Europe

The research, educational and training programs in Europe section comprises three main parts: (a) Program identification and selection; (b) Data processing and organizing, (c) Programs' presentation; and (d) Program courses' presentation.

6.1 Program identification and selection

Published online data in the website of each educational institute have been used as the main data collection source; secondary data sources include personal communication and institute prospectus. Personal communication and prospectus reviewing are time consuming activities and require a lot of resources. For this reason, a very small number of programs was covered through these two sources. However, most of important programs are found online, thus the majority of the selected programs were collected based on the first source. Programs which were selected to be reviewed in detail satisfied a set of qualitative criteria, as follows (the order reflects the priority that was given to each category):

1. Relevance to transport programs: According to the organisation proposed in Horizon 2020 these should cover one of the following transport modes: road, urban, waterborne, aviation, intermodal or rail).
2. Transport program focus: According to the available EU transport programs, identified programs were divided in two categories: "Generic" and "Specialized". Generic transport programs refer to all transport planning and engineering programs, whereas specialized include all others which were found usually to focus on Logistics, Business and Management. The survey was designed and conducted on educational institutes, which are active in providing generic and specialized knowledge on intermodal transportation, terminals and logistics, in regards to planning and operation. The share of generic and specialized transport programs is roughly equal, with 26 generic and 27 specialized transport programs.
3. Coverage of different geographical areas: A pan-European coverage was attempted.
4. Program focus: This refers to balance between generic and specialized transport programs and minimum number of 5 programs per 'focus' category. Program focus categories are explained in detail in paragraph 6.2.
5. Data availability and accessibility: The following information should be easily retrieved: goals, objectives, learning outcomes, course description, suggested bibliography, teaching and assessment methods.
6. Language of the program: English was the preferred language since these programs attract more foreign and international students. Other languages programs were also selected, based on the language skills of the research team.
7. Coverage of well reputed educational institutes and transport programs.

Applying the first criterion based on this criterion, 53 postgraduate programs were identified, narrowed down to 18 programs finally selected, which indicates a selection rate of 34%.

Table 6.1 presents all identified programs per country and educational organization and the programs finally selected, for further analysis.

Table 6.1: Total and selected EU Transport programs per education organization and country

No.	Country	University	Program	Selected
1	UK	Cardiff University	MSc. Transport & Planning	X
2		Edinburgh Napier	MSc. Transport Planning & Engineering	
3		Glasgow University	MSc. Urban Transport	
4		Imperial college	MSc. Transport	X
5			MSc. Transport with Business Management	
6			MSc. Transport with Sustainable Development	
7		Leeds University	MSc. Sustainability in Transport	X
8			MA Transport Economics	
9			MSc. Transport Planning	
10			MSc. Transport Planning and the Environment	
11			MSc. (Eng) Transport Planning and Engineering	
12			MSc. Mathematical Modelling for Transport	
13		Newcastle University	MSc. Transport Planning and Engineering	X
14			MSc. Transport Planning and Business Management	
15			MSc. Marine Transport with Management	X
16			MSc. Transport Planning and Intelligent Transport Systems	
17			MSc. Transport Planning and the Environment	
18		Salford University	MSc/PG Dip. Transport Engineering & Planning	
19		Sheffield Hallam University	MSc. Urban Planning	
20		Southampton University	MSc. Transportation Planning & Engineering	X
21		University College London	MSc. Transport and City Planning	
22			MSc. Mega Infrastructure Planning, Appraisal and Delivery	
23			MSc. in Transport, Health and Policy	
24		West of England University	MSc. Transport Planning	
25			MSc. Transport Engineering and Planning	
26		University of Glasgow	MSc. Urban Transport	
27		Westminster University	MSc. Transport Planning & Management	X
28		Loughborough University	MSc. Transport and Business Management	
29		University of Hertfordshire	MSc. Sustainable Planning and Transport	
30		City University London	MSc. Maritime Operations and Management	
31		Cranfield University	MSc. in Air Transport Management	
32		University of Wolverhampton	MSc. Transport and Infrastructure	
33		London South Bank University	MSc. Transport Engineering and Planning	

No.	Country	University	Program	Selected
34	Germany	Munich University of Technology	MSc. in Transportation Systems	X
35		University of Magdeburg	MSc. Logistics	X
36	Sweden	KTH Royal Institute of Technology	MSc. Transport and Geoinformation Technology	X
37		University of Gothenburg	MSc Logistics and Transport Management	
38	Switzerland	École Polytechnique Fédérale de Lausanne	MSc. Transport and Mobility	X
39	Netherlands	TU Delft	MSc. Transport, Infrastructure and Logistics	X
40		Rotterdam University	BSc. Logistics and Transport Management	
41	Belgium	University of Antwerp	Advanced Master in Maritime and Air Transport Economics	X
42			MSc. Transport and Logistics Management	X
43	Romania	Danubius University	Shipping International Trade and Finance	
44	Slovenia	University of Maribor	Traffic and Transportation Engineering	
45	Spain	University of the Basque Country	MSc. Transportation systems	
46		University of Oviedo	MSc. Port Management, Planning & Intermodal Transport	X
47	Greece	University of the Aegean	MSc. Shipping, Trade and Transport	X
48		Aristotle University of Thessaloniki	MSc. Planning, Organization and Management of Transport Systems	X
49		University of Thessaly	MSc. Transport planning and management	X
50	Italy	Sapienza University of Rome	M.Sc. Transport Systems Engineering	
51	France	EURECOM	MSc. Post Master - Communications for Intelligent Transport Systems	
52		Polytech Orléans and ISAT in Nevers	MSc. Automotive Engineering for Sustainable Mobility	
53		ESTACA, Engineering School	MEng. In Aeronautics, Automotive, Railway or Space	

Following a geographical coverage analysis, it was estimated that seven of all transport programs in the sample, both generalized and specialized related, are offered by UK education institutions whereas the other eight are offered by other EU based educational institutes. Figure 6.1 shows the UK and other EU based transport programs.

Despite all efforts, very few fields remained incomplete, owing to the lack of information provision in English. In this case the sign NA appears in the respective box, for “not available” information.

Figure 6.1: Geographical coverage of programs with transport oriented courses

6.2 Data processing and organizing

Each transport program has a set of aims that outlines briefly the overall objectives of the program. These aims relate to programme structure, student learning outcomes and educational staff of the institute. In the context of an organised educational institute, such as a course programme, an aim is a (relatively) long-term goal; an objective is a (relatively) shorter term goal which successful learners will achieve within the scope of the course itself (Wikipedia 2016).

Outlining aims and objectives is an important task because it will assist to design the transport program, the content, the methods, and the assessment of the course. It will also help identify the resources required to develop and operate effectively the program. Goals and objectives of transport programs in the sample are grouped in generic and specialized, as follows:

- Generic transport programs that focus on planning and engineering set specific goals and objectives and emphasize usually on road transport of people and goods, while considering the interactions of transport on society, economy and the environment. Although, other transport modes are not fully addressed in the majority of generic transport programs, the fundamentals are addressed in ways which are relevant to all modes of transport. While transport programs have been developed based on the country needs and requirements, all of them attempt to provide a general global view of transport in the society and thus equipping graduates for work in the field of transport

planning, engineering, operations, management, policy and research. While the objectives of each program differ, as these presented online, there is a common axis of knowledge that transport programs use, these were identified to be: transport policies at national and local levels, evaluation and appraisal methods for transport projects, understanding of travel behaviour and environmental impact.

- Specialized transport programs, opposed to generic transport programs present goals relevant to the mode for which the program has been developed, including rail, waterborne, aviation. Additionally, these programs appear to provide more explicit goals related to business, logistics and management of transport systems as opposed to the generic transport programs of planning and engineering. Logistics, supply chain and management of transport systems are rarely covered in a generic transport program, and most of the specialized transport programs address at least one course of logistics, business skills and supply chain management. On conclusion, specialized transport programs aim to enable people in the transport sector to upgrade their knowledge and abilities through state-of-the-art specialized courses by choosing any available major course offered by the transport programs or a set of courses, students tailor their programme to their specific interests and backgrounds. Transport program objectives are tailored to the description of the program and are usually focus on providing a deep understanding of the characteristics of the program's topic in the context of transport systems.

To disaggregate available information and perform a comprehensive gap analysis the transport programs were reviewed in terms of offered courses. In all of the 18 transport programs, 114 courses were identified to be relevant to the scope of the ALLIANCE project, according to their syllabus, thus related to interconnecting transportation networks. These are either core, mandatory or optional courses.

To better organize courses' analysis, courses were grouped in eight categories and each category is denoted by a letter as follows:

- Transport economics (E)
- Transport policy (C)
- Transport environment (N)
- Transport modelling and technology (M)
- Transport logistics and business (L)
- Transport operations (O)
- Transport planning (P)
- Transport engineering (D)

To facilitate transport program and course reference throughout ALLIANCE project the following coding is used for each transport course.

Course code: $XY_1.Y_2\_Z$

Where:

X refers to the transport program focus area: "G" for generic and "S" for specialized.

Y_1 refers to the program number for generalized and specialized programs, respectively.

Y_2 refers to the transport course sequence number in each transport program (Table 6.2 and 6.3).

Z refers to one of the eight transport categories, as presented, above.

For example, the course "Transport Engineering and Operations" offered by the Imperial College, UK is coded as *G2.2_O,* referring to *"G"* for generic transport program, "*2"* for second transport program in the focus category (Table 6.2), "*2"* for second transport course in the program and "*O*" for the Transport operations category.

6.3 Programs' presentation

This section presents the most important data collected, in the form of tables distinguished per program focus. The 18 selected transport programs have been reviewed and the information collected from the process has been inserted in Tables 6.2 and 6.3. For presentation reasons, four important fields are present in Tables 6.2 and 6.3 to reveal the correlation of transport program objectives, courses and learning outcome with the scope of the ALLIANCE project and to set the foundation for gap analysis in Chapter 7.

Table 6.2: Generic – Transport Planning and Engineering EU programs

ID	Program name and institution	Goal	Objectives	Course learning outcomes	Courses
G1	Cardiff University (UK) MSc. Transport & Planning	The aim of the course is to help students develop the capacity to contribute to the analysis, planning, policy making and management of transport systems in both the UK and overseas.	• Explain and demonstrate the principles and practice of transport scheme appraisal and evaluation; • Understand and be able to use statistical and modelling methods for analysing travel behaviour and a range of transport options • Appraise a range of transport policies for promoting greater sustainability at national, regional and local levels; • Design transport policies at the local level that respond to the economic, social, health and environmental challenges of the society.	• Practical knowledge of transport project appraisal and generation of sustainable transport plans • Identification of key transport impacts and policy responses at a range of geographical scales • Describe the different approaches to travel behaviour research and ability to critique them • Critically evaluate various approaches – top-down and bottom-up forms of governance, eco city and low carbon city • Evaluate the legislative, regulatory and institutional frameworks of planning in a given context, and the extent to which it address modern urban challenges • Critically analyse the content of regeneration policies and strategies.	G1.1_E: Principles of transport economics G1.2_C: Sustainable transport policies G1.3_P: Transport and the city G1.4_O: Transport analysis G1.5_C: Governance of the eco-city development process G1.6_P: Urban and regional development in practice G1.7_P: Space and place: International planning practice
G2	Intercollegiate MSc. in Transport Studies (CTS) at University College London (UCL) and Imperial College London MSc. (UK) MSc. Transport	The course places emphasis on road and rail transport in the more industrialised countries, whilst recognising the important roles of other forms of transport and interchange with them, and the different context in which transport problems present themselves in less industrialised countries. Subject to this emphasis,	• Provide a systematic understanding of the causes and motivations of personal travel and goods movement and of the means by which movement takes place. • Provide a grounding in techniques for analysing transport problems and developing and implementing policies and measures for resolving such problems. • Develop appreciation of the importance and methods of	• Understand the policy development cycle and its application to transport. Show awareness of the range of policy measures that could be used to meet policy objectives, • Set out basic engineering and operational concepts that are relevant to transport, and to consider the road system and more briefly the rail systems, together with the provision of public passenger transport and use of street space, in the light of these concepts.	G2.1_C: Transport policy G2.2_O: Transport engineering and operations G2.3_O: Ports and maritime transport G2.4_O: Air traffic management G2.5_O: Freight transport G2.6_N: Transport and the environment

ID	Program name and institution	Goal	Objectives	Course learning outcomes	Courses
		the fundamentals are addressed in ways which are relevant to all means of transport and to every kind of society.	evaluating transport projects, plans and policies, taking into account the need for public consultation and recognising the political, social, commercial and financial issues involved. • Produce graduates equipped to pursue careers in industry, the public sector and non-governmental organisations; • Provide the basis for the recognition and understanding of the major features of transport; • Develop an understanding of how this knowledge may be applied in practice in an economic and environmentally sustainable manner; • Foster the acquisition and implementation of broad research and analytical skills; • Develop new areas of teaching in response to the advance of scholarship and the needs of the community including vocational training.	• Obtain a thorough understanding of ports and maritime transport in the context of global supply chains. • Carry out strategic design of intermodal supply chains that involve maritime transport legs. • Understand the fundamentals of ATM, including its functional elements, technologies, the main organisations involved, and the main drivers of the constraints to the ATM system. • Possess a good understanding of freight transport, know fundamental concepts and principles in logistics, and acquire basic quantitative skills in freight planning. • Develop a clear understanding of the role of ITS and understanding policy conflicts and where technology solutions have succeeded and failed. Assess how technology solutions can be used to deliver a transport policy • Design and manage public transport systems. • Become aware of wider contexts associated with public transport.	G2.7_O: Public transport G2.8_E: Transport economics G2.7_M: Intelligent transport systems
G3	Leeds University *(*UK) MSc Sustainability in Transport	This programme considers the interactions between the economy, society, the environment and governance. It examines drivers such as climate change policies and corporate governance initiatives and develop the	Learning to conduct strategic reviews of transport and land-use policy, undertake sustainability assessments and conduct land-use zoning and development control exercises. Considering the roles of governments, markets and communities in encouraging	• Influencing decision making in transport towards environmentally and socially sustainable solutions • Provide an understanding of the fundamental relationships involved in transport systems, their interactions with other sectors, and future opportunities and challenges • Re-appraises supply chain logistics	G3.1_N: Environmental science and sustainability for transport G3.2_C: Shaping future transport systems G3.3_L: Green logistics G3.4_P: Public transport

ID	Program name and institution	Goal	Objectives	Course learning outcomes	Courses
		skills to help deliver integrated transport solutions.	sustainability and evaluate policy interventions across sectors and spatial scales.	using the latest thinking and endeavours to offer possibilities to reduce the environmental impact • To ensure that students have a sound understanding of the key issues affecting the planning, management and financing of public transport	planning and management
G4	Newcastle University (UK) MSc. Transport Planning and Engineering	The aim of the course is to help students develop the capacity to contribute to the analysis, planning, policy making and management of transport systems in both the UK and overseas.	Developing essential skills and understanding of the planning, management and operation of transport systems, we aim to help you establish a responsible attitude towards the needs of society, the environment and transport safety considerations.	• To describe the local, regional and national government structures relating to the delivery of transport services. • To introduce key policy documents and legislation at the local, national and international level in areas such as planning, policy and finance; alternative transport modes; environmental issues; health and safety; and energy; • To appreciate the constraints and challenges in creating sustainable transport infrastructure • Become familiar with planning and management and should be able to take up management positions in the railway and associated industries. • To understand the economic and environmental appraisal of transport activities. • To introduce the concept of multi-criteria assessment for comparison and ranking of alternatives.	G4.1_C: Transport policy and legislation G4.2_P: Transport planning and sustainable mobility G4.3_C: Public inquiry into a transport scheme G4.4_D: Design of transport infrastructure G4.5_D: Railway management, economics and planning G4.6_N: Economic and environmental appraisal of transport activities

ID	Program name and institution	Goal	Objectives	Course learning outcomes	Courses
G5	Southampton University (UK) MSc. Transportation Planning & Engineering	The aims of the programme are: 1. To gain a sound knowledge and understanding of the key issues and processes in transportation planning and engineering. 2. To develop skills in critical appraisal and analysis of transport options and systems, in independent research and in oral and written communications. 3. To enable you to become a professional transportation planner/engineer 4. To provide relevant in-career postgraduate training for professionals working in transportation planning and engineering	• Plan, conduct and report on an individual research programme. • Analyse and produce transport plans, consistent with policy statements • Analyse and solve engineering problems, using appropriate mathematical methods as necessary. • Be creative in the solution of problems and in design development. • Integrate and evaluate information and data from a variety of sources. • Identify and implement statistical techniques for analysing transport data, appropriate for the analysis requirements. • Take a holistic approach to solving problems and designing systems, applying professional judgement to balance risks, cost, benefits, safety, reliability, aesthetics and environmental impact.	• Recent trends in transport and the major drivers behind travel behaviour • The transport planning process • Data requirements for transport planning • The public inquiry process in the UK, where there is a transport component • How the transport sector attempts to achieve sustainability • Economic appraisal and evaluation methods and their application in developing and developed countries. • Traffic management, control and information systems in urban and inter-urban networks. • Factors affecting the demand for passenger transport. • The characteristics of bus and rail operations. • New technologies in passenger transport for information, control and management. • Port operations for freight and containerisation. • Waste logistics operations and the role local authorities	G5.1_P: Transportation planning: policies and methods G5.2_P: Transportation planning: practice G5.3_E: Transport economics G5.4_P: Transportation engineering: transport management G5.5_O: Passenger and freight transport G5.6_N: Transport, energy and the environment
G6	Munich University of Technology (Germany) MSc. Transportation Systems	NA	• Know how to design roads, traffic management systems and public transport networks. • Be familiar with the concepts of transportation demand management, integrated land-use and traffic management,	Students learn to design and to operate modern transportation systems and integrated inter-modal transport management systems	G6.1_M: System architectures and applications G6.2_M: Integrated land-use and transport modelling

