

Deliverable 3.7.1/T2.7.1

STUDY MODULES OF THE EDU-RAIL PROJECT

Leading partner:

TTK / Tallinna Tehnikakõrgkool /TTK University of Applied Sciences



Project partners:

KRAO / Kouvola Rautatie ja Aikuiskoulutus OY



**TSI/TTI / Transporta un Sakaru Instituts / Transport and
Telecommunication Institute**



HAMK / Hämeen ammattikorkeakoulu /Häme University of Applied Sciences



RTU / Rigas Tehniska Universitate /Riga Technical University



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1. Introduction

The project EDU-RAIL aims at reducing fragmentation of railway engineering and logistics vocational and higher education and training programmes in the region. By reducing fragmentation of railway education through jointly developed regional specialisation modules, the project contributes to the development and further integration of the Central Baltic labour market. The project jointly develops aligned specialisation modules that take into account the needs of the regional labour market, including shared challenges of further integration with European railway system and joint regional aspects. The harmonised and modernised specialisation modules allow the railway institutions to better prepare and educate specialists for the regional employers' needs and meet the demand to enable smooth cross-border rail transportation within the common transport area.

The process (steps) of development of the teaching and study modules of the EDU-RAIL project follows the structure presented below:

1st step: defining the directions of modules, which were approved on the 1st Steering Group Meeting of EDU-RAIL project (Tallinn, 9.10.2015)¹.

2nd step: outlining the scope of module areas and drafting the module content by themes².

3rd step: carrying out activities which supported the outline process of study modules. For this, two small scale studies were implemented³: 1) regional studies in three partner countries to highlight the needs of railway employers 2) comparative study of teaching methodology of the railway technology related subjects. In the frames of this activity, study visits to the Lund Technical University and to the Swedish Railway Training Centre were organized. This Swedish university together with the VET training centre are running the bachelor level railway technology related study programme. Three high-level events dedicated to railway transport were visited to have the newest knowledge for outlining EDU-RAIL study modules.

¹ Deliverable 2.1.1 Steering Group Suggestions (internal document). Outcome of the First Steering Group Meeting, Tallinn 10.11.2015.

² Deliverable 2.2.1. Scope of Module Areas; internal working document

³ Deliverables 2.3.1 and 2.4.1. Small Scale Study Reports

4th step: outlining the subject lists of modules⁴. Every module covers 15 ECTS credit points of curricula.

5th step: detailing subjects of the modules and outlining teaching methodology⁵.

2. Defining Directions of the EDU-RAIL Teaching and Study Module

The first task of the project consortium was to define the directions of study and teaching modules.

On the first Steering Group meeting⁶, the following was pointed out:

Railways infrastructure managers of all the three countries are in the need of renewing the old national control-command and signalling systems. The tasks pointed out as important were the renovation of power systems and catenary, implementing new track building and maintenance technology, digitalization and the use of new IT and communication technologies. Related to the business environment, the following issues were mentioned: liberalization of market entrance conditions, impact of the new legal environment, service oriented approach, use of smart solutions and the need for new thinking, especially in the economic model of railway undertakings. The implementation of Rail Baltic was seen as the driver of several new needs in the coming years. Russia and other CIS countries were mentioned as vital business partners for Finland, Estonia and Latvia.

It was approved to develop 5 teaching and study modules which will have the following directions and leading partners (Table 1.1)

⁴ Deliverable 2.5.1. Outline of Modules by Subject Lists; internal working document

⁵ Deliverable 3.1.1. Detailing Subjects and Working out Teaching Methodology. Internal working document

⁶ Deliverable 2.1.1

Table 1.1 Defining directions of the study modules

Directions	What could be covered	Responsible partner
On the way to the single European Railway Area	<p>Module 1 will give basic knowledge related the following items:</p> <ul style="list-style-type: none"> • basic principles of the European transport policy; • legislation of the Single European Railway Area; • content of the Single European Area; • European railway governance; • research and innovations in railway transport 	TSI/TTI, Riga
General railway traffic safety related professional knowledge	<p>Module 2 will give basic professional knowledge and requirements regarding train traffic safety, including license and certificate of train driver and other safety related professions (for VET and selected subjects of the professional higher education):</p> <ul style="list-style-type: none"> • principles of train traffic safety; • safety principles related to rolling stock; • tests and checks before starting train movement; • basic physics of wheel-rail contact; • operations with dangerous goods; • basic safety principles related to the infrastructure. 	KRAO
Service oriented and intelligent rail transport system in the context of opening markets	<p>Module 3 will give the basic knowledge how the railway transport business works on the context of opening markets:</p> <ul style="list-style-type: none"> • opening process of the European rail transport markets; • needs of the open markets related to infrastructure; • market of customized and intelligent services; • practical and guided case study related from choice of student: commuter or long distance passenger transport or rail freight. 	HAMK
Control and command	<p>Module 4 will give the basic knowledge of control-and-command systems of rail traffic:</p>	RTU, Riga

systems of rail traffic	<ul style="list-style-type: none"> European Rail Traffic Management System, control-command system, securing and controlling of the train movement on network, train positioning, software and hardware solutions; existing train traffic management systems, European Rail Traffic Management System ERTMS, communication systems including GSM-R, securing the train traffic, central control and command systems, real time control of train movement on network, train positioning including GPS systems, Software and hardware for communication including command function. 	
Logistic management and operating of rail transport	<p>Module 5 will cover the following topics:</p> <p>Management of rail freight operations, legislative bases of rail transport operations, role of railways in the logistic chains of transport, multimodal terminals and nodes, rolling stock for railway operations, operations with dangerous goods, risk analysis for rail operations, border crossing operations, services.</p>	TTK

3. Scope of the Module Areas

The aims and scope of the modules in general are defined in the EDU-RAIL internal document⁷:

Scoping of targeted and achieved knowledge and competences, which are common for curricula of all selected five study modules of EDU-RAIL.