ID	Program name and institution	Goal	Objectives	Course learning outcomes	Courses
			freight logistic concepts and intermodal traffic management.		G6.3_O: Traffic control G6.4_D: Road design G6.5_D: Rail design
G7	KTH Royal Institute of Technology (Sweden) MSc. Transport and Geoinformation Technology	The Master's programme aims to combine two closely related aspects of the built environment: Transport Systems and Geoinformation Technologies. In Transport Systems, we focus on analysing the movement of people and goods through space, and on planning, designing, constructing and operating the systems that accommodate these flows.	Have knowledge about collecting, structuring, storing, analysing and visualisation of geospatial and transport data. Have knowledge about analysis, planning, assessment, and operations of transport systems and other urban and regional phenomena at different spatial levels.	• Understand the fundamental traffic flow theories and identify basic traffic variables and their relationships including speed, density and flow. • Understand the use of advanced simulation methods for the analysis of traffic systems and software tools • Evaluate traffic impacts on the environment and safety. • Identify relevant policy measures and strategies to address transport oriented problems • Discuss the underlying principles for different appraisal frameworks • Apply multi-criteria analysis to transport projects • Explain and apply the principles of cost-benefit analysis to make economic appraisals of transport improvement projects; • Identify environmental impacts of transport and apply the environmental impact assessment approach on a transport project.	G7.1_D: Traffic engineering and management G7.2_C: Transport policy and evaluation G7.2_N: Transport and sustainable development G7.2_P: Railway traffic - market and planning G7.3_O: Public transport
G8	École Polytechnique Fédérale de Lausanne (Switzerland) Master in Civil	The programme aims to give to students the necessary knowledge to face important challenges: build infrastructures enabling an optimal running of our societies,	NA	• Assess / Evaluate the performance of transport systems • Optimize the level of mobility in a city • Analyze the different types of congestion	G8.1_O: Fundamentals of traffic operations and control

ID	Program name and institution	Goal	Objectives	Course learning outcomes	Courses
	Engineering	ensuring security, economic prosperity and respect towards the environment.		• Apply control strategies in congested networks • Illustrate with simple examples the complexity of transport systems • Establish methodologies to model congestion	

Table 6.3: Specialized EU Transport Logistics and Business Programs

ID	Program name and institution	Goal	Objectives	Courses' learning outcome	Courses that support the learning outcome
S1	University of Newcastle (UK) MSc. Marine Transport with Management	This program is aimed at numerate graduates who wish to work in the international shipping, logistics and port industries. It provides students with knowledge and skills relating to: shipping markets; shipping management; logistics and supply chain management; shipping investment analysis; risk management; and marine transport business.	NA	• Understand the Marine Transport market and the role of the marine technologists in it. • To provide students with embedded knowledge and understanding of the key elements of marine liability and law; • To understand the technical and economic factors which influence the efficient operation of freight shipping. • To give students a thorough knowledge of the shipping industry, its structure, the nature of ship owners and the practical issues facing the industry. • To help students understand the linkages between global trade, logistics and maritime transport	S1.1_L: Maritime transport business S1.2_C: Maritime liability insurance and law S1.3_E: Maritime transport economics S1.4_L: Shipping market analysis and risk management S1.5_L: Maritime logistics and ports
S2	Westminster University (UK) MSc. Logistics and Supply Chain Management	The aim of the programme is to develop to graduates an ability to initiate and carry out advanced analysis, research and problem solving in the field of logistics and supply chain management.	• Comprehend the increasingly global nature of the logistics sector, and the impacts of this on specific companies and supply chains • Understand fundamental theories and principles applicable to logistics analysis, planning and management. • Become familiar with the different roles played by	• Be aware of the components of the logistics system and how they interact with each other to influence the design and operation of supply chains • To provide the context for sustainable supply chains, examining the business and public policy reasons for attempting to address sustainability issues, and examining how sustainability impacts are measured, monitored and reported. • To focus on the freight transport	S2.1_L: Logistics management and planning S2.2_N: Sustainability and freight transport S2.3_O: Commercial distribution of fast moving goods S2.4: Freight transport and logistics services S2.5_O: Airport planning and management

ID	Program name and institution	Goal	Objectives	Courses' learning outcome	Courses that support the learning outcome
			logistics service providers, retailers and manufacturers in the supply chain, and understand how their respective roles influence decisions taken within distribution channels • Become aware of changes in public policies and the way these influence the options and decisions for logistics managers • Appreciate the way environmental, social and behavioural factors influence and constrain logistics activities and strategies	element of supply chain management, looking at the strategic, operational and public policy perspectives. • To evaluate economic principles in terms of costs and revenues, and assess the changing demands for new services. • To assess airport economics and performance, and discuss aeronautical and non-aeronautical revenues. To examine airport operations and capacity issues, terminal operations and airport marketing, airport expansion issues, and the role of regional airports. • To give an understanding of issues involved in planning and operation of public passenger transport systems.	S2.6_O: Public passenger transport
S3	Delft University (Netherlands) Transport, Infrastructure and Logistics	The programme aims to provide graduates with broad knowledge and understanding of all phases of the life cycle of transport and logistics systems: from transport policy making and spatial planning; through the design of transport systems, supply chains and infrastructure networks; to the operation, management and control of these systems.	Graduates have the capability to design new road, rail, air and water transportation services for passengers and/or freight; to efficiently manage transportation networks; and to design and control complex supply chains. In addition to providing an understanding of the complex decision-making processes during infrastructure development and planning, the programme provides	• Recognize importance of transport systems and logistics in society, in particular in supply chains and in production systems. • Analyse processes at a transfer point (terminal, warehouse) and to decide on number of equipment and handling capacity needed to handle transport flows; • Identify and describe the main components of transportation and land use models; • Set-up and perform a systematic modelling analysis to assess a transportation system and solution strategies;	S3.1_L: Introduction Transport and Logistic Engineering S3.2_M: Transportation and Spatial Modelling S3.3_D: Assessment of transport infrastructure and systems S3.4_P: Transport and spatial planning for urbanized regions S3.5_C: Transport Policy S3.6_D: Planning and

ID	Program name and institution	Goal	Objectives	Courses' learning outcome	Courses that support the learning outcome
			graduates with the interdisciplinary knowledge to make appropriate decisions for clients, employers and society.	• Be familiar with a framework to analyse the transport systems and spatial structures in urbanized regions; • Explain the most important characteristics of the airline industry; identify the main strategic and operational aspects of airline; • Getting knowledge in the function of strategic, tactical and real-time operations of public transport • Application of operations research models to railway timetabling and real-time railway traffic management • To understand the functioning of the logistics sub-systems and their interrelations with other sub-systems • Analysing and understanding the dynamic behaviour of multi modal chains • Insight in logistic chains and logistics chain decisions	Design of Multi-Modal Infrastructure Networks S3.7_P: Airline planning & optimization S3.8_D: Design and control of public transport systems S3.9_O: Railway traffic management S3.10_D: Transport, routing and scheduling S3.11_M: Freight transportation systems: Analysis and modelling S3.12_L: Supply chain analysis and engineering S3.13_L: Design and management of multi-modal logistic chains
S4	Antwerpen University (Belgium) Advanced Master in Maritime and Air Transport Economics	It aims to enable people in the transport sector to upgrade their knowledge and abilities through state-of-the-art specialist courses, combined with general management training. Choosing one of the two majors (air transport or maritime economics), students tailor their programme to their specific interests and backgrounds.	The main objective of the programme is to help executive staff members from transport-related companies and organizations (shipping companies, port authorities, terminal operators, airlines, airports etc.) to become top-notch executives.	• To critically assess developments in transport companies and policy areas and judge their impact on the transport sector. • To become aware of the different actors playing a part in Airport Management and their underlying relationships • To gain a deeper understanding of the maritime supply chain- related decision problems and comprehend the relevant theories and methods, best practices and emerging innovative techniques to design	S4.1_E: Transport business economics and policy S4.2_O: Airport management S4.3_M: Maritime supply chains S4.4_M: Technology and innovation

ID	Program name and institution	Goal	Objectives	Courses' learning outcome	Courses that support the learning outcome
				supply chain processes • To get insight in the way innovation processes are working; a view on the different types of settings in which different types of innovation can be applied.	
S5	Antwerpen University (Belgium) Transport and Logistics Management	The main objective of this programme is to provide participants with state-of-the-art know-how and know-who in the field of transport, logistics and the maritime industry and to enable each participant to apply and master the business skills offered in the various courses.	To enable students to master and apply the business skills offered in various courses.	• Conceptualise transport problems in economic terms • Critically evaluate transport policies and programs • To be capable of applying core POM skills and understand how they contribute to improved operations and supply chain management. • Be able to explain how concepts in transport logistics and their supporting technologies (ICT) apply to small case studies. • To understand key methods for supporting supply chain decision making • To understand which key managerial levers are available for improving supply chain profitability • Understand how to design, manage and control the movement and storage of materials within the warehouse. • Offers a thorough grasp of different aspects of container and RO/RO terminal activities, the various factors that determine demand for services	S5.1_M: Logistics strategy S5.2_O: Production and operations management S5.3_L: Transport and logistics information systems S5.4_L: Supply chain management tools S5.5_L: Warehouse and hinterland distribution management S5.6_E: Port economics and management S5.7_O: Terminal management S5.8_E: Transport economics and policy
S6	University de Oviado (Spain) MSc. Port	NA	NA	NA	S6.1_P: Shipping S6.2_C: International commerce

ID	Program name and institution	Goal	Objectives	Courses' learning outcome	Courses that support the learning outcome
	Management, Planning & Intermodal Transport				S6.3_E: Port economy S6.4_E: Planning the economic regime of Port Authorities S6.5_L: Sectorial logistics S6.6_E: Economic evaluation of port infrastructures S6.7_L: Planning logistic activities S6.8_L: Logistics associated with specific traffic port terminals S6.9_L: Logistic operators S6.10_P: Port services S6.11_O: Port operations S6.12_N: Sustainability, safety and environment S6.13_L: Globalization and logistics chain
S7	University of the Aegean (Greece) MSc. Shipping, Trade and Transport	The programme aims to generate and transfer knowledge, know-how methodologies, functional tools and research conclusions in the field of shipping, transport and trade. The postgraduate study programme aspires to contribute a new generation of modern and competitive scientists and it is geared towards postgraduate specialization in managing	• Have a deep understanding of the special characteristics of shipping • Master the nature and structure of the various maritime markets • Understand the nature of endogenous and exogenous factors affecting shipping	• Analyse the function of economic mechanisms affecting freight rate levels • Distinguish between different charting and investment strategies under different market conditions • Understand the needs for safe management and the consequences of the lack of electronic systems, • Appreciate transport policy-making in cities with different characteristics • Analysing, planning and evaluating the performance of "door-to-door" transport chains and logistics channels	S7.1_E: Maritime economics S7.2_M: Information and communication technology (ICT) systems for shipping trade and transport S7.3_C: Transport and the city S7.4_O: Integrated transport systems S7.5_C: European port policy S7.6_P: Urban and regional

ID	Program name and institution	Goal	Objectives	Courses' learning outcome	Courses that support the learning outcome
		business institutions and organizations.		• To know the structure and the decision making process from the EU to know the major European port Policies • To provide the basis for the study and critical analysis of the issues related to passenger and freight transport. • To be aware of the effects of shipping on the environment.	development in practice S7.7_N: Maritime environmental management
S8	Aristotle University of Thessaloniki MSc. Planning, Organization and Management of Transport Systems	To provide a high level educational program in the domain of transportation To cover requirements of higher level engineers in Greece	To offer knowledge on analysing transportation systems, covering all modes of transport, from planning, design, to operation, maintenance and exploitation	• To familiarize with European and national transportation policies • To estimate transportation demand and define requirements for capacity provision • To solve optimization problems in the domain of transportation	S8.1_C: Transport policy S8.2_O: Organisation and management of traffic and parking systems S8.3_O: Organization and management of freight transport S8.4_O: Planning and management of railway transport S8.5_E: Elements of transport economics - Evaluation of transport projects and transport systems S8.6_M: System Analysis-Advanced transportation demand Models S8.7_O: Organization and management of urban public transport systems S8.8_O: Organization and management of air transport and airports S8.9_O: Organization and

ID	Program name and institution	Goal	Objectives	Courses' learning outcome	Courses that support the learning outcome
					management of maritime transport
S9	University of Thessaly MSc. Transport planning and management	The aim of the program is to provide knowledge on management of transportation programs and cover the gap that exists in the national educational institutes in this domain.	• To provide detailed knowledge on Project Management techniques, governance, planning, financing of transportation projects • To explain the role of freight and logistics through systematic analysis, and agent-based modeling • To acquire knowledge on ITS and ICT and familiarity with smart transportation solutions • To explain in depth urban planning concepts • To provide training on implementing statistics for analysing transportation systems and assessing performance	• To identify the role of project management and the parameters affecting its performance • To plan and organize technical projects applying advanced methods, considering risks and uncertainty • To design transportation projects taking into account urban planning and regional development principles and plans • To optimize resources and performance of transportation projects • To forecast, assess impacts and evaluate alternative scenarios • To identify the optimum and feasible smart solutions for increasing interoperability and sustainability of transportation projects • To gain knowledge on legal and institutional aspects in the domain of transportation in EU and Greece • To understand concepts related to the operation of freight transport and logistics, the legal and regulatory framework, the organization and roles of stakeholders	S9.1_L: Project management S9.2_L: Freight transport and logistics S9.3_P: Project appraisal
S10	University of Magdeburg (Germany) MSc. Logistics	The program serves Logistics which is getting internationally a more and more recognized science discipline. In particular the program focuses on: • Virtual technologies for	• To acquire a broad, detailed and critical understanding and knowledge of logistics and material flow technologies. • To acquire the ability to	• To obtain knowledge about basic understanding of information logistics and the selection , arrangement and application of IT systems; • Deepening knowledge about procedure for planning of logistics	S10.1_L: Information logistics S10.2_L: Planning of logistics systems S10.3_M: Modelling and simulation in logistics

ID	Program name and institution	Goal	Objectives	Courses' learning outcome	Courses that support the learning outcome
		analysing , planning and operation of complex logistics systems and networks • The development and application of special modelling and simulation methods as the mesoscopic simulation, • Future topics such as electro mobility, identification technologies, positioning, navigation and communication research. • Energy efficient and sustainable logistic systems and processes and intelligent, environmentally oriented material flow systems.	apply scientific methods and to know and to use innovative technologies independently • To familiarize themselves with the various tasks related to real applications, research and teaching in different activity areas;	systems • Deepening knowledge about procedure for planning of logistics systems • Typical decision situations in logistics planning, in which mathematical modelling and simulation can be effectively used	planning

6.4 Programs' courses presentation

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.

Based on course analysis, the share of each course category to the total number of courses is shown in Figure 6.2. Transport operations and logistics based courses have the highest share among all transport categories which supports to the relevance of the selected transport programs to the scope of ALLIANCE.

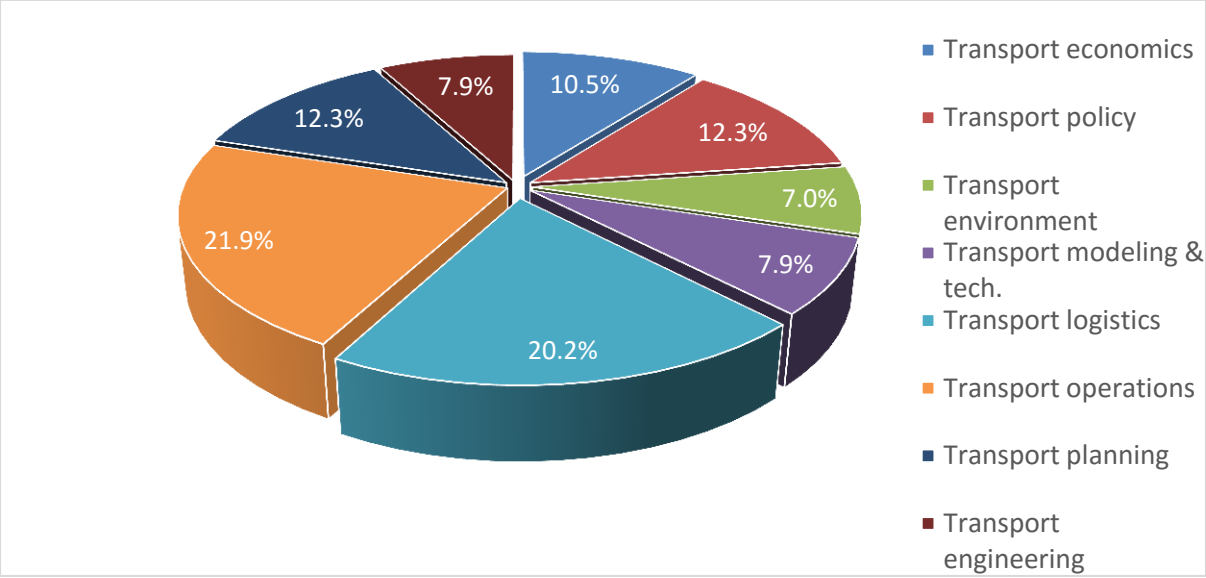

Figure 6.2: Course category share for selected transport programs

This section summarizes courses and learning outcomes, combining them with the respective programs' aims and objectives for each one of the eight transport categories for the EU region (Figures 6.3 to 6.10).

Transport courses include compulsory courses – modules that must be taken in order to fulfil the requirements of the degree transport programme – and optional courses which aim usually to fulfil requirements of a specific cluster in the program. The dominant courses per transport category are presented.

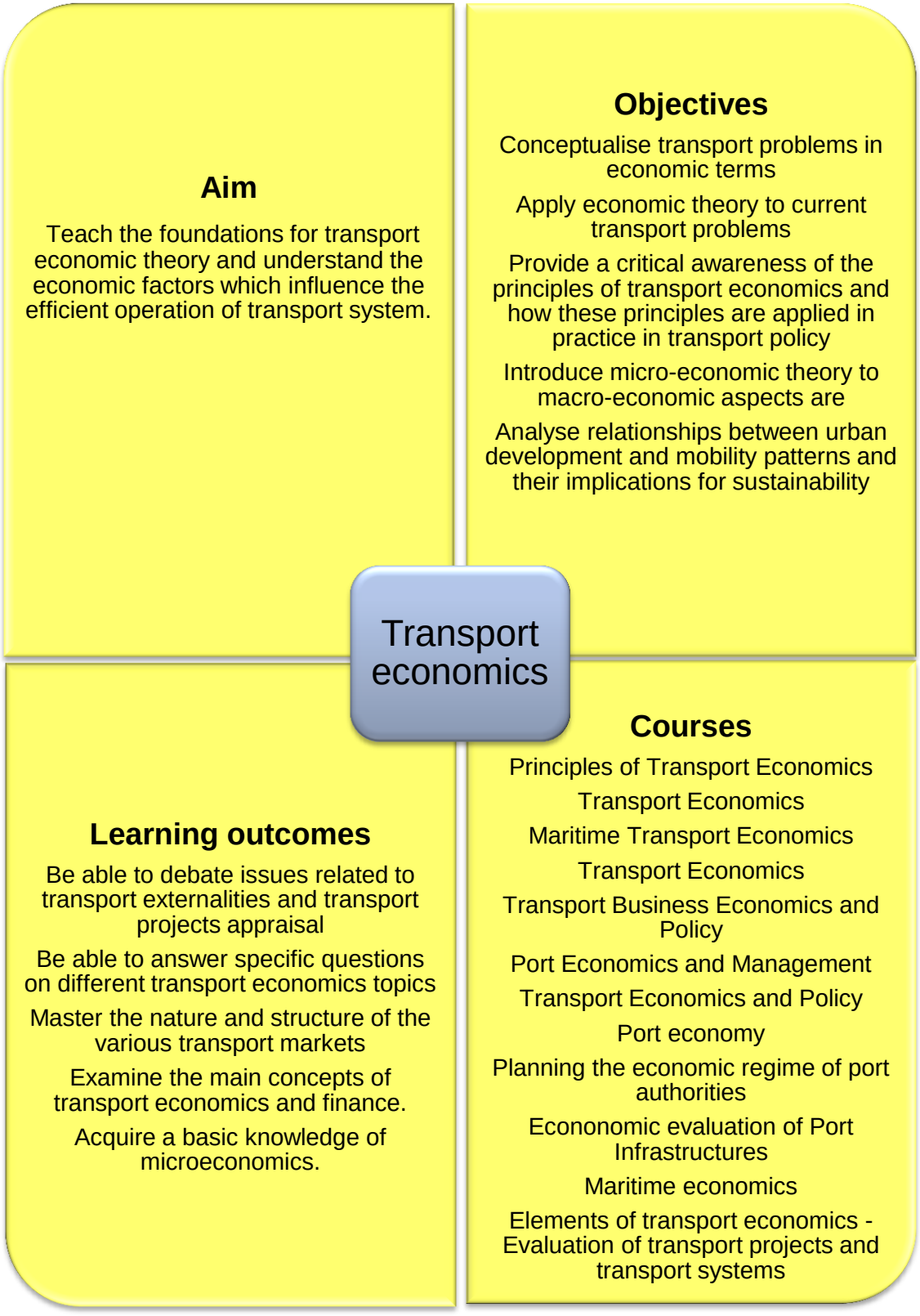

Figure 6.3: Summary of transport economics courses

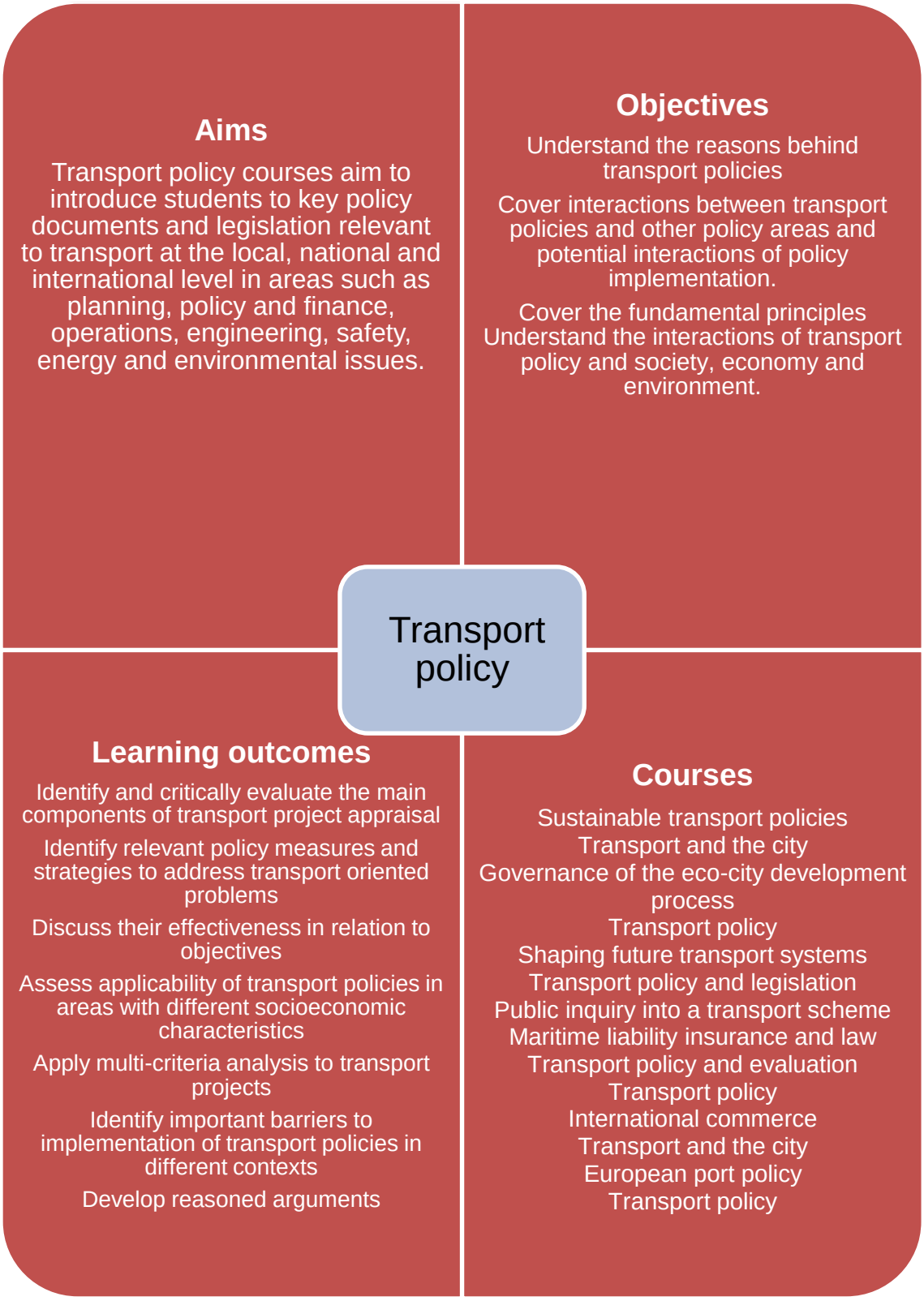

Figure 6.4: Summary of transport policy courses

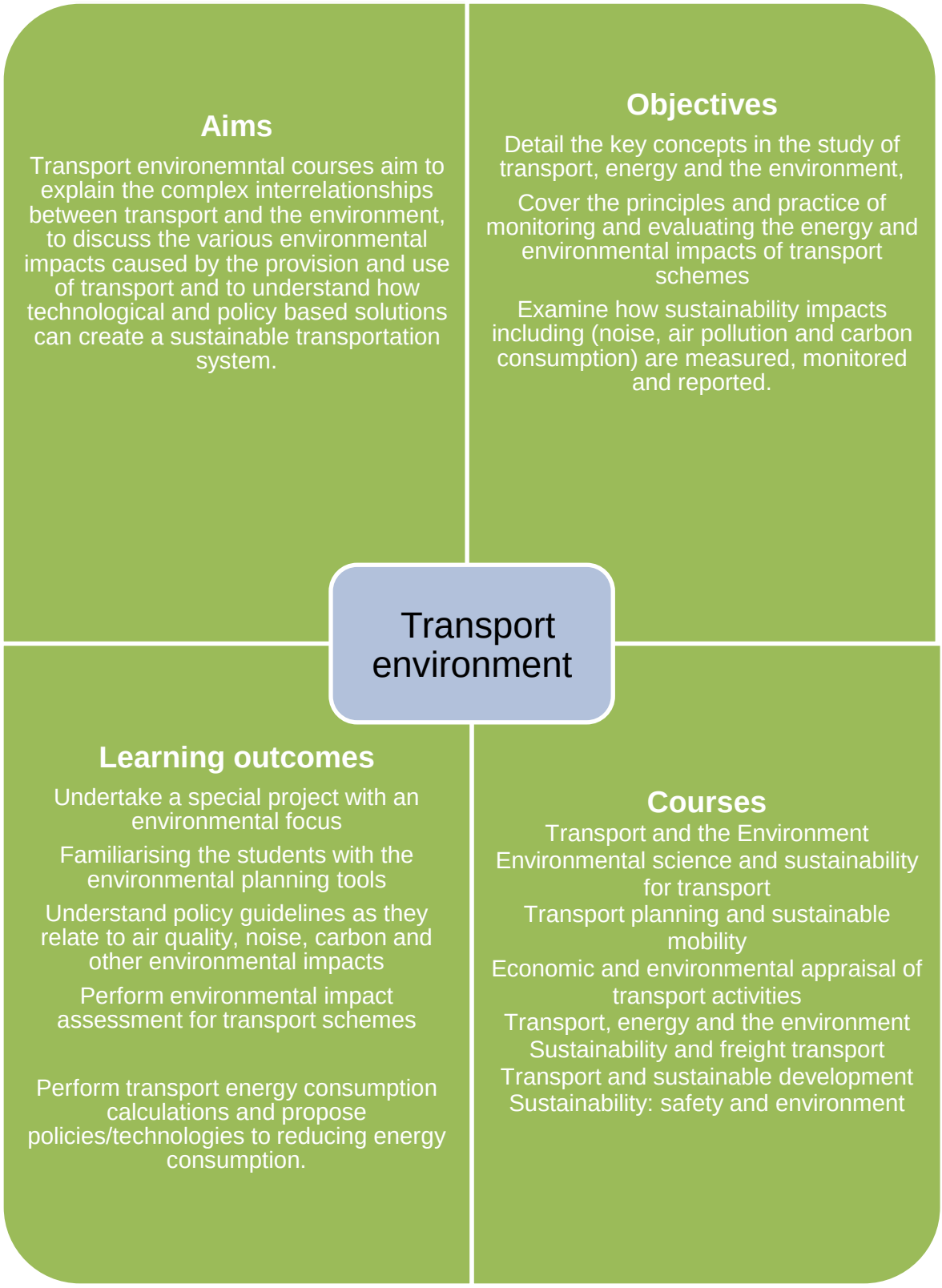

Figure 6.5: Summary of transport environment courses

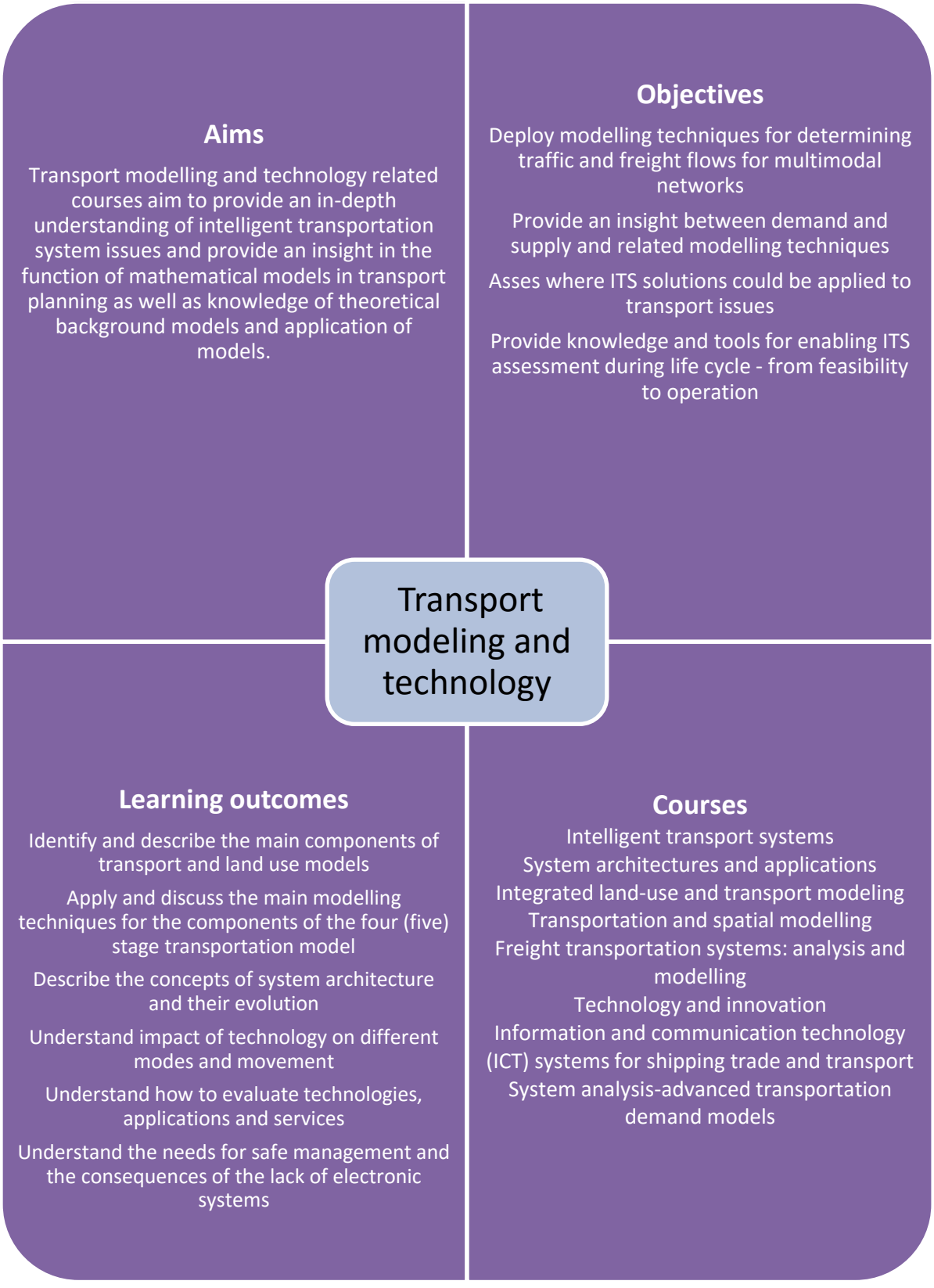

Figure 6.6: Summary of transport modelling and technology courses

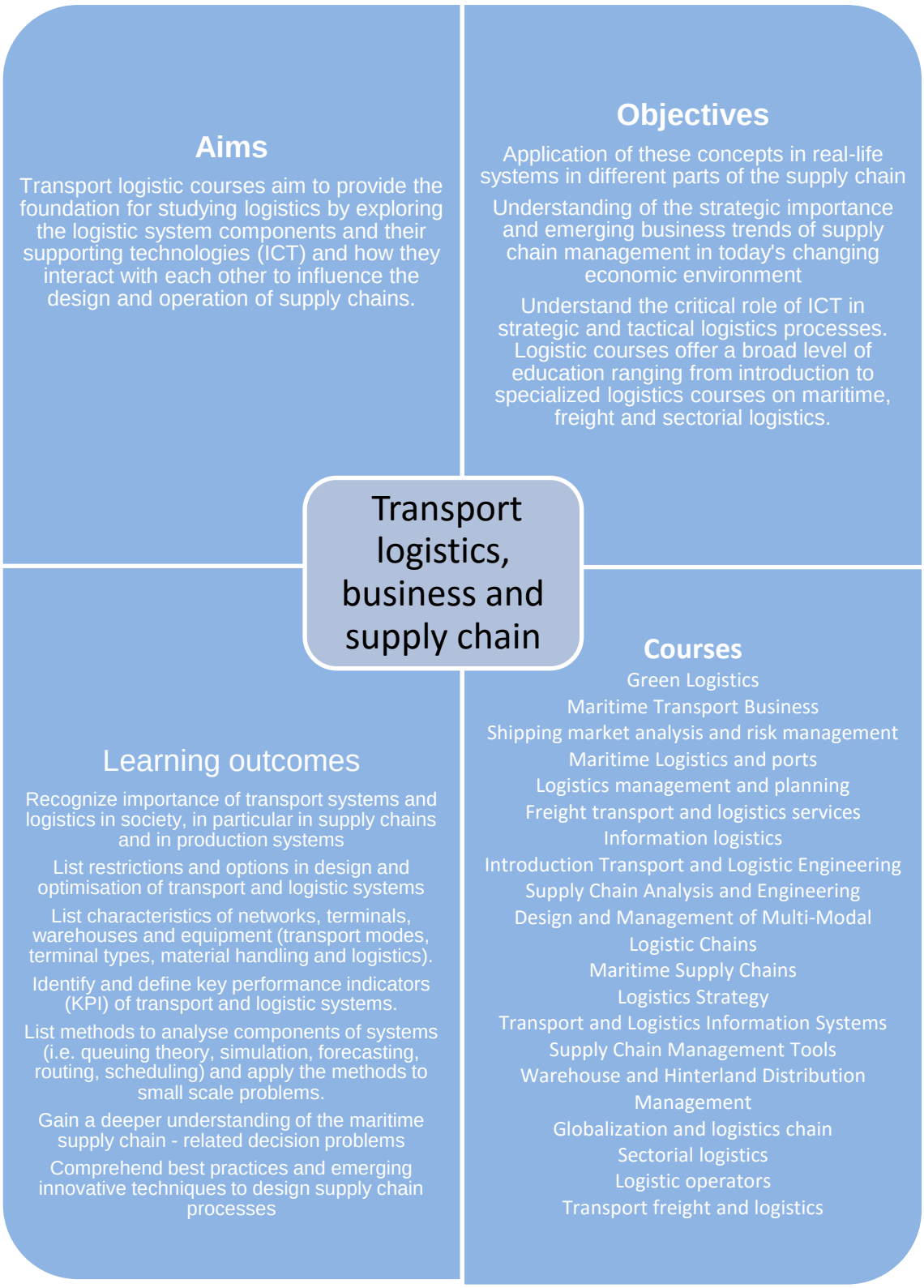

Figure 6.7: Summary of transport logistics, business and supply chain courses

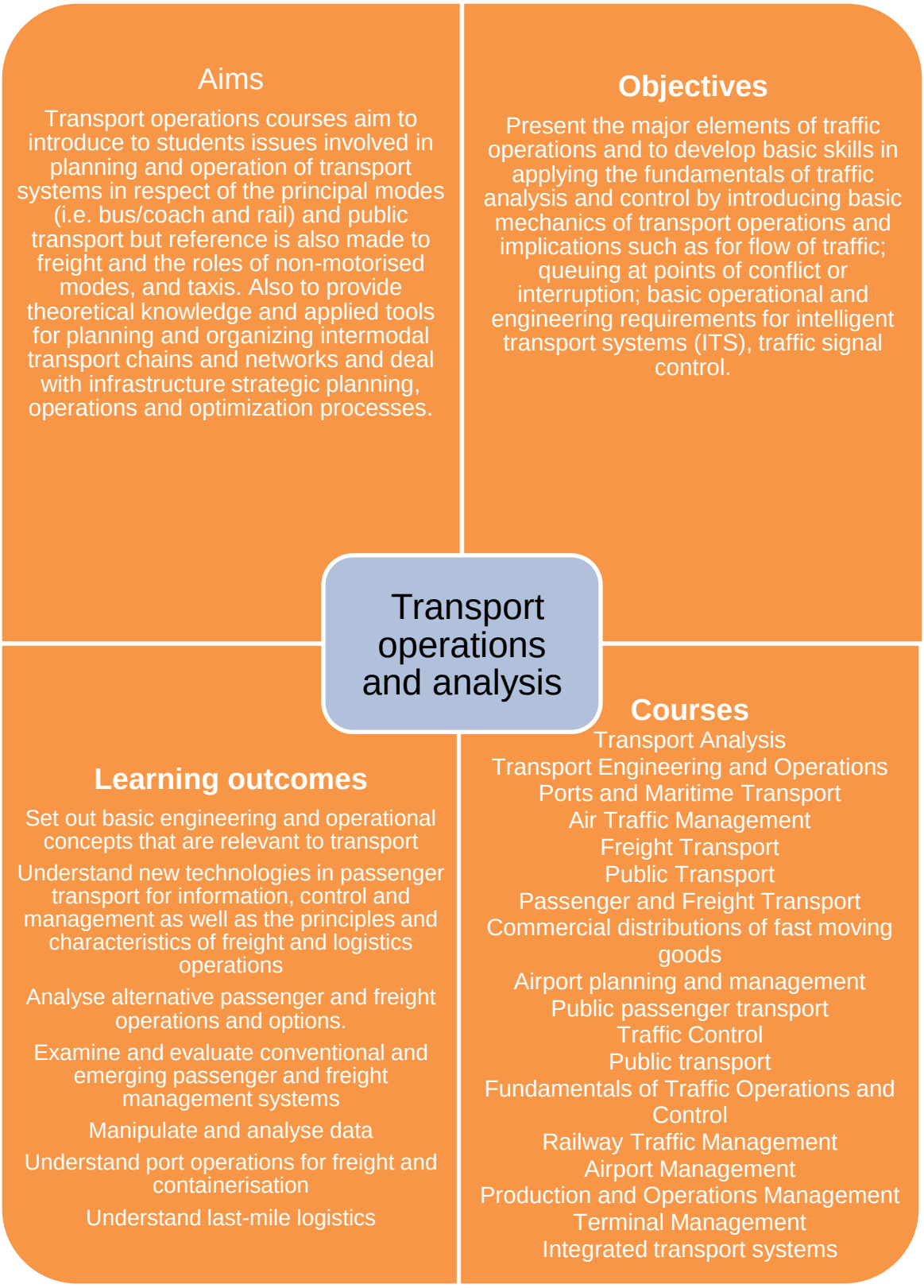

Figure 6.8: Summary of transport operations and analysis courses

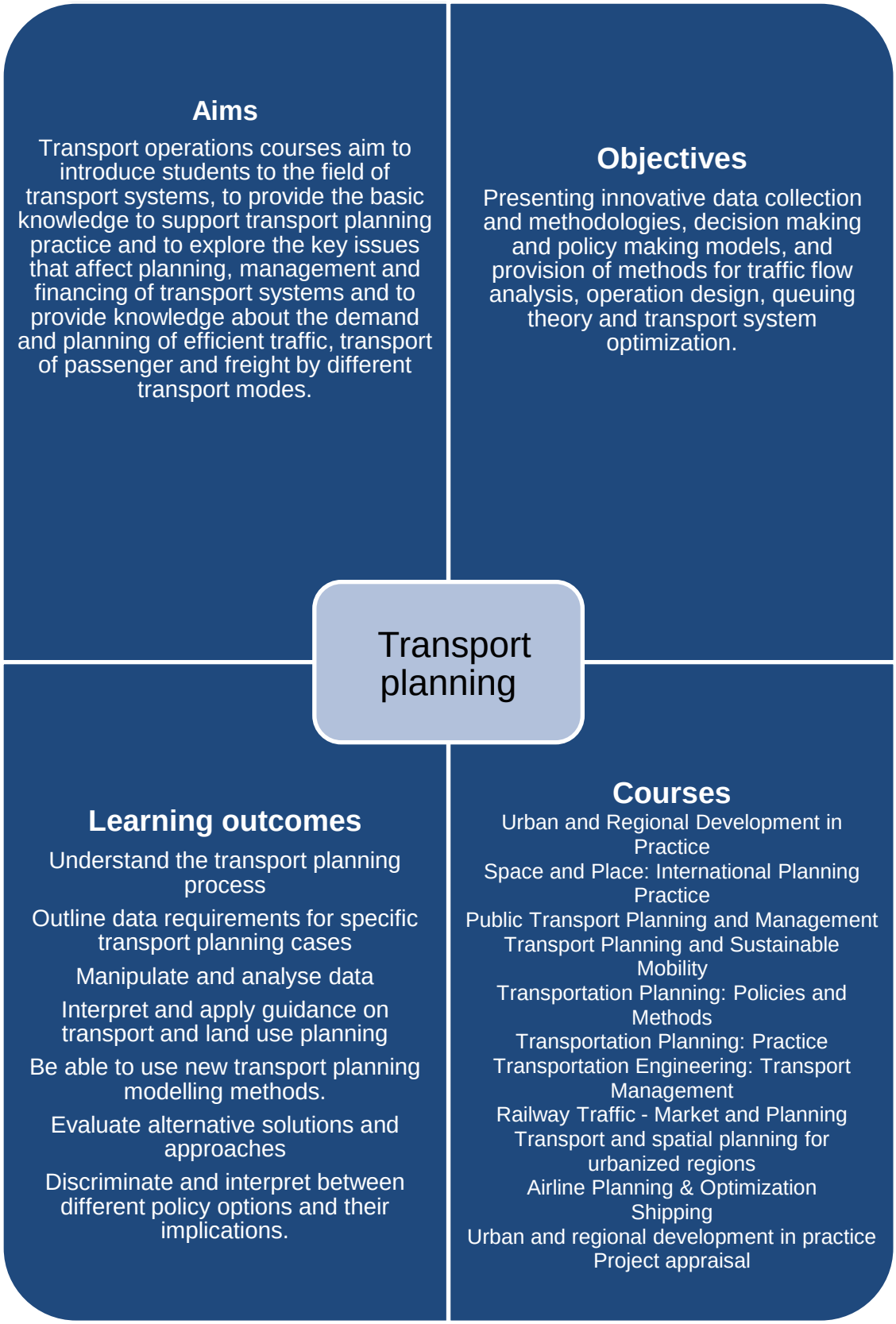

Figure 6.9: Summary of transport planning courses

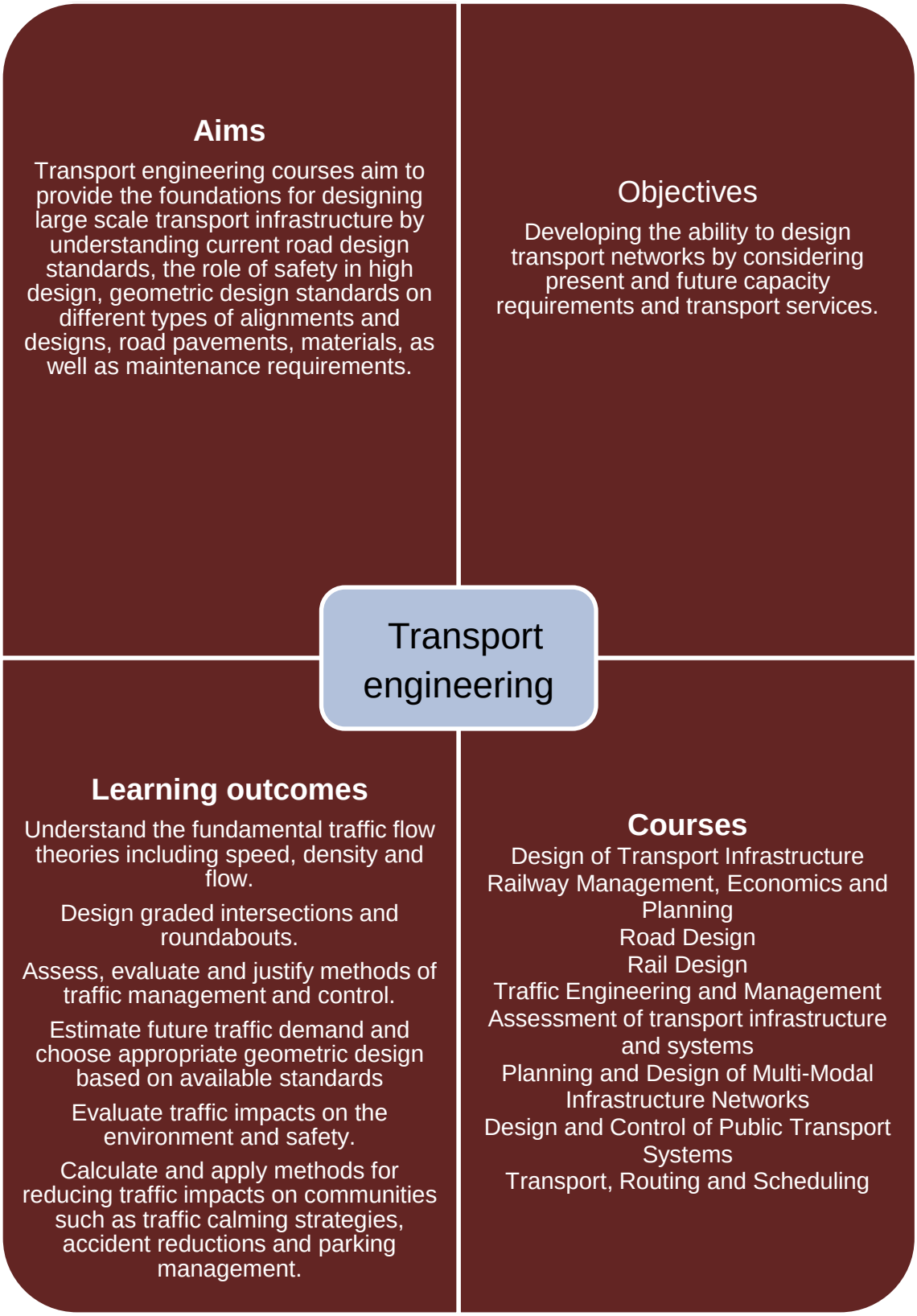

Figure 6.10: Summary of transport engineering courses

7 GAP analysis

7.1 Implementation of the selected method

The gap analysis that was developed in the scope of ALLIANCE project was implemented in two levels to determine the gaps that might exist; first, between the interconnecting networks in EU on one hand and the Latvia and the region, on the other; second, between the interconnecting networks in EU and the Latvia and the region (Gap analysis I) and the existing research, educational and training programs in Latvia and the region.

The input used is based on results and findings from previous chapters, related to interconnecting networks and research, educational and training programs in EU and Latvia and the region. The gap analysis for both the current interconnecting networks and the research, educational and training programs is performed with respect to three thematic areas: 1) Governance and policy, 2) Smart solutions, and 3) Decision-making.

Furthermore, consideration is given to the planned interconnecting transportation network of Latvia and the adjacent area, so that to validate the two level gap analysis findings. Finally, recommendations are deployed to provide the foundation for developing the educational program for Latvia and the region, which is task of the following deliverable D2.2.

7.2 GAP analysis I

7.2.1 Passenger interchanges

In Table 7.1, a summary of good practices met in European and Latvian and the region's interchanges is presented, grouped under the three thematic areas: governance and policy, smart solutions and decision-making. Each thematic area is further broken down into topics, as identified from the literature review. In some cases, reference to the specific interchanges is made, and the code used in the respective chapter is mentioned.

Table 7.1: Summary of practices for passenger interchanges

Thematic area	Topic	EU practices	Latvia and region – state of practice
Governance	Stakeholders	Clear identification of the roles and responsibilities of multiple stakeholders. Use of concession contracts for the organization of the station operation.	Roles and responsibilities clearly identified (e.g.PB3). Various types of participation available.