Basic objectives of the EDU-RAIL project, which are common for all study modules:

- more harmonized and less fragmented railway education curricula as a basis for all modules;
- development of single European Railway Area (interoperability, regional aspects);
- operating in open market of rail services, ability for team work in multinational environments;
- ability to work in a digitalized operating environment with cyber risks;
- new thinking models for rail businesses;
- evaluating environmental protection aspects, ethical problems and safety and security aspects.

⁷ Deliverable 2.2.1

It was recommended to stress in the study process of all the modules that engineers of the future will be placed in tasks marked by different engineering skills, namely project management and implementation, process and asset management, design and resource planning. It was decided that every module will cover 15 ECTS credit points.

The goal of acquisition of common professional knowledge and skills is to reduce the fragmentation of railway engineering education and support the better understanding the EU Railway System and legislation.

Module 1: Single European Railway Area

The goal of the module is to introduce the students to the strategic legislative and technical documents related to the development and operation of the rail sector in the Single European Transport Area, with focus on the Single European Railway Area. The goal is to give a comprehensive understanding of the EU strategies for transport in general, with focus on rail related issues such as directives, railway packages, technical specifications, research and development. The passing of the module will give students the skills to be able to orientate in the legislative and technical basic documentation on the EU, on national and on operator's level.

The EU and national level governance are especially highlighted. The European Transport Policy and strategies were introduced through White Paper and Green Paper in 2011. The comprehensive approach will cover the development problems of the European transport area, the Euro-Asian connections and the regional developments in the Baltic Sea area with focus on the Central Baltic area. The following issues will be highlighted: the opening of rail freight and passenger markets, harmonizing the training and vocational competences, especially for train drivers and safety related personnel. The aim of the module is to open the principles of how the Single European Transport Area will be operating. The role of governing and supporting functions in the EU and national level will be highlighted, including TEN-t developments with ERTMS and technical standards for interoperability of cross border services. Finally, the module will concentrate on the development and innovative activities needed towards achieving the Single European Railway area.

The overall goal of the module is to acquire the skills of applying the main documents of the EU transport policy sphere and legislation according to the tasks and development of a particular transport organisation.

The main goals of the module:

- to introduce students to the key principles of transport policymaking in international context;

- to provide students with an understanding of the fundamentals of transport planning in the context of wider policy making;
- to equip students with a conceptual and practical understanding of transport appraisal.

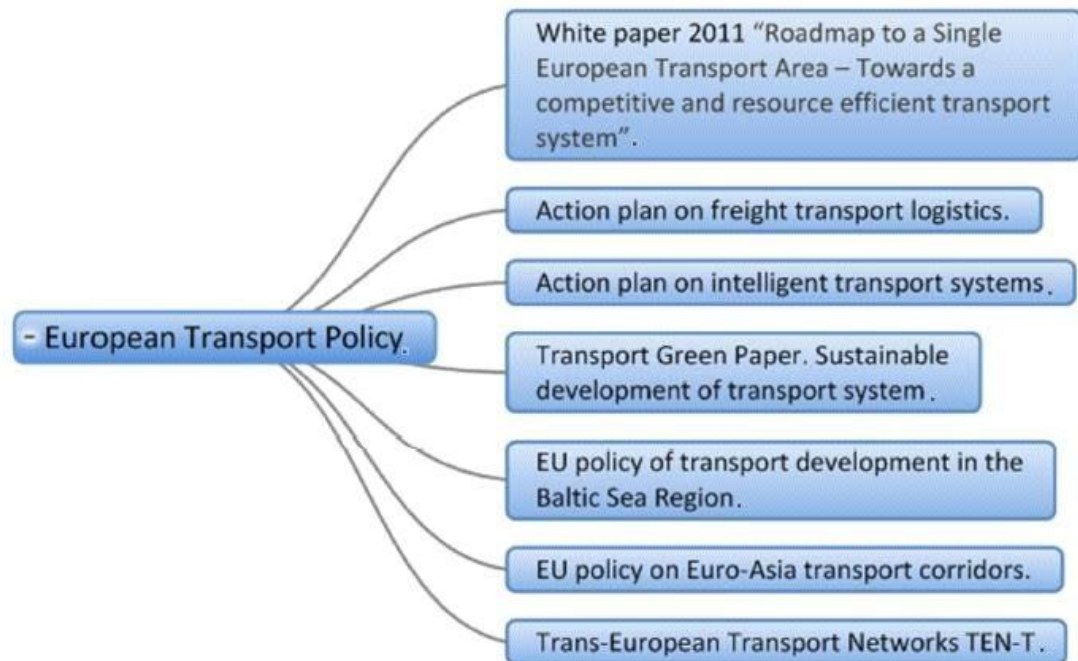


Fig 1. European railway governance

Module 2: General Professional Knowledge and Requirements Regarding the License

The aim of module is to facilitate VET programs for rail traffic safety related professions. The focus will be on teaching train drivers. Module content is based on the following Community documents:

- [Commission Decision on the adoption of basic parameters for registers of train driving licenses and complementary certificates provided for under Directive 2007/59/EC](#)
- [Directive on Safety on the Community's railways](#)
- [Directive on the certification of train drivers operating locomotives and trains on the railway system in the Community](#)

The overall objective is to provide skills of “general competence” on all aspects that are relevant to the train driver profession. The general training in this respect will focus on basic knowledge and principles that are applicable independently of the type and nature of rolling stock or infrastructure.