	Policy	When the municipality has clear roles and responsibilities, then it can lead the processes at an interchange and bring in funding sources, if needed. National and regional authorities make efforts to familiarize transport and terminal operators with relevant policies.	National/regional/local policies for strategic development exist. National and local authorities have interest in establishment of interchange terminals (e.g. PB5).
	Ownership	Pursuit of public/private model to	Limited involvement of private

Thematic area	Topic	EU practices	Latvia and region – state of practice
		ensure that the operations and management are co-ordinated across all the transport and other functions. Organizing the relationships between public and private according to the local context and functions of the interchange. Ownership separation from operation.	investors due to small market. Restriction on the use of the public-private partnership model by the government. Poor use of public-private partnerships.
	Sustainable development	Involvement of private sector and pursuit of private funding. Development plan for city integration.	Development plans include integration of transport sector at the municipality level, not enough emphasis on integration of transportation modes at the national level.
	Management	Development of Interchange Management Plan.	Fragmented existence of management plan; may not cover all aspects of functionalities. The cities and the government of Latvia are eager to better control their subsidies to public transports companies, and they need automatic passenger counter systems widely accepted across the country.
	Operation	Integrated coordination among transport operators and modes.	Poor operation integration among various operators at the state level.
Smart solutions	Information	Real time information: Pre-trip planning, electric departure time display, multilanguage information. Way finding plan: maps, floor plans, directional signals (WC, ticket booth, concise, clear, consistent and ambiguous information).	Smart solutions applied fragmentarily. Basic information is provided.
	Services	Integrating ticketing: ticket sale for all services in the interchange facility zone, definition of fare paid areas, staff presence, smart ticket readers. Safety: Design covering all emergency and security requirements (hand rails, anti-sleep flooring, and lighting), avoidance of conflicts between pedestrians and vehicles, emergency management plan amongst stakeholders, trained	Different ticketing systems developed for various modes of transport (e.g.PB1). Design in terms of safety does not correspond to today's requirements in cases of old passenger interchanges. Average level of security is provided.

Thematic area	Topic	EU practices	Latvia and region – state of practice
		staff, emergency exits. Security: Consultation of crime prevention specialists during the design phase, consideration of crime prevention through environmental design, good lighting, CCTV, trained key staff presence.	
	Physical properties	Appropriate design and layout of access/egress. Accessibility for all users. Environmental concerns and energy efficiency. Variety and high quality facilities.	Design and layout of access varies depending on facility's age. Energy efficiency is taken into account for new projects.
Decision-making	Interchange status assessment and users' feedback	Pursuit of public participation. Customer satisfaction surveys.	User feedback is used fragmentarily (e.g. PB2).

Then, Table 7.2 presents the gaps identified by the comparison between EU and Latvian and region's practices from Table 7.1, and formulates the requirements for encountering or dealing with these gaps.

Table 7.2: Identification of gaps/requirements for passenger interchanges

Thematic area	Topic	Gap I	Requirement
Governance	Stakeholders	-	-
	Policy	Legal framework does not focus on interchanges.	Harmonization of policies.
	Ownership	Limited involvement of several authorities.	Building incentives and opening opportunities for investors.
	Sustainable development	Limited incorporation of interchanges in urban and rural development plans.	Integrated development planning.
	Management	Interchange Management Plan not including all aspects of interchange functionalities and interests.	Enrichment of interchange Master Plan.
	Operation	Limited coordination among modes and operators at the regional and national levels.	Promoting operational integration.
Smart solutions	Information	Limited multimodal information at the regional and national levels.	Providing integrated information at the national level.
	Services	Limited integrating ticketing.	Policy development for

Thematic area	Topic	Gap I	Requirement
		Existing services do not offer travelers real-time information across all stages of a multimodal trip Possible conflicts between vehicles and pedestrians. Not sufficient security level.	integrated ticketing at the national level. Real–time information for support door-to-door trip on all stages of planning and implementation. To be more integrated with the help of the same technological platforms: ticket validation systems, based on rechargeable and contactless e-cards, and real-time information system for all modes of transport, either in panels at stops or stations, or via smart phone applications. Spatial separation of passengers' movement from movement of transportation means. Increasing monitoring, warning and presence of police and interchange staff.
	Physical properties	Limited access for all. Insufficient cycling and walking facilities. Environmental concerns vary depending on facilities' age.	Improving accessibility for all user groups providing more flexible and individualized service. Designing and implementing walking and cycling facilities. Development of energy efficiency plan.
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.	Enhancement of customers' satisfaction surveys. Public realm improvement scheme. Exploitation of BIG data opportunities.

7.2.2 Freight interchanges

Similarly to passenger interchanges, two respective tables (Table 7.3 and 7.4) have been developed for practices, gaps and requirements in freight interchanges.

Table 7.3 presents the summary of practices met in European and Latvian and the region's interchanges for each thematic area and topic. Where reference to the specific interchanges is made, the interchange code is used as presented in the respective chapter.

Table 7.4 presents the gaps and requirements for each of the topics for freight interchanges.

Table 7.3: Summary of practices for freight interchanges

Thematic area	Topic	EU practices	Latvia and region – state of practice
Governance	Stakeholders	Absence of clear identification of the roles and responsibilities of multiple stakeholders.	Roles and responsibilities clearly identified (e.g.PB4).
	Policy	Not harmonized policy.	National transport policies are in line with the EU transport policy. Fragmented focus on intermodality, in some cases effective integration of different modes of transport (e.g. FB5). Segmented policy on tariffs (for different transport modes).
	Ownership	Access to all companies to terminals under equal conditions of ownership.	Public and private ownership. Poor use of public-private partnerships.
	Sustainable development	Involvement of private sector and pursuit of private funding.	Sustainable development is foreseen in strategic plans (e.g.FB2).
	Management	Development of Master Plan.	Master Plan exists for each freight terminal.
	Operation	Integrated coordination among transport operators and modes.	Provision of high-level productivity, fast and reliable services (e.g.FB2). Effective integration of different transport modes (e.g.FB5).
Smart solutions	New consolidation/distribution and logistics cooperative concepts	Establishment of urban consolidation centers. Business and transport operational plan.	Consolidated distribution centers continue to develop (e.g. FB4).
	Information technologies	Use of Information and Communication Technologies for developing Truck Management Systems and Warehouse Management Systems.	IT systems introduced and used for supply-chain management, trip planning and fleet management, e.g. in FB4, high standard technologies in FB2.
	Smart transshipment	Use of equipment for loading-unloading operations and movements within the interchange facilities.	Use of equipment for loading-unloading operations and movements. Fragmented use of energy effective and environmentally friendly equipment.

Thematic area	Topic	EU practices	Latvia and region – state of practice
Decision-making	Decision-support methods	Agent-based modeling approach and multi-stakeholder multi-criteria analysis.	Several decision support tools used such as environmental impact assessment, traffic forecasting, economic analysis and risk assessment (e.g. FB1). Fragmented data collection and analysis.

Table 7.4: Identification of gaps/requirements for freight interchanges

Thematic area	Topic	Gap I	Requirement
Governance	Stakeholders	-	-
	Policy	Not harmonized policy for interchanges.	Harmonization of policies.
	Ownership	Limited business models development.	Development of business models for different ownership schemes.
	Sustainable development	Limited incorporation of interchanges in regional and national development plans.	Integrated development planning.
	Management	-	Enhancing administrative and cooperative schemes between public and private sector.
	Operation	-	Enhance administrative and cooperative schemes between public and private sector.
Smart solutions	New consolidation/distribution and logistics cooperative concepts	Individually planned urban consolidation centers. Limited business and transport operational planning.	Development of a rational strategic plan of urban consolidation/distribution centers taking into account market demand. Establishment of coherent cooperative logistics schemes.
	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.	Promotion of cooperative logistics solutions and other smart solutions.
	Smart transshipment	Limited use of alternative, friendly to environment and energy equipment.	Application of alternative fuels and propulsion technologies.

Thematic area	Topic	Gap I	Requirement
Decision-making	Decision-support methods	Limited sharing of data.	Exploitation of BIG data opportunities.

7.3 GAP analysis II

Results of the first level gap analysis were combined with existing research, educational and training transport programs in Latvia and the region to identify potential gaps in the aims and content offered by these educational programs as compared with practice requirements. To perform the gap analysis, the courses as part of the transport educational programs in Latvia and the region, were grouped in the following three thematic areas:

1. Governance and policy development (52%)
2. Smart solutions (13%)
3. Decision making framework (52%)

Additionally to facilitate data processing, Latvian courses were grouped in the same eight categories as the EU transport programs, which were presented in chapter 6:

- Transport economics (4%)
- Transport policy (8%)
- Transport environment (1%)
- Transport modelling and technology (15%)
- Transport logistics and business (17%)
- Transport operations (19%)
- Transport planning (19%)
- Transport engineering (17%)

All 159 courses in the sample of research, educational and training transport programs for Latvia and the region are summarized per course category and thematic area in Table 7.5.

Table 7.5: Summary of selected transport courses in Latvia and the region

Course category	Course	Code	Thematic areas		
			Governance and policy development	Smart solutions	Decision making
Transport economics	Transport Economics	LV3.1	X		
	Economics of Transport Enterprises	LV4.5	X		X
	Economic and Financial Analyse of International Carrier	LV5.3	X		X
	Transport Risks and Insurance	LV5.4			X
	Economics of Transport Service	LT8.6	X		X
	Transport Economics	LT10.7	X		
	Optimization of transport costs	PL17.8			X
Transport policy	Transport Policy of the EU and LR	LV3.6	X		
	Transport Systems	LV4.1	X		
	System and analysis concepts	LT7.1	X		X
	Lithuanian transport system	LT7.6	X		
	Multimodal transport International maritime organizations	LT7.9	X		
	Transport Policy and Innovations	LT8.4	X	X	
	Regulation of Urban Planning and Democracy	LT9.4	X		
	Transport Policy and Innovations	LT10.1	X	X	
	Traffic safety legal regulation	LT10.4	X		
	Legal Regulation of Urban Planning and Construction	LT11.1	X		
	Traffic Safety Legal Regulations	LT13.4	X		
	Engineering Traffic Safety Measures and Their Evaluation	LT13.5			X
Transport environment	Sustainable Development of the City	LT9.6	X		
	Sustainable Development of Territory	LT15.1	X		X
Transport modeling & technology	Modelling and Simulation in Logistics	LV2.1	X	X	X
	Simulation Modelling in Transport and Logistics	LV3.4	X	X	
	Modelling of Transport Processes	LV4.2	X	X	X
	Global Logistics	LV4.4	X	X	
	Modelling of Transport Processes	LV5.2	X	X	X
	Intelligent transport systems	LT7.7	X	X	
	Mathematical Simulation of Transport Systems	LT8.5	X	X	X
	Urban Engineering Information Systems	LT9.3	X	X	
	Using GIS for Planning and Modeling	LT9.7		X	X

Course category	Course	Code	Thematic areas		
			Governance and policy development	Smart solutions	Decision making
	GIS Based Computer Designing	LT9.10		X	X
	Road Information Systems	LT11.7	X	X	
	Geographic Information Systems	LT11.8	X	X	
	Road Integrated Research	LT11.9		X	X
	Urban Information Systems	LT11.16	X	X	
	Using GIS for Planning and Modeling	LT11.26		X	X
	Traffic Safety Information Systems	LT13.9	X	X	
	Modeling of Transport Flows	LT13.13	X	X	X
	Computer Urban Analysis (of GIS Base)	L16.3	X	X	X
	Computer systems in transport	PL17.4		X	
	Geographical Information Systems (GIS)	LV18.1	X	X	
	Traffic Management and Modelling	LV19.2		X	X
	Intellectual Technologies and Systems	LV19.3		X	
	Computer-aided Management systems	LV19.5		X	X
Transport logistics	Logistics and Transport Systems	LV1.1:	X		X
	Multimodal and Intermodal Transportation	LV1.2	X		X
	Supply Chain Network Management Technologies	LV2.3		X	X
	Global Markets and Supply Chains	LV2.4	X		X
	Logistics and Supply Chain Management European Dimension	LV2.5	X		X
	Decision Synthesis Principles and Practice in Logistics	LV2.6			X
	Logistics Systems and Logistics Chains	LV3.3	X		X
	Risk Management in Supply Chains	LV3.5			X
	Global Logistics	LV5.1	X		
	Transport Logistics	LV5.5	X		
	Warehouse and Inventory Management	LT8.2			X
	Reverse Logistics	LT8.7			X
	Strategic Supply Chain Management	LT8.8	X		X
	Resource and Operation Management in Logistics	LT8.9			X
	Management of the Logistics System Structural Units	LT10.8			X
	Logistics management	PL17.2			X
	Design of processes and logistics systems	PL17.3			X
	Management of logistics project	PL17.5			X
	Logistics controlling	PL17.6			X
	International logistics	PL17.7	X		

Course category	Course	Code	Thematic areas		
			Governance and policy development	Smart solutions	Decision making
	Models and algorithms for logistics	PL17.10		X	X
	Logistics planning	PL17.11	X		X
	Optimization of logistics processes	PL17.12			X
	Transport Management and Logistics	LV19.1			X
	Logistics	LV19.4	X		
	Warehouse Management	LV19.6			X
Transport operations	Transport Systems Functioning	LV1.3			X
	Materials Handling and Transportation Technologies	LV2.2			X
	Management of Transport Systems	LV4.3			X
	Organisation of Transport Production	LV4.6			X
	Commercial Management of Transport Systems	LV4.7			X
	Risk Management of Transport Systems	LV4.8			X
	Management of Transport Enterprises	LV5.6			X
	Sea and land transport interaction	LT7.3	X		X
	Sea transport managing systems	LT7.4			X
	European water transport system	LT7.5	X		
	Intermodal transports and Ro-Ro shipping	LT7.8	X		
	Transportation Services of International Trade	LT8.1	X		X
	Transportation Infrastructure	LT9.1	X		X
	Road Traffic Organization and Control	LT10.2		X	X
	Road Vehicle Safety	LT10.3		X	X
	Interaction Between Transport System Elements	LT10.9	X		X
	Tests and Expertise of Transport Technological Systems	LT10.10		X	X
	Urban Transport Systems	LT11.11	X		X
	Railway Management	LT11.15			X
	Urban Public Transport	LT11.17	X		X
	Train Traffic Organization and Traffic Safety	LT11.19		X	X
	Mobility Management	LT11.23	X		X
	Management of Urban Development	LT11.25	X		X
	System of Traffic Safety on Roads and Streets	LT13.1		X	X
	Traffic Safety Management	LT13.2			X
	Vehicle Dynamics and Traffic Accident Expertise	LT13.3			X

Course category	Course	Code	Thematic areas		
			Governance and policy development	Smart solutions	Decision making
	Urban Transport System	LT13.8	X		
	Road Safety Audit and Management	LT13.10			X
	Traffic Safety Management	LT14.2			X
	Transport management	PL17.1			X
Transport planning	Geography of Transport Systems	LV3.2	X		
	Urban Strategies	EE6.1	X		X
	Spatial Strategies	EE6.2	X		X
	Quality Management Systems in Transport	LT8.3			X
	Urban Infrastructure	LT9.2	X		
	Urban Planning Theory and Methodology	LT9.5	X		X
	Architecture of Urban Landscape	LT9.8	X		
	Expertise of Road Accidents	LT10.11			X
	Total Quality Management in Transport System	LT10.12			X
	Road Building Quality	LT11.6			X
	Railway Modernization	LT11.10		X	X
	Theory of Traffic Flow	LT11.12	X		
	Theory of Territorial Planning	LT11.13	X		
	Systemic Analysis of Roads	LT11.20			X
	Planning of Transportation Infrastructure	LT11.24	X		X
	Road and Street Network Planning	LT13.6	X		X
	Country and Cities Planning	LT13.12	X		X
	Road Integrated Research	LT14.1		X	X
	Road and Streets Network Planning	LT14.9	X		
	Land Use Planning	LT14.10	X		
	Analysis of Architectural and Urban Structures	LT16.1			X
	Principles of Urban Design	LT16.2	X		
	City Urban Structure: Planned and Spatial Development	LT16.4			X
	Urban Complex in Redeveloped Town Environment	LT16.5	X		
	Composition of Urbanizes Landscape	LT16.6	X		
	City Urban Structure: the Reconstruction of the City Central Part	LT16.7	X		
	Spatial and Volume Concept of Urban Complex	LT16.8	X		
	Planning of Technical Infrastructure	LV18.2			X
	Planning of Spatial Development	LV18.3			X

Course category	Course	Code	Thematic areas		
			Governance and policy development	Smart solutions	Decision making
Transport engineering	Transport system components	LT7.2	X		
	Urban Engineering Network	LT9.9	X		
	Road Building Engineering	LT10.5	X		
	Integrated Transport Systems	LT10.6	X		
	Theory of Railway Construction	LT11.2	X		
	Urban Infrastructure	LT11.3	X		
	Modern Roads Technologies	LT11.5	X	X	
	Theory of Road Maintenance	LT11.14	X		
	Design of Railway Station	LT11.21			X
	Theory of Road Maintenance	LT11.22	X		
	Reinforced concrete bridge design, evaluation of the archaeological and climatological factors	LT12.1			X
	Timber and Polymeric Bridges	LT12.2	X		
	Composite bridge decks	LT12.3	X		
	Computer aided design of bridges and special structures	LT12.4		X	X
	Steel fiber reinforced concrete bridge structures	LT12.5			X
	Innovative Steel Bridge Structures	LT12.6			X
	Modern Road Design Methods	LT13.7			X
	Theory of Road Maintenance Management	LT13.11	X		
	Steel-concrete Composite Bridge	LT14.3			X
	Computer Aided Design of Bridges	LT14.4		X	X
	Dimensional Road Design Reinforced Concrete Bridges	LT14.5			X
	Risk and safety in bridge engineering	LT14.6			X
	Innovative Timber and Reinforced Concrete Bridges	LT14.7			X
	Durability of Bridge Structures	LT14.8	X		
	Reliability and maintenance	PL17.9	X		
	Transport Engineering Service	LV19.7	X		X
	Auto transport and environment	LV19.8	X		

The educational coverage per thematic area that is provided by the eight transport categories is presented in Figure 7.1.

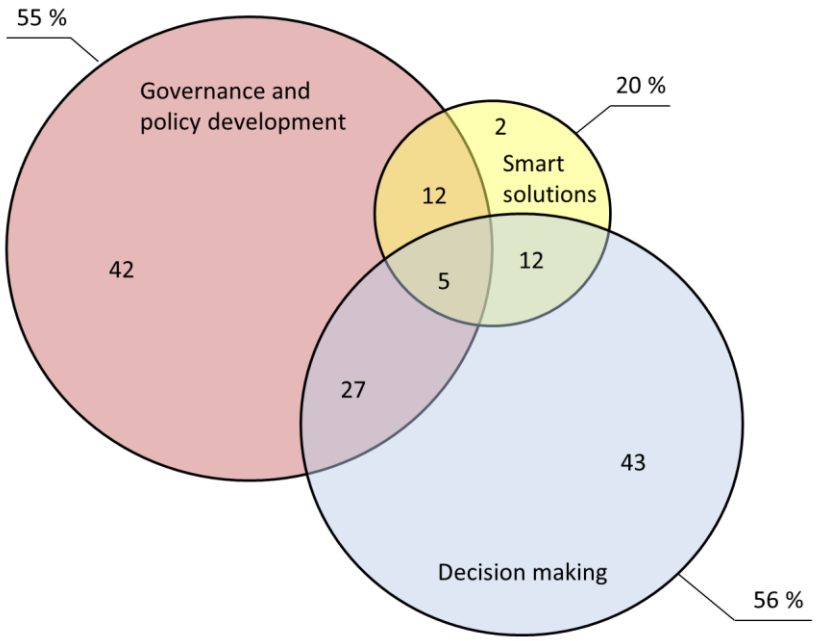

Figure 7.1: Transport course categories share per thematic area

Table 7.6 converts the gaps identified in gap analysis I both for passenger and freight interchanges, into educational requirements, whilst Figure 7.1 assesses the degree of coverage by existing courses. The requirements in Table 7.6 are the outcome of gap analysis II.