It can be organized without practical exercises in field. Competence with regard to specific types of rolling stock or with regard to safety and operating rules and techniques for a particular infrastructure is not part of “general competence”. Training with specific rolling stock or infrastructure competence is related to the train driver's certificate. Subjects of the module are supported with exercises on the rail simulators.

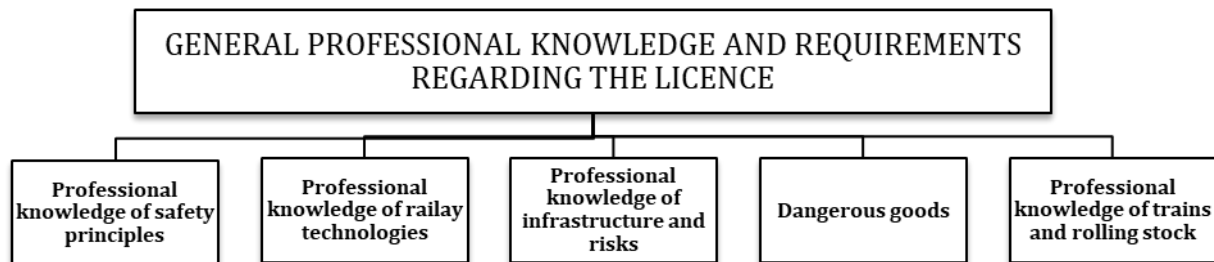


Fig 2: Outline of the structure of the module 2

Module 3: Service Oriented and Intelligent Transport Systems and Services in the Context of Opening Markets

The aim of the module is to give the basic knowledge of how to organize a railway business in the context of opening markets and the development towards the Single European Railway Area. The role of the Rail Regulatory Body and security certificate will be highlighted. The focus will be on the impact of the new and open business environment, use of innovations and new thinking model, which is based on the use of smart solutions, is client oriented and offers customized services. Mobility is understood as a service.

The process of opening rail freight and passenger markets gives challenging tasks for every country. It is a long-term process consisting of a number of preparation activities. Market opening and competition in the field of freight and passenger services will be presented using the examples of the partner countries of EDU-RAIL. Impact from new smart and customized services in the use of capacity of rail infrastructure (optimizing timetables and more trains on the same infrastructure) will be tackled in the subjects of the module. The module will prepare the students of professional higher education to work in the new and multinational rail business with open markets and more integrated labour force of Central Baltic Region. The module is focused on the passenger services; rail freight issues are handled on general level.



Fig 3. First vision of the scope of Module 3.

Module 4: Control and Command Systems of Rail Traffic

The main target of the Module is to understand and harmonize train control systems of the national railways taking into account international transit corridors and the necessity to support passenger and freight transportation among countries. The scope of module embraces the main principles of building any train control systems, also takes into account the specifics and practices of each viewed country both from a technical point of view and in terms of legal regulation. The material of the Module includes information about the common Train Control System (European Rail Traffic Management System- ERTMS), the system of GSM-R data transmission and the material about national systems of traffic management and communication. As a result of familiarization with the Module a student will have knowledge that allows him to develop technical solutions for solving problems of interoperability among railways, different train control systems' implementation and maintenance skills and also he will have comprehensive understanding of the technical problems in combining different systems.

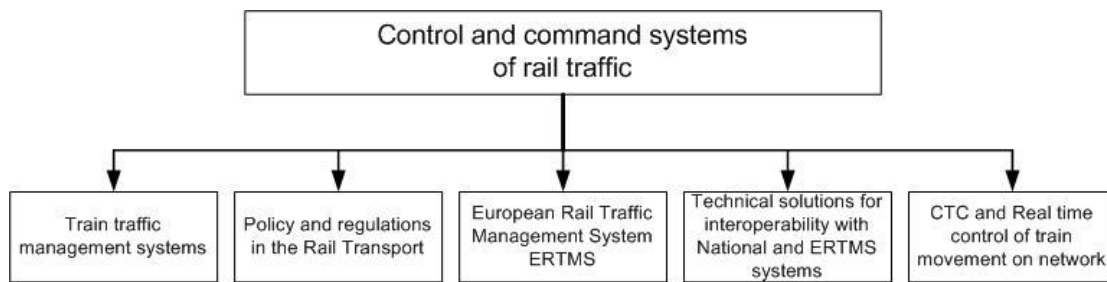


Fig 4. Structure of the Module 4

Module 5: Logistic Management and Operating of Rail Transport

The module is centred on the rail transportation systems as whole, particularly on the role of rail freight systems and their components. The module provides the knowledge and skills in the field of overall logistics management, including railway technology and management. After completing the module, the students have the systematic knowledge of the logistics and transport systems and about the operating of rail transport. The purpose of acquisition of professional knowledge and skills is to reduce the fragmentation of railway engineering education and to support the better understanding the EU Railway System and legislation. This module provides a common understanding of the railway system, freight transport operations, management and technology required for sustainable and intelligent rail freight system design and operation. The developed module with the learning material is used fully or partly for formal and continuing education for all partners of this project.

The following themes will be highlighted:

- the role of rail transport in supply chain;
- policy and regulations in rail transport;
- railway freight operations and management;
- railway asset management and pricing;
- rail environment and crew management.