Table 7.6: Educational requirements for Latvia and the region (GAP analysis II)

Topic		Gap I	Requirement
Governance	Stakeholders	-	Incorporation of organizational and business models in course material.
	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.
		Not harmonized policy for interchanges.	**Improvement of course content on transport legal frameworks with reference to EU, freight transport and environmental legislation**
	Ownership	Limited involvement of several authorities.	Incorporation of courses oriented on public private

Topic		Gap I	Requirement
			partnerships (PPP) models and mega infrastructure financing schemes in educational and training the programme.
		Limited business models development.	**Incorporation of innovative business models in course material.**
	Sustainable development	Limited incorporation of interchanges in regional and national development plans.	Incorporation in the programme topics with integrated development plans with reference to sustainable development and the environment.
		Limited incorporation of interchanges in regional and national development plans.	**Incorporation in the programme topics with integrated development plans with reference to sustainable development and the environment.**
	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.
		-	**Incorporation of innovative business and management models in course material.**
	Operation	Limited coordination among modes and operators.	Incorporation of transport operations education and training materials that will focus on multimodal systems.
		-	**Development of education material on integrated coordination and operation of mega infrastructure facilities with special reference to interchanges and the utilization of technological advances.**
Smart solutions	Information	Limited multimodal information.	Exploration and utilization of technologies to respond to transport information based needs.
	Services	Limited integrating ticketing. Existing services do not offer travelers real-time information	Development of course that integrates public transport with smart solutions (technology and

Topic		Gap I	Requirement
		across all stages of a multimodal trip Possible conflicts between vehicles and pedestrians. Not sufficient security level.	policy oriented) and potential sustainability impacts. Incorporation in the programme topics with interchange and terminal design and planning with reference to their special characteristics and safety issues.
	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 fulfill sustainability principles.
	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.**
	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.**
	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.**
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.
	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 transportation.**

Note: Grey hatched cells are freight based.

Existing research, educational and training programs in transport in Latvia and the region present an adequate coverage of traditional transport principles and the generic methods that are used in transport for planning and design. However, these courses are not specialized on intermodality. Additionally, the environmental courses appear to be scarce for covering transport planning and design in accordance to EU legislation. Knowledge is required that describes, measures, and quantifies environmental impacts of individual behaviour, of transport policies and of transport projects and skills to disaggregate the inter-relationships between sustainability, the environment, energy and transport.

Also, as indicated in Figure 7.1, educational coverage of new technologies in the transport area (i.e., intelligent transport systems, ICT technologies, etc.) is not adequate in Latvian and region's transport education programs. Learning of smart solutions for the interconnection of transportation networks practically is limited from the content of transport programs and courses relative to other two thematic areas. Approximately 28% of the courses that focus on one of the other two thematic areas (i.e., governance and decision making) cover simultaneously the area of smart solutions.

Transport education is national oriented from the point of view of content, language and training material, and therefore integration of the Baltic transport networks with the European transport network should be especially included in transport programmes. Additionally, standardization of approaches in terms of content and methodology of transport education are absent at national level and joint or intercollegiate programmes among educational institutes in transport area are limited. On overall, Latvia and the region is found to have limited and non well-functioning educational networks among institutes at national as well as international level with the aim of increasing the competence of educational system in the area of international transport. Increasing the number of courses offered in English is expected to enhance education visibility and enable international cooperation. ALLIANCE will enhance collaboration in international aspects and will strengthen intercollegiate education (there are special planned activities in WP3 and WP4). Finally, the development of special courses for vocational transport training to support distance learning will create incentives to practitioners and stakeholders to improve their knowledge and skills and adopt state-of-the-art solutions in interconnecting transportation networks successfully.

7.4 Planned development of Latvian transportation network interconnections

Latvia is a gateway to the EU and Russia/CIS. As home to the largest city in the Baltics, and one of only four EU countries sharing a border with Russia, Latvia is an ideal base for east-west trade. The transport system provides an appropriate infrastructure base to facilitate the trade flows between the EU and Russia and the CIS. To meet the needs of local export/import operators, Latvia offers:

- Free ports in Ventspils, Riga and Liepaja that remain ice-free and active throughout the winter,
- Pipeline systems for Russian oil/natural gas transit and distribution,
- An extensive and functional road network, connecting both European and CIS road networks, as well as ports of Latvia,
- The railway connecting Riga to Moscow by the shortest and most direct route, and there are other specialized, high-capacity railway corridors linking Latvian ports with Russia and the Far East.

7.4.1 Development of Latvian transportation network interconnections: European level

Latvia has one TEN-T Core Network Corridor crossing its country - The North Sea-Baltic Corridor. It covers rail, road, airports, ports, and inland waterways. Pre-identified projects in the North Sea-Baltic Core Network Corridor are listed in Table 7.7.

Table 7.7: Pre-identified projects in the North Sea-Baltic Core Network Corridor in BSR

Helsinki - Tallinn	Ports, MoS	Port interconnections, (further) development of multimodal platforms and their interconnections, icebreaking capacity, MoS
Tallinn - Riga - Kaunas - Warszawa	Rail	(detailed) Studies for new UIC gauge fully interoperable line; works for new line to start before 2020; upgrading and new line on PL territory; rail – airports/ports interconnections, rail-road terminals, MoS
Ventspils – Riga	Rail	Upgrading, port interconnections, MoS
Klaipeda – Kaunas	Rail	Upgrading, port interconnections, MoS
Kaunas – Vilnius	Rail	Upgrading, airports interconnections, rail-road terminals
Via Baltica Corridor	Road	Works for cross-border sections (EE, LV, LT, PL)
BY border - Warszawa - Poznań - DE border	Rail	Works on existing line, studies for high speed rail

The key project is "Rail Baltica", a UIC standard gauge railway between north-eastern Poland, Kaunas, Riga and Tallinn. The goal of Rail Baltic project is to integrate the Baltic States in the European rail network. The project includes four EU countries – Poland, Lithuania, Latvia, Estonia and indirectly also Finland since the connection Tallinn-Helsinki with the project is being prolonged.

The project is supposed to link Finland, the Baltic States and Poland and also improve the connection between Central and Northern Europe (Figure 7.2). It envisages a continuous rail link from Tallinn (Estonia), to Warsaw (Poland), going via Riga (Latvia) and Kaunas (Lithuania). It will bypass the Kaliningrad Oblast (Russia) and Hrodna (Belarus), which have historically hosted two Poland–Lithuania rail routes. The building of the railway is planned to start in 2020. The route Tallinn–Riga–Kaunas is planned to be finished in 2025 and the connection with Warsaw in 2030. There is also a plan to extend the route to Venice (Italy).

The section from Helsinki to Tallinn will be operated by existing commercial ferries. In the future a proposed Helsinki to Tallinn Tunnel could provide a rail link between the two cities. The length of the railway between Tallinn and Warsaw will be at least 950 kilometres.

Rail Baltica creates the possibility to shift the major freight transport in the regions from road to rail, which for the time being is transported towards Russia and then north by heavy trucks. In the case of Poland the trucks follow the local roads and directly cross the villages of Podlaskie Voivodeship (Source: Wikipedia.com).

In case of a successful project implementation, a high quality rail connection between the Baltic States and the biggest economic, administrative and culture centers of Western Europe will be ensured. Opportunities for a new cargo way (Nordic – Southern) as well as the development of logistics services are expected.

Figure 7.2: Rail Baltica project (Source: www.telekonta.lt)

7.4.2 Latvian Transportation Development Guidelines 2014-2020

Since the Government has adopted the National Development Plan 2014-2020 (NAP) and the Ministry of Transportation has published the National Transportation Development Guidelines 2014-2020 (TAP), the focus is changing from planning to implementation. As the ministries begin prioritizing and implementing these long term programs, predictability will be critical for success. The Transport development guidelines 2014-2020 outline the economic, institutional and infrastructure development of the national transport system. The key goal is to ensure the coherent development of an efficient transport system. Transport research and consultancy projects conducted for the Ministry of Transport need to follow the directions established by the National Transport Development Programme.

In accordance with the national Transportation Development Guidelines 2014-2020, the main directions of Latvian transport system development include the following:

1) Supporting a multimodal Single European Transport Area by investing in TEN-T
   a) Increasing security level in big ports and improving the mobility of the transport network.
   b) Ensuring necessary infrastructure on trunk-line flyovers of Riga and preventing fragmentary nature of trunk-line streets.
   c) Interlinking of city infrastructure with the TEN-T network.
   d) Reconstructing the surface, increasing the carrying capacity of main national motor roads.
2) Developing and restoration of comprehensive, quality and interoperable railway systems, and promoting noise reduction measures
   a) Electrification of main railway lines;
   b) Unified trains movement planning and management information system
   c) Upgrading the railway passenger infrastructure.
3) Enhancing regional mobility by connecting secondary and tertiary nodes to TEN-T infrastructure, including multimodal nodes.

One of the directions of action for the achievement of the aim is ensured inner and outer accessibility, and high quality mobility opportunities all over the country, which means qualitative and safe optional modes of transport for all social groups that is competitive with personal cars and considers the arrangement of the administrative spatial structure, changes in the residential pattern, location of services, trends in regional mobility, etc.

It is planned to integrate all public transportation types within a single public transportation route system, incl. city transport, considering that the rail transport, where feasible, is of first priority (Figure 7.3):

- to optimise regularly traffic schedules according to the actual situation;
- to improve availability of information;
- to ensure compliance of vehicles with European technical standards and environmental requirements by introducing new, modern, and qualitative vehicles and ensuring the use of eco-friendly energy resources;
- to ensure safety of the service (safe trip, getting in and off).

It also states that the development of Rail Baltica is significant in light of implementing the EU Strategy for the Baltic Sea Region. Under the justification for railway segment the guidelines state that implementation of Rail Baltica II will establish a more solid link with the European central areas thus contributing to mutually beneficial cooperation. The mobility of the inhabitants of the Baltic region will grow, and this will act as a stimulus for new economic activities. Besides employment will also be facilitated, including the construction industry.

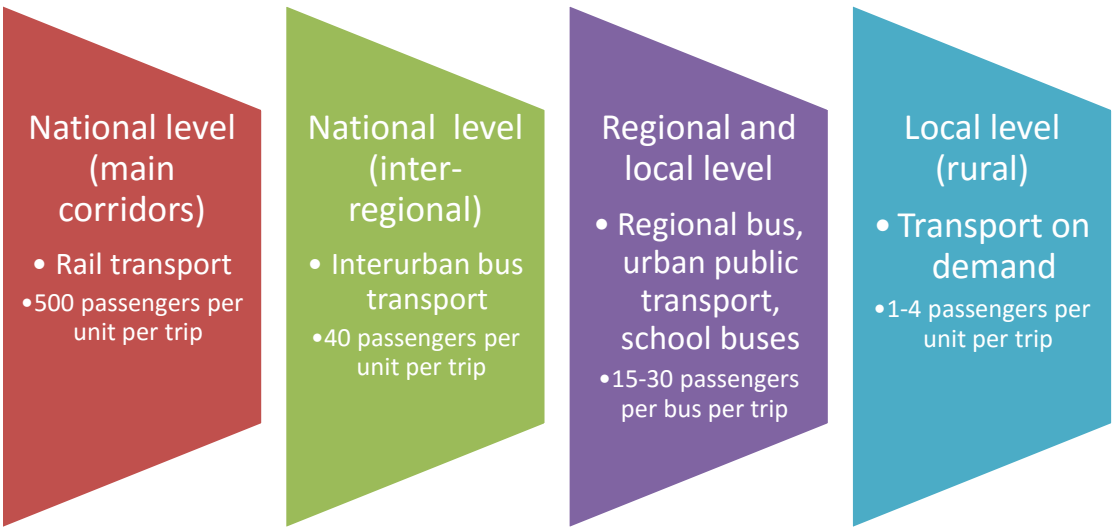

Figure 7.3: Planned public transport network in Latvia

7.4.3 The urban transport system development

The Riga Sustainable Development Strategy until 2030 (approved in 2014) defines that the key public transport infrastructure element will be the Riga Central Railway Station with multimodal functions. Riga shall be the only Rail Baltic stop in Latvia, which will be conveniently linked with

the Riga International Airport and the Riga International Coach Terminal. The largest bicycle parking lot will be established here, providing for a safe overnight bicycle parking.

Riga Central Multimodal Public Transportation Hub will be a site merging in a single infrastructure international and domestic passenger railway traffic; national, regional, and Riga city public transport, as well as cars.

7.5 Validation of educational and training requirements for Latvian Institutes

The creation of a continuous European transport network without restrictions or barriers to access becomes one of the principal objectives of transport policy in Europe. Transport is being acknowledged as an important human activity that will require extensive professional and academic training and disciplinary research. While training and education is objectively at the meeting-point between researches, technological and organisational systems, major features of transport sector need to be considered towards the development of a transport program that focus on intermodal transport terminals. These include the: 1) Global character of transport as a subject of studies, 2) Creation of a continuous transport service in Europe, 3) Alliance of information and telecommunication technologies with transport, and 4) Formation of new technological directions – intelligent transport systems.

The new developments for Latvia which are foreseen in: 1) Ports and aim to promote the performance of business activities; 2) Railway network that aim to serve ports and connect Latvia and the region with EU transport corridors; and 3) The Riga International Airport that aims to improve the environmental conditions, highlight the need for integrated planning and management to provide viable infrastructural intermodal terminals. More specifically, the integration of the transport infrastructure with the trans-European system requires the development of coast shipping and combined transport. Also, the enhancement of regional mobility requires the connection of secondary and tertiary nodes to TEN-T infrastructure, and the increase in the carrying capacity of main national motor roads requires the rehabilitation of the pavement. The shift of transport sector in the Latvia and the region from road based transport to multimodal based transport and the forthcoming “Rail Baltica” project – a high quality rail connection- that will connect Baltic States and the centers of Western Europe highlight the necessity to assess existing transport programs and amend them based on Latvia’s transport development. Planned infrastructure development for Latvia and the region requires integrated transport development that will be supported by smart mobility solutions, both technology and policy based, to create sustainable transport systems.

Although gap analysis showed the relationship that exists between practice and education in Latvia the EU education directions should not be omitted towards improvement of existing transport programs in Latvia and the region. Research on educational postgraduate transport courses in EU has shown that 59%, 34% and 52% of the courses focus on governance and policy development, smart solutions and decision making, respectively as shown in Figure 7.4. However, it was noticed that multiple courses cover more than one thematic areas in most cases. More specifically, 25% and 31% of transport courses on governance and policy development cover smart solutions and decision making as well. Similarly, 43% of transport courses on smart solutions cover additionally governance and policy development and decision making and 34% and 28% of transport courses on decision making cover additionally governance and policy development and smart solutions, respectively. EU based courses at postgraduate level were found to cover very often more than one thematic area. The number of transport environmental courses are four times higher in EU compared to Latvia and the region,

and in most cases they appear to provide a well-structured course that embraces at least two thematic areas, simultaneously. On the other hand, Latvia and the region include a much higher number of transport engineering courses in their programs compared to EU.

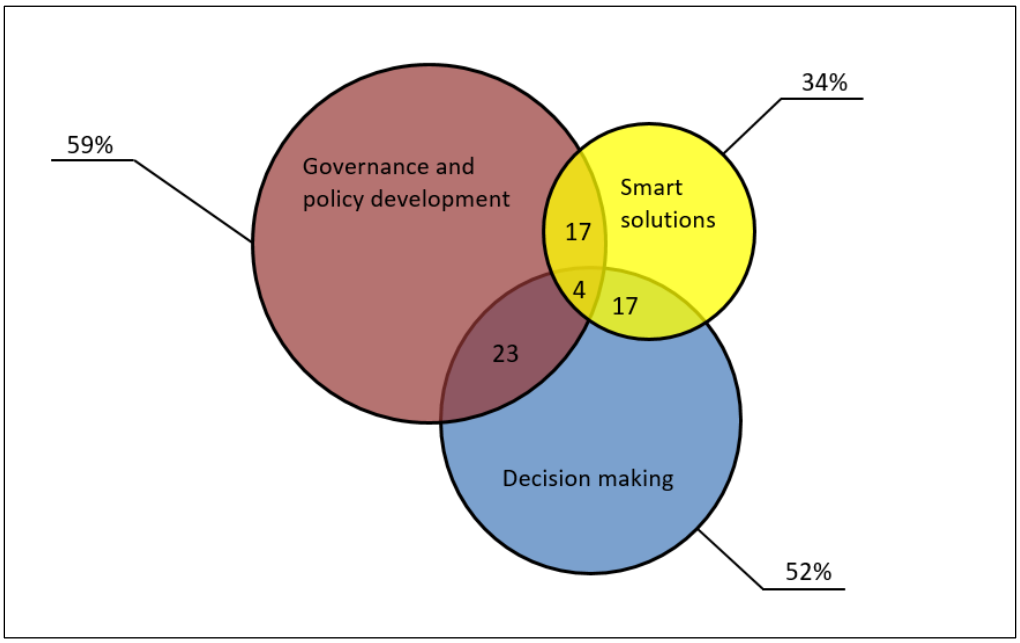

Figure 7.4: Distribution of EU courses per thematic area

The variety of postgraduate transport courses that was presented in Chapter 6 shows that EU educational institutions tend to provide well integrated transport courses and the majority of them, either generic or specialized programs, promote the incorporation of technological advances and EU legislation. The EU educational experience shows that has the potential to support actions for addressing deficiencies for the Latvia and the region. For example, for rail based courses selected EU programs were found to provide well-structured content that could supplement partly educational courses in Latvia and the region. Such knowledge could cover the process of rail planning and building, methods to create a timetable for the railway, economic analysis of passenger and freight transport on the railway, application of multi-criteria analysis to transport projects and evaluation of traffic impacts on the environment and safety.

In the same way as transport systems and services evolve within a European framework, transport education and training in transport need to change its content to adopt to new socioeconomic and technological conditions by taking into account international aspects and globalisation and move from conventional to networked environments. Initial transport education processes at professional and higher educational levels must be a part of these dynamic changes to enable their graduates to meet employers' needs and operate on the one single market. To this end the recommendations for the curriculum of developed courses that will cover the interconnecting transport networks are formulated as follows:

1. *Governance and policy development*. The courses that are included in this thematic area will cover:
   - Issues related to the interconnection of transportation with land use planning, legislative, institutional and organizational frameworks.

- The legal, organizational and institutional framework that applies in EU countries, with emphasis on good practices.
- Regional development and transportation planning tools for predicting demand for travel and transport.
- The methodologies, criteria and indicators determining the selection of site location for passenger and/or freight city hub establishment, as well as the factors boosting their development.
- The types of stakeholders involved (internal) or attached (external) in the city hub's establishment, development and operation and their roles, duties and jurisdiction.

2. *Smart solutions.* The courses that are included in this thematic area will cover:
   - Technological advancements and other innovative measures and tools, which enable the efficient operation of intermodal terminals, and provide high quality service and environmental and energy protection and sustainability.
   - The detailed description of the methods, frameworks, measures and actions concerning smart solutions for the enhancement of operation and the upgrading of the provided level of service in intermodal terminals/city hubs.

3. *Decision making.* The courses that are included in this thematic area will cover:
   - The tools and methods, which feed the decision making.
   - Traffic simulation and environmental impact assessment models, risk analysis tools, life-cycle analysis models and economic analysis methods.
   - Evaluation methods based on multi-stakeholder multi-criteria decision making (MSMC-DM) and sustainable business and organizational models for collaborative schemes amongst the stakeholders of the intermodal transportation chain.
   - Applications and management of smart solutions in intermodal terminals.

8 Conclusions

The project has sought to address the topic of intermodal interconnections, through analysis of data collection on interchanges for passenger mobility and freight transportation, and educational and training transport programs. ALLIANCE has identified existing gaps between the transport industry and practice, and the research, education and training programs in Latvia. The analysis focused on in-depth investigation of the current situation and trends that exist in EU and the Latvia, about the planning and operation of intermodal terminals and the related educational and training transport programs. The two levels gap analysis that was developed and implemented in the scope of ALLIANCE project with respect to the three thematic areas of 1) *Governance and policy development*, 2) *Smart solutions, and 3) Decision-making,* and the validation process that followed, has revealed several gaps and requirements that currently exist for passenger and freight interchanges and educational programs for the Latvia and the region.

The first level gap analysis that was performed between the interconnecting networks in EU and the Latvia and the region showed that Latvia and the region cover most of the thematic areas in terms of practices for both passenger and freight interchanges. Latvia and the region corresponds adequately to basic needs and requirements; however, compared to EU practices it performs poorer mainly due to limited incorporation of sustainability principles into planning and operation of terminals and limited integration of technological advances with new transport trends as well as business and management plans. Regarding the passenger interchanges, the identified gaps impose in terms of governance and development a faster harmonization with EU legal framework on interchanges and promotion of operational integration to improve coordination among modes and operators. Regarding the area of smart solutions it was noted a rather limited integration of technological and policy solutions in the transport system which is complemented by the need of improving interchange design to accommodate the needs of all users. Although freight interchange policy challenges were found to be similar to passenger interchanges, other identified gaps for freight based interchanges focus to ownership, management and operation of interchanges in Latvia and the region that require the enhancement of administrative and cooperative schemes between public and private sector as well as the development of business models. Regarding smart solutions the individually planned urban consolidation centers and the limited business and transport operation planning led to the need to develop a more rational strategic plan of urban consolidation/distribution centers by considering the market demand.

The second level gap analysis used as input the results from the first level and data for existing educational, research and training programs in Latvia and the region to converse practice related requirements into educational gaps and requirements. On balance, the analysis showed that although several transport related programs in Latvia and region offer a wide variety of courses there is not a common integrated approach for the development of transport programs and transport courses content. Based on the analysis that was conducted, the transport courses that cover smart solutions (20%) in Latvia and region is lower relative to the other two thematic areas of 1) Governance and policy development (55%), and 2) Decision making (56%), which highlights the need for developing well integrated transport courses that mix smart solutions with the other two thematic areas for interconnecting networks. Smart solutions based courses should benefit by the development of courses that integrate public transport with smart solutions, and interchange and terminal design with accessibility and sustainability impacts.

To maintain a competitive educational program, innovative methods of data collection and exploitation of big data opportunities in decision making and analytics of transport freight should be considered to provide a competitive and sustainable transport strategy for interconnecting

networks. Decision making based courses are ranked first in terms of number of courses, nevertheless there is a need to develop integrated course material that will focus on assessment practices with focus on interchanges and life cycle impacts (society, environment and economy). Educational based requirements showed the need to create a transport program that corresponds to forthcoming challenges and that will incorporate courses that cover more than thematic area simultaneously to enable a holistic education of graduates. The importance to develop educational programs which are adapted to local and Baltic region environment is highlighted by the presence of Baltic Transport Network as Gateway between East and West.

Given the projected infrastructural developments for Latvia and region, port interconnections, rail upgrade and connections with international transport corridors and networks there is a necessity to increase the competence of its educational system in the area of international transport by creating an educational program that adopts its content based to regional needs and European best practices.

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10 Annexes

Annex A: Data collection templates

Annex B: Smart transhipment good practices

Annex C: Additional information and analysis of programs and courses

Annex A

Table 1a: Review template – Part A

SOURCE DESCRIPTION						
Title (1)					Source ID (2)	
Author(s) (3)						
Language (4)			Country (5)			
Year of publication (6)		URL (7)				
Type of source (8)	Paper		Project/study		Case study	
Reference details used to access source (9)						
Reviewed by (10)						
GENERAL INFORMATION						
Level of coverage (11)	Strategic		Tactical		Operational	
Coverage of ALLIANCE thematic areas (12)	Governance & policy		Smart solutions		Decision-making	
DETAILED INFORMATION						
Transport type (13)		Passenger		Freight		
Spatial scale (14)						
Urban		City freight terminal		National		
Interurban		Freight village		European		
Short/long distance		Industrial and logistic park		International		
Last mile		Special logistic area		Other		
Number of passengers (15)	*Please clarify the scale: year, day, etc.*					
Goods' flow (16)	*Please clarify the unit: TEU, etc.*					
Short description of the practice/trend (17)						
Scope and objectives of the practice/trend (18)						

Transportation modes/terminals involved (19)							
Car		Truck (>3,5tons)		Van (<3,5 tons)		Electric vehicle	
Taxi		Bus		Tram		Rail	
Metro		Port		Airport		Motorcycle	
Bicycle		Walking		Kiss & ride		Other	
In case of freight transport: type of transported goods (20)							
Topic addressed (21)							
Policy & governance		Station operations		Management & maintenance			
Safety & security		Finance & revenue streams		Interchange design			
Accessibility		Services		Connectivity		ITS/ICT	
Stakeholders involved (22)							
Technologies used (23)							
METHODOLOGY							
Approach (needs' analysis, situation analysis, etc.) (24)							
Data collection and analysis (25)							
Methods and techniques used to assess results (CBA, MCA, impact assessment) (26)							
FINAL COMMENTS							
The opinion of the reviewer regarding the practice or trend (27)							

Table 1b: Review template – Part B

OVERALL ASSESSEMENT (28)	
Strengths	**Weaknesses**
Opportunities	**Threats**

EDUCATIONAL AND TRAINING PROGRAMS
REVIEW TEMPLATE

Table 1: Program review template

PROGRAM #...				
Program type	Educational		Training	
Program title				
Main focus				
Program objectives (capabilities pursued and learning results)				
Prerequisites				
Institution				
City				
Country				
Program level	Undergraduate		Postgraduate	
Language				
Number of courses		% of courses in transportation		

Table 2: Course review template

PROGRAM #... – Course #...				
Title				
Main focus				
Aim				
Objectives (capabilities pursued and learning results)				
Prerequisites				
Language				
Type	Mandatory		Optional	

Category	Basic		Orientation	
Key words				
Thematic areas				
Contents				
Material (book, notes)				
Suggested bibliography				
Teaching methods	Teaching			
	Seminars			
	Demonstrations			
	Laboratory			
	Exercises			
	Visits at facilities			
	Other (describe) ……			
Evaluation methods	Homework			
	Class project			
	Interim examination			
	Final examinations			
	Other (describe) ……			
Digitalized material	(YES or NO, if YES, add link)			

Annex B

Smart transhipment good practices

A first example is **compact terminals**, which are in particularly suitable for handling operations with short distances and simple procedures. The modular design of these terminals allows individual attention to customer needs. Compact terminals are permanently installed at the handling place, however are characterized by great flexibility regarding the kind of logistics services and transportation volume. Compact terminals serve rai-rail and rail street transhipment.

Figure B.1: Compact terminal Tuchschmid (Source: Tuchschmid, 2012)

With the use of container **Quick handling facility**, trains can be loaded and unloaded while passing by. Data from cars and cargo are detected by sensors and by real-time imaging systems the gantry cranes are controlled. After the speed synchronization, the load is taken and placed on a cross conveyor. Thus, turnaround times for a 600m long train with 40 containers can be realized within 15 minutes.

Figure B.2: Container-quick handling facility (Source: Winkels, 1999)

Platform vehicle, in the intermodal terminal usually Heavy-Duty Transport Vehicles (HDTV) are trackless, sides movable, heavy-duty transport vehicles. Basic embodiments are trailers and self-propelled platform vehicles mostly with diesel-electric drive. They are especially suitable for transporting heavy loads of all kinds e.g. sheet metal, steel girders, coils, machine parts, containers . For loading and unloading platform trailers other technologies such as cranes or straddle carriers are needed. Through its modular design platform trailers can be adjusted to many specific requirements. When run as a trailer vehicles Heavy - Duty Trucks, Prime Mover) are used for their movement.

Figure B.3: Left: Platform car; right: selfdriving-platform car (Source: HUBTEX Maschinenbau GmbH & Co. KG, 2014)

The **roller container** is an important part of the combined road-rail transport. The system consists of a roll-off container with a standardized underframe. Specially equipped trucks with chain or hook device take over the road transport. Railway companies make so called good wagons with rotating frame available. The transfer between road and rail can thus occur quickly and without stationary loading aids such as forklifts or cranes. A similar operating principle has the so-called Wieskötter system for the transshipment of swap-bridges.

Figure B.4: Roll-off container (Source: Corrà Transporte, 2014)

The **rolling road** is a transport system that was originally developed for the accompanied combined transport of complete trucks by rail. In close-coupled low-floor rail wagons, trucks are sequentially loaded. Drivers are carried during the journey in a seat. At the endpoints of the train are special loading ramps to load and unload the truck. A modification of the rolling road is the so-called piggyback traffic where the trailers are transported.

Figure B.5: Loading station of the rolling road (Source: Industriemagazin GmbH, 2009)

The **CargoBeamer system** is a fully automatic working envelope system between road and rail. With this system, all the trains can be loaded and unloaded at the same time , so that very high throughput rates can be achieved (for example, 72 semi-trailer in 15 minutes) . To operate the system specially equipped terminals, special wagons and wagon essays are required. The operating principle can be briefly described as follows: Trailer or container are loaded and placed in parallel to the railroad. When the train arrives, the wagon essays are discharged automatically at one side, while they are loaded at the same time from the other side (Randelhoff CargoBeamer soll Guterumschlag revolutionieren, 2010).

Figure B.6: Fully automatic loading and unloading with CargoBeamer (Source: CargoBeamer AG, 2014)

WB mobiler is a changer from road to rail and vice versa. The changer is equipped with a portable system for a horizontal low swap and a hub gear. The power supply and control is carried out from the lorry.

Figure B.7: WB Mobiler (Source: Terberg-Nordlift GmbH, 2014)

The **combi-lifters** is a wagon with integrated lifting device to swap containers. Each combi-lifters can hold two containers. The system is independent of expensive infrastructure such as cranes or forklifts. Since about 1999 there are operations with 10 combi-lifters between Stuttgart and Bremen in Daimler locations.

Figure B.8: Combilifter at work (Source: AXIT AG, 2014)

The **ModaLohr concept** is based on a special low-floor double carriage with a middle joint, that leads to a faster turnover of semi-trailers and complete truck between rail and road. The system was, developed by the French manufacturer Lohr transport technology.

The principle is as follows: To load the trolley bag is rotated on the carriage by 30° and thus forms the up / drive-off ramps at the terminal. The truck is on the ramp and pulls the trailer completely onto the wagon. After uncoupling the carriages bag is turned back again and the loading process is complete.

Figure B.9: ModaLohr system (Source: Lohr Industrie S.A. - F, 2006)

The **Flexi-wagon concept** offers the possibility for truck and trailer to load without a terminal or additional ramps. This concept serves as special wagon, the loading unit can be moved out to both side. In addition, the Flexi-wagon leads with two fold-out ramps, so the load module can driven from both sides.

Figure B.10: Flexi-wagon concept (Source: Randelhoff, Flexiwaggon – flexibel ohne Terminals, 2010)

The **Translifter Cassette System** includes a container cartridge for receiving a single container or two stacked containers (Trans Lifter Cassette system of TTS). This cassette can be recorded by means of a lift truck, either trailed or self-propelled vehicle (AGV) and moves at the terminal. To bridge larger distances between different terminal or to provide containers for container cranes at the sea side, rail transport racks can moved under the cassettes and carried on automatic during further transport. This crease a long row of containers, which enables rapid uptake by container bridges.

Figure B.11: Container Cassettes (Source: TTS Port Equipment AB, 2014)

The **linear motor technology** (linear motor based Technology Transfer or LMTT) to replace driverless transport systems in port terminals on the sea-side. The concept is based on a rail-guided, electromagnetically driven trolley. The trolleys move automatically in parallel and at right angles to each other rails arranged in longitudinal and transverse directions. The drive and positioning components are integrated in the rail system.

Figure B.12: LMTT (Source: Konings, Priemus, & Nijkamp, 2008)

A **wagon tipping system** allows lateral turn of wagons. Over a rail system driving the bulk goods loaded wagons onto the handling equipment. After fixation, the car it is rotated by tilting and thus discharged. Significant advantages are the speed of the discharge and the reduced handling of the goods to be unloaded.

Figure B.13: Wagon tipping system (Source: Badische Stahlwerke GmbH, 2011)

Yard Trucks are special towing vehicles and trailers for moving within ports (roll-on / roll-off handling), storage and transport terminals. They are small and relatively slow vehicles. Their advantage lies in the good all-round visibility for the driver and the very precise positioning of trailers.

Figure B.14: Yard Trucks (Source: Green Car Congress, 2014)

Water trucks are self-loading and unloading container ships. The loading and unloading system is directly on the ship. Thus containers can be unloaded at wharves regardless of the technical facilities of the port of destination.

Annex C

Table C.1: Sample transport programs and relevant courses

Country	University	Program	Course
Latvia	Latvian University	MSc. Spatial Planning	Geographical Information Systems (GIS)
			Planning of Technical Infrastructure
			Planning of Spatial Development
	Riga Technical University	MSc. Transportation Engineering	Logistics and Transport Systems
			Multimodal and Intermodal Transportation
			Transport Systems Functioning
		MSc. Logistics and Supply Chain Management	Modelling and Simulation in Logistics
			Materials Handling and Transportation Technologies
			Supply Chain Network Management Technologies
			Global Markets and Supply Chains
			Logistics and Supply Chain Management European Dimension
			Decision Synthesis Principles and Practice in Logistics
	Transport and Telecommunication Institute	MSc. Transport and Logistics	Transport Economics
			Geography of Transport Systems
			Logistics Systems and Logistics Chains
			Simulation Modelling in Transport and Logistics
			Risk Management in Supply Chains
			Transport Policy of the EU and LR
	Latvian Agriculture University	MSc. Agricultural Engineering with specialization Automotive Transport	Transport Management and Logistics
			Traffic Management and Modelling
			Intellectual Technologies and Systems
			Logistics
			Computer-aided Management systems
			Warehouse Management
			Transport Engineering Service

Country	University	Program	Course
			Auto transport and environment
	Riga Aeronautical Institute	MSc. International Carrier Management	Global Logistics
			Modelling of Transport Processes
			Economic and Financial Analyse of International Carrier
			Transport Risks and Insurance
			Transport Logistics
		MSc. Transport system management	Management of Transport Enterprises
			Transport Systems
			Modelling of Transport Processes
			Management of Transport Systems
			Global Logistics
			Economics of Transport Enterprises
			Global Logistics
			Organisation of Transport Production
			Commercial Management of Transport Systems
			Risk Management of Transport Systems
Estonia	Tallinn University of Technology	MSc. Spatial Planning	Contemporary Planning and Sustainability
			Town planning theory and urbanism
			Planning and Roads
		MSc. Mechatronics	Automotive Mechatronics
			Measurements in Mechanical Engineering and Mechatronics
		MSc. European Architecture	Urban Strategies
			Spatial Strategies
Lithuania	Klaipeda University	MSc. Sea Ports Management	System and analysis concepts
			Transport system components
			Sea and land transport interaction
			Sea transport managing systems
			European water transport system
			Lithuanian transport system

Country	University	Program	Course
			Intelligent transport systems
			Intermodal transports and Ro-Ro shipping
			Multimodal transport
			International maritime organizations
	Vilnius Gediminas Technical University	MSc. Transport Engineering Economics and Management	Transportation Services of International Trade
			Warehouse and Inventory Management
			Quality Management Systems in Transport
			Transport Policy and Innovations
			Mathematical Simulation of Transport Systems
			Economics of Transport Service
			Reverse Logistics
			Strategic Supply Chain Management
			Resource and Operation Management in Logistics
		MSc. Urban Planning and Engineering	Transportation Infrastructure
			Urban Infrastructure
			Urban Engineering Information Systems
			Regulation of Urban Planning and Democracy
			Urban Planning Theory and Methodology
			Sustainable Development of the City
			Using GIS for Planning and Modelling
			Architecture of Urban Landscape
			Urban Engineering Network
			GIS Based Computer Designing
		MSc. Aviation Mechanics Engineering	Maintenance management
			Engineering of airplane propellers
			Computational Aerodynamics
			Stability and Control of Airplane
			Human Factor in Aviation
			Finite Element Method for Aerospace Structures
			Mechanics of Mechatronic