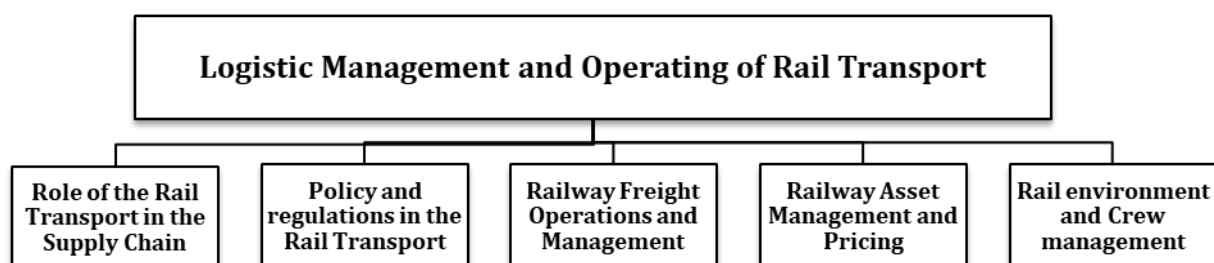


Fig 4. Structure of the module 5

4. Outlining of the Modules by Subjects List⁸

In the study process of all modules was recommend to stress that engineers of the future will be placed in tasks marked by different engineering skills, namely project management and implementation, process and asset management, design and resource planning.

In general, the outlines of the five EDU-RAIL modules had the following structure:

- general objectives of the subject;
- learning outcomes (achieved knowledge and skills).

Outline of subjects of the Modules:

- general objective of the subject;
- learning outcomes (achieved knowledge and skills);
- short description of content of the subject;
- basic references for study materials of the subject.

Detailed subject lists of study modules are presented below.

Module 1. Single European Railway Area, responsible TTI

Subjects of the Module 1 are:

- Subject 1. European Transport Policy
- Subject 2. Legislation of Single European Railway Area
- Subject 3. Single European Railway Area Content
- Subject 4. European Railway Governance
- Subject 5. Rail Research and Innovation in Europe

Module 2. General Professional Knowledge and Requirements Regarding the License, responsible KRAO

Subjects of the Module 2 are:

- Subject 1. Professional Knowledge of Safety Principles
- Subject 2. Professional Knowledge of Trains and Rolling Stock
- Subject 3. Professional Knowledge of Railway Technologies
- Subject 4. Dangerous Goods
- Subject 5. Professional Knowledge of infrastructure and Risks

⁸ Outline of modules is based on the internal documents 2.5.1 and small scale studies 2.3.1. and 2.4.1

Module 3. Service Oriented and Intelligent Transport System in the Context of Opening Markets, responsible HAMK

Subjects of Module 3 are:

- Subject 1. Markets - The Opening Railway Markets
- Subject 2. Infrastructure - The Needs of the Opening Railway Markets
- Subject 3. Customised Services, Intelligent Solutions
- Subject 4. Case Study

Module 4. Control and Command Systems of Rail Traffic, responsible RTU

Subjects of the Module 4 are:

- Subject 1. Train Traffic Management Systems
- Subject 2. Policy and Regulations in the Rail Transport
- Subject 3. European Rail Traffic Management System ERTMS
- Subject 4. Technical Solutions for Interoperability with National and ERTMS Systems
- Subject 5. CTC and Real Time Control of Train Movement on Network

Module 5. Logistic Management and Operating of Rail Transport, responsible TTK

Themes which are covered:

- Subject 1. Role of Rail Transport in Supply Chain
- Subject 2. Policy and Regulations in Rail Transport
- Subject 3. Railway Freight Operations and Management
- Subject 4. Railway Asset Management and Pricing
- Subject 5. Environment and Cross-Border Resource Management in Rail Transport

5. Detailing the Content of the Modules

The second step of detailing the modules included the following: if necessary, the subjects of teaching modules were detailed or upgraded; objectives were highlighted⁹, learning outcomes detailed and specified in comparison of content of the deliverable 2.5.1:

- general objective of the subjects (themes) of module;

⁹ As defined in the Guidelines for activity 2.5.1.

- learning outcomes (achieved knowledge and skills);
- short description of content of the subjects of module for every subject (theme of study module);
- basic references (links and sources) for study materials for the subjects of module.

In the description of the subjects, teaching methodologies and the following issues were highlighted:

- timeframe for planning themes (subjects) and necessary activities (active classroom work, practical training, seminars, hours for self-training);
- the description of use the modelling tools in teaching and study process;
- themes for practical exercises;
- content and form of students' independent work in the study process;
- description of evaluation process and weights of different activities in forming the accept of the scores of the study process (actions that will be assessed, proportions of the final grade formation).

Full description of the results of detailing of five study modules is presented in the internal working document Deliverable 2.5.1 "Outlining Modules by Subject List". It is possible to apply for the accessing of the document form the partner organizations of the EDU-RAIL project.

Module 1, Single European Railway Area, responsible TTI

General objectives of the module:

- to acquire the skills of applying the main documents of the sphere of the EU transport policy according to the tasks of development of the particular transport organizations;
- to introduce students to the key principles of transport policymaking in an international context;
- to provide students with an understanding of the fundamentals of rail transport planning in the context of wider policy making;
- to equip students with a conceptual and practical understanding of rail transport appraisal.

General outcomes

On successful completion of the course, students will have the following knowledge, skills and competences:

A. knowledge and understanding of:

- the principles of sustainable transport management;
- the basics of sustainable transport planning;
- strategic issues in local and international transport;
- current challenges and emerging issues in sustainable transport management.

B. practical skills to:

- explain, interpret and critically analyse transport systems;
- analyse arising controversial issues in transport processes and functions, discuss emerging problems of transport development;
- explore strategic decision-making process in evaluation and improvement of transport systems;
- classify a transport operation in terms of its scale and scope.

C. competences. On a successful completion of the module, students will be able to:

- analyse different aspects of transport modes;
- explore variety of problems in passenger and freight transport;
- tackle the major issues in public transport systems;
- investigate local and international transport development issues;

- give an overview of the main European and international institutions involved in railway policy development.

Module 2, General Professional Knowledge and Requirements, responsible KRAO

The objective of the “general training” is to provide “general” competence on all aspects that are relevant to the train driver's profession. The general training in this respect will focus on basic knowledge and principles that are applicable independently of the type and nature of rolling stock or infrastructure.

General objectives:

- acquiring the knowledge and procedures regarding of railway technologies, including safety principles and the philosophy behind operational regulations;
- acquiring knowledge and procedures regarding the risks related to railway operation and the various means to be used to combat them;
- acquiring knowledge and procedures regarding the principles guiding one or more railway operating modes;
- acquiring knowledge and procedures regarding trains, their composition and technical requirements on traction units, wagons, coaches and other rolling stock.

The aim of this course is to provide knowledge about railway automation and communication systems of railway.

Learning outcomes:

After completion of the model, the students will

- understand the specific requirements for working in the profession of driver, its importance, and the professional and personal demands (long periods of work, being away from home, etc.);
- be able to apply staff safety rules identify rolling stock know and apply a working method in a precise manner;
- be able to identify the reference and applications documents (manual of procedures and manual of lines as defined in the ‘Operations’ TSI driver’s manual, breakdown manual, etc.);
- have learned behaviours which are compatible with safety-critical responsibilities;
- be able to identify the procedures applicable to accidents;
- be able to involve persons to distinguish the hazards involved in railway operations in general;

- know the principles governing traffic safety;
- know the principles of electric technology.

Methodology:

The teaching process of subjects of the module follow the recommended stream line. The learning process of next subject will start after having passed the theoretical part of the previous subject of the module.

Methodology proposes that the responsibility of learning should increasingly reside with the trainee, and the roles of instructor would change to that of facilitator who mentors the trainee during their active exploration of a given issue. Methodology applies the concept of simulator-supported collaborative learning to provide opportunities to practice skills in driving, communication, knowledge sharing and critical thinking; discussions allowed for expression of independent thought and encouraged negotiating with the ideas of others.

The scope of the Module is 15 ECTS credit points.

Module 2 highlights the following areas:

1) Professional knowledge of safety principles:

work of a train driver, the work environment, the driver's role and responsibility in the process of rail operation, the professional and personal demands of the driver's duties including safety principles and the philosophy behind operational regulations.

Knowledge and procedures regarding to the principles guiding one or more railway operating modes.

2) Professional knowledge of trains and rolling stock

Trains, their composition and the technical requirements for traction units, wagons, coaches and other rolling stock. Knowledge and procedures regarding trains, their composition and technical requirements on traction units, wagons, coaches and other rolling stock.

3) Professional knowledge of railway technologies

Railway technologies, including safety principles behind operational regulations.

Basic principles of operational communication. Knowledge and procedures regarding of railway technologies.

4) Operating with dangerous goods

Specific training programme related to the rail transport and handling of dangerous goods.

5) Professional knowledge of infrastructure and risks

Basic principles of railway infrastructure. Hazards involved in railway operations in general.

Basic principles of physics. Knowledge and procedures regarding the risks related to railway operation and the various means to be used to tackle them.

Subjects of module 2:

- Subject 1: A driver's work, the work environment, the driver's role and responsibility in the process of rail operation, the professional and personal demands of the driver's duties
- Subject 2: Railway technologies, including safety principles behind operational regulations
- Subject 3: Basic principles of railway infrastructure
- Subject 4: Basic principles of operational communication
- Subject 5: Trains, their composition and the technical requirements for traction units, wagons, coaches and other rolling stock
- Subject 6: Hazards involved in railway operations in general
- Subject 7: Basic principles of rail-wheel physics

Subject 1. A driver's work, the work environment, the driver's role and responsibility in the process of rail operation, the professional and personal demands of the driver's duties

Teaching methodology: Study works, contact learning

Goals:

- to know the general thrust of legislation and rules applicable to rail operation and safety (requirements and procedures regarding the certification of train drivers, dangerous goods, environmental protection, fire protection, etc.);
- to understand the specific requirements and professional and personal demands (working mainly on one's own, shift work over 24-hour cycle, individual protection and security, reading and updating documents, etc.);
- to understand behaviours which are compatible with safety-critical responsibilities (medication, alcohol, drugs and other psychoactive substances, illness, stress, fatigue, etc.);
- to identify the reference and operating documents (e.g. rule book, route book, driver's manual, etc.);
- to identify the responsibilities and functions of persons involved;
- to understand the importance of being precise in carrying out duties and in working methods;
- to understand occupational health and safety (e.g. code of behaviour on and near tracks, code of behaviour for getting on and off the traction unit safely, ergonomics, staff safety rules, personal protective equipment, etc.);

- to know behavioural skills and principles (stress management, extreme situations, etc.)
- to know the principles of environmental protection (sustainable driving, etc.)

Subject 2. Railway technologies, including safety principles behind operational regulations

Teaching methodology: Study works, contact learning

Goals:

- to know the principles, regulations and provisions regarding safety in rail operation;
- to identify the responsibilities and functions of persons involved.

Subject 3. Basic principles of railway infrastructure

Teaching methodology: Study works, contact learning

Goals:

- to know systematic and structural principles and parameters;
- to know the general characteristics of tracks, stations, marshalling yards;
- to know railway structures (bridges, tunnels, points, etc.);
- to know operating modes (single track, double track operation, etc.);
- to know signalling and train control systems;
- to know safety installations (hot-axle box detectors, smoke detectors in tunnels, etc.);
- to know traction power supply (catenary, third rail, etc.).