Country	University	Program	Course
			Systems
			Aviation Engine Theory
			Non-destructive methods of aircraft
			Aviation Systems of Computer Design
			Optimisation of Aviation Constructions with Finite Element Method
		MSc. Safety Engineering	Theory and Methods of Optimization in Technics
		MSc. Geodesy and Cartography	Digital Cartography
			Geoinformation Data Bases
			Theory of Geodetic Networks
			Planning of Geoinformation System
			Facility of Spatial Information
			Geoinformation Systems Technology
			Geoinformation Systems on the Internet
			Special Geodedic Networks
			Digital Terrain Models
		MSc. Transport Engineering	Theory of Reliability of Transport Machinery
			Transport Policy and Innovations
			Road Traffic Organization and Control
			Road Vehicle Safety
			Traffic safety legal regulation
			Technological Robot in Transport
			Rail Vehicle Dynamics
			Road Building Engineering
			Integrated Transport Systems
			Transport Economics
			Optimization of the Control System of Transport Machines
			Management of the Logistics System Structural Units
			Interaction Between Transport System Elements
			Tests and Expertise of Transport Technological Systems
			Expertise of Road Accidents

Country	University	Program	Course
			Modelling Transport Machines' System
			Rail Vehicle Diagnostics
			Railway Transport Energetics
			Total Quality Management in Transport System
			Predicting the Remaining Service Life of Transport Technological Equipment
			Methods of Evaluating Transport Elements
		MSc. Civil Engineering	Legal Regulation of Urban Planning and Construction
			Theory of Railway Construction
			Urban Infrastructure
			Legal Regulation of Urban Planning and Construction
			Modern Roads Technologies
			Road Building Quality
			Road Information Systems
			Geographic Information Systems
			Road Integrated Research
			Railway Modernization
			Urban Transport Systems
			Theory of Traffic Flow
			Theory of Territorial Planning
			Theory of Road Maintenance
			Railway Management
			Urban Information Systems
			Urban Public Transport
			Traffic Safety Management
			Train Traffic Organization and Traffic Safety
			Systemic Analysis of Roads
			Design of Railway Station
			Theory of Road Maintenance
			Mobility Management
			Planning of Transportation Infrastructure
			Management of Urban Development
			Using GIS for Planning and Modelling
		MSc. Structural Engineering	Reinforced concrete bridge design, evaluation of the rheological and climatological factors

Country	University	Program	Course
			Timber and Polymeric Bridges
			Composite bridge decks
			Computer aided design of bridges and special structures
			Steel fiber reinforced concrete bridge structures
			Innovative Steel Bridge Structures
		MSc. Roads Traffic Safety Engineering	System of Traffic Safety on Roads and Streets
			Traffic Safety Management
			Vehicle Dynamics and Traffic Accident Expertise
			Traffic Safety Legal Regulations
			Engineering Traffic Safety Measures and Their Evaluation
			Road and Street Network Planning
			Psychology of Traffic Users
			Design Safety of Automobiles
			Modern Road Design Methods
			Urban Transport System
			Traffic Safety Information Systems
			Road Safety Audit and Management
			Theory of Road Maintenance Management
			Country and Cities Planning
			Modelling of Transport Flows
		MSc. Innovative Road and Bridge Engineering	Nonlinear Analysis of Reinforced Concrete Bridges
			Road Integrated Research
			Traffic Safety Management
			Steel-concrete Composite Bridge
			Computer Aided Design of Bridges
			Dimensional Road Design
			Risk and safety in bridge engineering
			Innovative Timber and Reinforced Concrete Bridges
			Durability of Bridge Structures
			Road and Streets Network Planning
			Land Use Planning

Country	University	Program	Course
			Composite materials for bridges
		MSc. Construction Technologies and Management	Sustainable Development of Territories
		MSc. Solar Cell and Modules Engineering	The Potential of Solar Energy in Transport Engineering
		MSc. Architecture	Analysis of Architectural and Urban Structures
			Principles of Urban Design
			Computer Urban Analysis (of GIS Base)
			City Urban Structure: Planned and Spatial Development
			Urban Complex in Redeveloped Town Environment
			Composition of Urbanizes Landscape
			City Urban Structure: the Reconstruction of the City Central Part
			Spatial and Volume Concept of Urban Complex
Poland	International University of Logistics and Transport in Wroclaw	Master's of Science Studies with specializations: • Production Logistics Manager • Supply Chain Manager • Transport Manager	Information absent
		MSc. In Engineering with specialization: Industrial Systems Engineering	Transport management
			Logistics management
			Design of processes and logistics systems
			Computer systems in transport
			Management of logistics project
			Logistics controlling
			International logistics
			Optimization of transport costs
			Models and algorithms for logistics
			Logistics planning
			Optimization of logistics processes

Table C.2: Generic transport programs

No.	Country	University	Program
1	UK	Cardiff University	MSc. Transport & Planning
2		Imperial college	MSc. Transport
3		Leeds University	MSc. Sustainability in Transport
4		Newcastle University	MSc. Transport Planning and Engineering
5		Southampton University	MSc. Transportation Planning & Engineering
6	Germany	Munich University of Technology	MSc. in Transportation Systems
7	Sweden	KTH Royal Institute of Technology	MSc. Transport and Geoinformation Technology
8	Switzerland	École Polytechnique Fédérale de Lausanne	MSc. Transport and Mobility

Table C.3: Specialized transport programs

No.	Country	University	Program
1	UK	Newcastle University	MSc. Marine Transport with Management
2		Westminster University	MSc. Transport Planning & Management
3	The Netherlands	TU Delft	MSc. Transport, Infrastructure and Logistics
4	Belgium	University of Antwerp	Advanced Master in Maritime and Air Transport Economics
5			MSc. Transport and Logistics Management
6	Spain	University of Oviedo	MSc. Port Management, Planning & Intermodal Transport
7	Greece	University of the Aegean	MSc. Shipping, Trade and Transport
8		Aristotle University of Thessaloniki	MSc. Planning, Organization and Management of Transport Systems
9		University of Thessaly	MSc. Transport planning and management
10	Germany	University of Magdeburg	MSc. Logistics

Table C.4: Sample transport programs and relevant courses

No.	Country	University	Program	Course
1	UK	Cardiff University	MSc. Transport & Planning	Principles of transport economics
2				Sustainable transport policies
3				Transport and the city
4				Transport analysis
5				Governance of the eco-city development process
6				Urban and regional development in practice
7				Space and place: international planning practice
8		Imperial college	MSc. Transport	Transport policy
9				Transport engineering and operations
10				Transport economics
11				Ports and maritime transport
12				Air traffic management
13				Freight transport
14				Intelligent transport systems
15				Transport and the environment
16				Public transport
17		Leeds University	MSc. Sustainability in Transport	Environmental science and sustainability for transport
18				Shaping future transport systems
19				Green logistics
20				Public transport planning and management
21		Newcastle University	MSc. Transport Planning and Engineering	Transport policy and legislation
22				Transport planning and sustainable mobility
23				Public inquiry into a transport scheme
24				Design of transport infrastructure
25				Railway management, economics and planning
26				Economic and environmental appraisal of transport activities
27			MSc. Marine Transport with Management	Maritime transport business
28				Maritime liability insurance and law
29				Maritime transport economics
30				Shipping market analysis and risk management
31				Maritime logistics and ports
32		Southampton University	MSc. Transportation Planning & Engineering	Transportation planning: Policies and methods
33				Transportation planning: practice
34				Transport economics

No.	Country	University	Program	Course
35				Transportation engineering: Transport management
36				Passenger and freight transport
37				Transport, energy and the environment
38		Westminster University	MSc. Transport Planning & Management	Logistics management and planning
39				Sustainability and freight transport
40				Commercial distributions of fast moving goods
41				Freight transport and logistics services
42				Airport planning and management
43				Public passenger transport
44	Germany	Munich University of Technology	MSc. in Transportation Systems	Road design
45				Rail design
46				Traffic control
47				System architectures and applications
48				Integrated land-Use and transport modeling
49		University of Magdeburg	MSc. Logistics	Information logistics
50				Planning of logistics systems
51				Modelling and simulation in logistics planning
52	Sweden	KTH Royal Institute of Technology	MSc. Transport and Geoinformation Technology	Traffic engineering and management
53				Transport policy and evaluation
54				Transport and sustainable development
55				Railway traffic - Market and planning
56				Public transport
57	Switzerland	École Polytechnique Fédérale de Lausanne	MSc. Transport and Mobility	Fundamentals of traffic operations and control
58	Netherlands	TU Delft	MSc. Transport, Infrastructure and Logistics	Introduction transport and logistic engineering
59				Transportation and spatial modelling
60				Assessment of transport infrastructure and systems
61				Transport and spatial planning for urbanized regions
62				Transport policy
63				Planning and design of multi-modal infrastructure networks
64				Airline planning & optimization
65				Design and control of public transport systems
66				Railway traffic management
67				Transport, routing and scheduling
68				Freight transportation systems: Analysis and modelling
69				Supply chain analysis and engineering

No.	Country	University	Program	Course
70				Design and management of multi-modal logistic chains
71	Belgium	University of Antwerp	Advanced Master in Maritime and Air Transport Economics	Transport business economics and policy
72				Airport management
73				Maritime supply chains
74				Technology and innovation
75			MSc. Transport and Logistics Management	Logistics strategy
76				Production and operations management
77				Transport and logistics information systems
78				Supply chain management tools
79				Warehouse and hinterland distribution management
80				Port economics and management
81				Terminal management
82				Transport economics and policy
83	Spain	University of Oviedo	MSc. Port Management, Planning & Intermodal Transport	Shipping
84				International commerce
85				Port economy
86				Globalization and logistics chain
87				Sectorial logistics
88				Logistic operators
89				Planning logistic activities
90				Planning the economic regime of port authorities
91				Economic evaluation of port infrastructures
92				Logistics associated with specific traffic. port terminals
93				Port services
94				Port operations
95				Sustainability: safety and environment
96	Greece	University of the Aegean	MSc. Shipping, Trade and Transport	Maritime economics
97				Information and communication technology (ICT) systems for shipping trade and transport
98				Transport and the city
99				Integrated transport systems
100				European port policy
101				Urban and regional development in practice
102				Maritime environmental management
103		Aristotle University of Thessaloniki	MSc. Planning, Organization and Management of Transport Systems	Transport policies
104				Organization and management of traffic and parking systems
105				Organization and management of freight transport

No.	Country	University	Program	Course
106				Planning and management of railway transport
107				Elements of transport economics - Evaluation of transport projects and transport systems
108				System analysis-Advanced transportation demand models
109				Organization and management of urban public transport systems
110				Organization and management of air transport and airports
111				Organization and management of maritime transport
112		University of Thessaly	MSc. Transport planning and management	Project management
113				Transport freight and logistics
114				Project appraisal

Table C.5: Summary of transport courses per transport category and thematic area

Course category	Course	Code	Thematic areas		
			Governance and policy development	Smart solutions	Decision making
Transport economics	Principles of transport economics	G1.1_E			X
	Transport economics	G2.8_E			X
	Maritime transport economics	S1.3_E			X
	Transport economics	G5.3_E			X
	Transport business economics and policy	S4.1_E	X		X
	Port economics and management	S5.6_E	X		X
	Transport economics and policy	S5.8_E	X		X
	Port economy	S6.3_E			X
	Planning the economic regime of port authorities	S6.4_E			X
	Economic evaluation of port infrastructures	S6.6_E			X
	Maritime economics	S7.1_E			X
	Elements of transport economics - Evaluation of transport projects and transport systems	S8.5_E			X
Transport policy	Sustainable transport policies	G1.2_C	X	X	
	Transport and the city	G1.3_C	X	X	
	Governance of the Eco-City development process	G1.5_C	X	X	
	Transport policy	G2.1_C	X		
	Shaping future transport systems	G3.2_C	X		
	Transport policy and legislation	G4.1_C	X		
	Public Inquiry into a transport scheme	G4.3_C	X		
	Maritime liability insurance and law	S1.2_C	X		

Course category	Course	Code	Thematic areas		
			Governance and policy development	Smart solutions	Decision making
	Transport policy and evaluation	G7.2_C	X		X
	Transport policy	S3.5_C	X		
	International commerce	S6.2_C	X		
	Transport and the city	S7.3_C	X		
	European port policy	S7.5_C	X		
	Transport policy	S8.1_C	X		
Transport environment	Transport and the Environment	G2.6_N		X	X
	Environmental science and sustainability for transport	G3.1_N		X	
	Economic and environmental appraisal of transport activities	G4.6_N			X
	Transport, energy and the environment	G5.6_N	X	X	
	Sustainability and freight transport	S2.2_N	X	X	
	Transport and sustainable development	G7.2_N	X	X	
	Sustainability, safety and environment	S6.12_N	X	X	
	Maritime environmental management	S7.7_N	X		
Transport modeling & tech.	Intelligent transport systems	G2.7_M		X	
	System architectures and applications	G6.1_M		X	
	Integrated land-use and transport modeling	G6.2_M	X		
	Modelling and simulation in logistics planning	S10.3_M	X		
	Transportation and spatial modelling	S3.2_M	X		
	Freight transportation systems: analysis and modelling	S3.11_M	X		
	Technology and innovation	S4.4_M		X	
	Information and communication technology (ICT) systems for shipping trade and transport	S7.2_M		X	
	System analysis-advanced transportation demand models	S8.6_M	X		
Transport logistics	Green logistics	G3.3_L	X	X	
	Maritime transport business	S1.1_L	X		
	Shipping market analysis and risk management	S1.4_L			X
	Maritime logistics and ports	S1.5_L		X	X
	Logistics management and planning	S2.1_L	X		
	Freight transport and logistics services	S2.4_L	X		
	Information logistics	S10.1_L	X		
	Introduction transport and logistic engineering	S3.1_L		X	X
	Supply chain analysis and engineering	S3.12_L	X		
	Design and management of multi-modal	S3.13_L	X		

Course category	Course	Code	Thematic areas		
			Governance and policy development	Smart solutions	Decision making
	logistic chains				
	Maritime supply chains	S4.3_L	X		
	Logistics strategy	S5.1_L	X		
	Transport and logistics information systems	S5.3_L		X	
	Supply chain management tools	S5.4_L	X		X
	Warehouse and hinterland distribution management	S5.5_L	X		
	Globalization and logistics chain	S6.13_L	X		
	Sectorial logistics	S6.5_L	X		
	Logistic operators	S6.9_L	X		
	Planning logistic activities	S6.7_L	X		X
	Planning of logistics systems	S10.2_L	X		X
	Logistics associated with specific traffic port terminals	S6.8_L		X	
	Project management	S9.1_L	X		
	Transport freight and logistics	S9.2_L	X	X	
Transport operations	Transport analysis	G1.4_O			X
	Transport engineering and operations	G2.2_O		X	X
	Ports and maritime transport	G2.3_O		X	
	Air traffic management	G2.4_O	X	X	
	Freight transport	G2.5_O	X	X	
	Public transport	G2.7_O	X	X	
	Passenger and freight transport	G5.5_O	X	X	
	Commercial distributions of fast moving goods	S2.3_O		X	X
	Airport planning and management	S2.5_O	X		
	Public passenger transport	S2.6_O		X	X
	Traffic control	G6.3_O		X	
	Public transport	G7.3_O		X	X
	Fundamentals of traffic operations and control	G8.1_O		X	X
	Railway traffic management	S3.9_O	X		
	Airport management	S4.2_O	X		
	Production and operations management	S5.2_O			X
	Terminal management	S5.7_O	X		
	Port operations	S6.11_O			X
	Integrated transport systems	S7.4_O			X
	Organization and management of traffic and parking systems	S8.2_O	X	X	X
	Organization and management of freight transport	S8.3_O	X	X	X

Course category	Course	Code	Thematic areas		
			Governance and policy development	Smart solutions	Decision making
	Planning and management of railway transport	S8.4_O	X	X	X
	Organization and management of urban public transport systems	S8.7_O	X		X
	Organization and management of air transport and airports	S8.8_O	X		X
	Organization and management of maritime transport	S8.9_O	X		X
Transport planning	Urban and regional development in practice	S7.6_P	X		X
	Space and place: International planning practice	G1.7_P			X
	Public transport planning and management	G3.4_P	X		X
	Transport planning and sustainable mobility	G4.2_P	X		X
	Transportation planning: policies and methods	G5.1_P	X		X
	Transportation planning: practice	G5.2_P			X
	Transportation engineering: transport management	G5.4_P	X		X
	Railway traffic - Market and planning	G7.2_P	X		X
	Transport and spatial planning for urbanized regions	S3.4_P			X
	Airline planning & optimization	S3.7_P			X
	Shipping	S6.1_P			X
	Port services	S6.10_P		X	X
	Urban and regional development in practice	G1.6_P			X
	Project appraisal	S9.3_P			X
Transport engineering	Design of transport infrastructure	G4.4_D		X	X
	Railway management, economics and planning	G4.5_D	X		X
	Road design	G6.4_D		X	X
	Rail design	G6.5_D		X	X
	Traffic engineering and management	G7.1_D	X	X	X
	Assessment of transport infrastructure and systems	S3.3_D			X
	Planning and design of multi-modal infrastructure networks	S3.6_D		X	X
	Design and control of public transport systems	S3.8_D			X
	Transport, routing and scheduling	S3.10_D			X