Subject 4. Basic principles of operational communication

Teaching methodology: Study works, contact learning

Goals:

- to know the significance of communication and the means and procedures for communicating;
- to identify persons, the driver needs to contact and their role and responsibility (staff of the infrastructure manager, working duties of other train staff, etc.);
- to identify situations/causes that require communication to be initiated;
- to understand communication methods.

Subject 5. Trains, their composition and the technical requirements for traction units, wagons, coaches and other rolling stock

Teaching methodology: Study works, contact learning

Goals:

- to know the generic types of traction (electric, diesel, steam, etc.);
- to describe the layout of a vehicle (bogies, bodies, driving cab, protection systems, etc.);
- to know the content and systems of labelling;
- to know the documentation on train composition;
- to understand braking systems and performance calculation;
- to identify train speed;
- to identify maximum load and forces at the coupler;
- to know the operation and purpose of the train management system.

Subject 6. Hazards involved in railway operations in general

Teaching methodology: Study works, contact learning

Goals:

- to understand the principles governing traffic safety;
- to know the risks related to railway operation and the various means to be used to mitigate them;
- to know safety-relevant incidents and understand the required behaviour/reaction;
- to know the procedures applicable to accidents involving persons (e.g. evacuation).

Subject 7. Basic principles of physics

Teaching methodology: Study works, contact learning

Goals:

- to understand forces at the wheel;
- to identify factors influencing accelerating and braking performance (weather conditions, braking equipment, reduced adhesion, sanding, etc.);
- to understand principles of electricity (circuits, measuring voltage, etc.).

Description of independent work and evaluation

(To be done in accordance with local conditions)

The specific topic for learning and vocabulary are presented to students in detail. The teacher selects information and resources that will allow students to interact and understand the lesson objective. The teacher models, explains and/or demonstrates student expectations for the new learning.

Assessment criteria for implemented work are exams; competence test; results of assessment might have following values: rejected, acknowledged or good, excellent.

Professional knowledge of rolling stock and requirements regarding the certificate

Matters relating to rolling stock:

- tests and checks prior to departure;
- knowledge of rolling stock;
- testing the brakes;
- operating mode and maximum speed of the train in relation to the line characteristics;
- driving the train in a way which does not damage installations or vehicles;
- anomalies;
- operating incidents and accidents, fires and accidents involving persons;
- conditions for continuing running after an incident involving rolling stock;
- immobilization of the train.

Details related to the tests and checks prior to departure, about rolling stock, are presented in the Deliverable¹⁰ 3.2.1/2.

Knowledge of rolling stock and operations

Learning outcomes:

To operate a locomotive, drivers must be familiar with all the controls and indicators placed at their disposal, those concerning traction, braking, traffic safety related elements.

Driving the train in a way which does not damage installations or vehicles

Learning outcomes

Drivers must be able to:

- use all available control systems in accordance with the applicable rules;

¹⁰ Deliverable 3.2.1/2 Teaching and Study Materials for Module 2 GENERAL PROFESSIONAL KNOWLEDGE AND REQUIREMENTS REGARDING THE LICENSE / Traffic Safety; Draft of Internal working document

- start the train taking account of adhesion and power constraints;
- apply the brakes for decelerations and stops, taking account of the rolling stock and installations.

Anomalies

Drivers can:

- be attentive to unusual occurrences concerning the behaviour of the train;
- inspect the train and identify signs of anomalies, distinguish between them, react according to their relative importance and try to remedy them, always giving priority to the safety of rail traffic and persons;
- know the available means of protection and communication.

Operating incidents and accidents, fires and accidents involving persons

Drivers must:

- be able to take steps to protect the train and summon assistance in the event of an accident involving persons on board the train;
- be able to determine whether the train is transporting dangerous goods and identify them on the basis of train documents and wagon lists;
- know the procedures relating to the evacuation of a train in case of emergency.

Conditions for continuing running after an incident involving rolling stock

After an incident, drivers must be able to:

- assess whether the vehicle can continue to run and under what conditions, to inform the infrastructure manager of those conditions as soon as possible;
- determine if an expert evaluation is necessary before the train can continue.

Immobilization of the train

Drivers must be able to take measures to ensure that the train, or parts thereof, does not start up or move unexpectedly, even in the most difficult conditions.

Furthermore, drivers must have knowledge about measures which can stop a train or parts thereof in case it has started to move unexpectedly.

Module 3, Service Oriented and Intelligent Transport System in the Context of Opening Markets, responsible HAMK

Detailing subjects and working out teaching methodology for each module

Studying at Häme University of Applied Sciences in the Traffic Management Programme is based on a constructive approach to learning, where learners construct knowledge out of their own personal experiences and upon earlier learning experiences, thus enabling an evolvement of understanding. Learning is a goal-oriented, collaborative, explorative, innovative and creative activity. The offset for student guidance is students' own activity supported by teachers and the whole personnel of the university.

In traditional contact classes, learning is founded on autonomous learning, data acquisition as well as lectures combined with individual and team projects. In e-learning, which is at a new stage of development, the focus is on autonomous learning, data acquisition, web-based lectures as well as individual and team projects online. University library and separate self-study areas furnished with literature and computers support students in their studies. E-learning is being constantly developed with the goal of creating a virtual, supportive learning environment online.

In Module 3, by HAMK, there are four themes; three of these with traditional teaching methods alternating lectures with individual studies and learning assignments. In individual studies and with learning assignments students have the possibility of utilizing their previously acquired skills and knowledge. In e-learning, lectures are given online and independent studies are also supported there. Learning assignments are conducted as team projects e.g. through Skype. The Moodle learning environment is used as an online platform. The first three topics are:

Theme 1 **Market - The Opening Railway Market**

Theme 2 **Infrastructure - The Needs of the Opening Railway Market**

Theme 3 **Customized Services, Intelligent Solutions**

In theme 4, the focus is on a case study. Students perform extensive assignments based on topics of their own choice. During the assignment, the objective is to learn one of the most important working methods required in positions of expertise in working life today, i.e. project work. The case study proceeds by combining previously acquired knowledge, especially the theory and practice acquired during themes 1, 2 and 3 of this course for performing the individually chosen case study. In the assignment, students apply academic writing skills and referencing style. In the written assignment, the contribution of the students is most clearly seen in the discussion and conclusion

part of the assignment. After the completion of the module, students are able to deliver well-founded presentations and arguments as experts in the field. Students condense the case study assignment into written form as 10-12 pages of a Word document.

Theme 4: Case Study

The module is concluded as a contact day at the HAMK Riihimäki Campus under the theme “case study presentations”. During the day, students present their learning assignments for theme 4. The goal of the day is to distribute what each student has learnt in his/her case study to all the other students and thereby students learn from each other's experiences. During the case study day, feedback is gathered from the students for further development of the course.

The share of contact classes and independent studies at HAMK is composed so that in contact classes the work load of one credit (1 ECTS) is divided as follows:

- contact classes, traditional lectures or virtual lectures 21h;
- independent work by the student 21 h;
- preparatory work for teaching by the teacher 21 h.

E-learning and the virtual solutions are in the developing process.

In this module, themes: 1, 2, and 3 are all of 4 ECTS, and hence the work load of each is divided as follows:

- contact classes, traditional lectures or virtual lectures 84h;
- independent work by the student 84 h;
- preparatory work by the teacher 84 h;

The extent of Theme 4, 'Case Study', is 3 cr. In this theme, the total work load is composed of independent work by the student $(21h + 21h) \times 3$ less the seminar day (8h) organized at the Riihimäki Campus. In this theme, the teacher's work load is divided as follows: 50% (63h) for preparatory work, and 50% (63h) for commenting and assessing the assignments, as well as for giving feedback to the students.

Scope of Module 3: Service Oriented and Intelligent Transport System in the Context of Opening Markets; HAMK is 15 ECTS credits

Subject 1 Markets	4 ECTS credits
Subject 2 Infrastructure	4 ECTS credits
Subject 3 Customized Services, Intelligent Solutions	4 ECTS credits
Subject 4 Case Study Research	3 ECTS credits

Module 3: Service Oriented and Intelligent Transport System in the Context of Opening Market

After completing the third module, the students have an up-to-date knowledge from the railway operator's point of view either about the passenger traffic market, the freight traffic market or the labour market. During the module, the students perceive the needs of the infrastructure in an operational environment where the market is open up to competition. New tools such as digitalization and service design can be used at the same time as there is a need to develop and customize operator based service products.

The students also get new general knowledge of working life needs such as the tendering process and economic thinking, learn to perceive changes in the market, learn about teamwork and communication skills. During the case study, students can practice the skills they have learned during the course and also the skills they acquired earlier.

Short description of achieved knowledge and targeted competences per subject (theme) of module 3:

- theme 1 **Market - The Opening Railway Market**

The passenger traffic market is changing through a tendering process in the big Helsinki area year by 2021. The long distance train market will be open for the competition in year 2024. What kind of changes can we expect? The freight market opened to competition in 2007. What kind of changes have we seen because of that? What is the situation today? How are the changes reflected in the traditional railway professions in the labour market?

- theme 2 **Infrastructure - The Needs of the Opening Railway Market**

During the last ten years, the authorities have made the necessary changes to the railway infrastructure before opening the market for tendering in the big Helsinki area and before competition in the long distance train market can start. What kind of changes has this caused to the freight traffic?

- theme 3 **Customised Services, Intelligent Solutions**

More operators are entering the market. How to customize your service products? New tools such as digitalization and service design are available at the same time as there is a need to develop and customize operator-based service products.

- theme 4 **Case Study**

According to the students' interest in the assignment, the case study targets are in the commuter, long distance or freight traffic. During the study, students can practice the skills they have learned during the course and also the skills they have acquired earlier.

Module 4, Control and Command Systems of Rail Traffic, responsible RTU

Methodology

Module 15 credit points (5 Subjects)

Subjects (Themes) of module 4:

- Subject 1 Train Traffic Management Systems
- Subject 2 Policy and Regulations in the Rail Transport
- Subject 3 European Rail Traffic Management System ERTMS
- Subject 4 Technical Solutions for Interoperability with National and ERTMS Systems
- Subject 5 CTC and Real Time Control of Train Movement on Network

Proportions of the students' work

1. Lecture 20%
2. Practical work (classroom joint work or visiting or discussion seminar) 20%
3. Independent work 50%, including:
 - With e-learning materials 20%
 - With e-learning tasks 20%
 - Problem-based modelling for knowledge and skills control 20%

Auditory part in all the five subjects are lectures. Independent work with e-learning materials will take place in parallel with the lectures.

The teaching process of subjects of the module use to follow the recommended stream line order. The learning process of next subject will start after having passed the theoretical part of the previous subject of the module.

Practical activities depend on the subject content. Some of practical work student do in classroom on simulator, some of them is theoretical calculating. Part of practical and lecture lessons will be learned in the course of discussions, problem-based learning in seminars.

Independent work with e-learning tasks takes place after the completion of the auditorium or the practical activities in the company.

Evaluation is carried out based on the independent work problem-task solution file integrity, and the basis of the result of the defence in front of fellow students.

General objective of the module:

The Aims of Module: The aim of the course is to provide students with fundamental knowledge of control and command systems of rail traffic, taking into consideration the different types of traffic management systems and analysing their structure and basic safety solutions.

General outcomes (knowledge and competences, which are common for five subjects of module 4);

Knowledge and understanding

For a passing grade the student must:

- have an understanding of the construction of the train traffic management systems;
- know the principles of operation systems;
- be able to classify and analyse the different kinds of train traffic management systems.

Competences and skills

For a passing grade the student must:

- have the skills to design train traffic management systems;
- have the knowledge of systems' maintenance and diagnostics;
- have an understanding of the technical and design documentation.

Short overall description of the content of the module

The study course covers the topic of railway movement organization systems, focusing especially on the movement control principles on stages. Special attention is paid to suburban and high-speed movement.

A separate section is dedicated to train movement organization in stations. Definitions and concepts of the basic principles of control and signalization are given.

Special attention is paid to safety organization principles in technical systems and on analysing differences in different systems.

Outline of the common framework of methodology for teaching and study materials for all subjects (themes) of module (15 credit points).

This framework will cover the common objectives for teaching and learning process of the module 4.

Outline of teaching methodology defined subjects (themes) of module 4.

If necessary, the subjects of teaching module will be detailed or upgraded.

Subjects of the Module 4 are:

- Subject 1. Train Traffic Management Systems
- Subject 2. Policy and Regulations in the Rail Transport

- Subject 3. European Rail Traffic Management System ERTMS
- Subject 4. Technical Solutions for Interoperability with National and ERTMS Systems
- Subject 5. CTC and Real Time Control of Train Movement on Network

Subject 1. Train Traffic Management Systems

Volume 4 ECTS

Valid from: 2016/17

Language of instruction: English

Aim:

the aim of the course is to provide students with fundamental knowledge of traffic management systems. Considering different types of traffic management systems, students will analyse their structure and basic safety solutions.

Learning outcomes:

Knowledge and understanding

For a passing grade the student must:

- have an understanding of the construction of the train traffic management systems;
- know the principles of operation systems;
- be able to classify and analyse the different kind of train traffic management systems.

Competences and skills

For a passing grade the student must:

- have the skills to design train traffic management systems;
- have the knowledge of systems maintenance and diagnostics;
- have an understanding of the technical and design documentation.

Contents

The study course covers the topic of railway movement organization systems, focusing especially on the movement control principles on stages. Special attention is paid to suburban and high-speed movement.

A separate section is dedicated to train movement organization in stations. Definitions and concepts of the basic principles of control and signalization are given.

Special attention is paid to safety organization principles in technical systems and on analysing differences in different systems.

Examination details

Assessment: Written exam. Individual technical work of a train traffic management system building.

Subject 2. Policy and regulations in the Rail Transport

Volume: 4 ECTS

Valid from: 2016/17

Language of instruction: English

Aim:

to acquire basic knowledge on the regulatory framework of the Russian and the European Union railways and international organizations in the field of railway transport.

Learning outcomes

Knowledge and understanding

For a passing grade, the student must:

- know basic international treaties in the field of international passenger transportations (СМПС, КОТИФ/ЦИВ);
- know basic parameters for the following subsystems: infrastructure (track and track facilities), rolling stock (locomotives and passenger wagons, motor wagon rolling stock).

Competences and skills

For a passing grade, the student must:

- know interoperability policy bases and technical specifications structure, its application features on the bases of contact group ОСЖД/ЕЖДА work in the interaction of railway system track 1520mm/1435mm;
- be able to navigate in the international organizations normative-technical documentation in the field of railway (ОСЖД, ОТИФ, МСЖД) and know basic tendencies of development.

Contents

The students will get to know the special terminology in the field of railway movement organization, movement control technical means on railway transport, railway infrastructure and traction electricity supply means, railway rolling stock.

At the end of the course, students will have the knowledge on the normative documents that define international transportation organization and exploitation work organization principles.

Examination details

Assessment: Written exam. Individual technical work of a train traffic management system building.

Subject 3. European Rail Traffic Management System ERTMS

Volume: 2 ECTS

Valid from: 2016/17

Language of instruction: English

Aim:

the aim of the course is to provide students with knowledge of European Rail Traffic Management System, focusing on the principles of the system and its implementation at various levels.

Learning outcomes

Knowledge and understanding

For a passing grade the student must:

- have an understanding of the construction of the European Rail Traffic Management System;
- know the principles of operation system;
- be able to classify and analyse the different levels and equipment of railway systems

Competences and skills

For a passing grade the student must:

- have the skills to design European Rail Traffic Management System;
- have knowledge of the systems' maintenance and diagnostics;
- have an understanding of the technical and design documentation.

Contents

The course examines the European Rail Traffic Management System, as a unique system for all Europe Union countries in the future. Detailed attention is paid to the system's realization levels, distinctive features and technical capability.

A full overview of necessary technical equipment, realization capability and functional set is given for each system level. Detailed attention is paid on transmission and safety provision methods of the new system.

Examination details

Assessment: Written exam. Individual technical work of a train traffic management system building.

Subject 4. Technical Solutions for Interoperability with National and ERTMS Systems

Volume: 2 ECTS

Valid from: 2016/17

Language of instruction: English

Aim:

the objective of the course is to teach the student to design a variety of technical solutions for interfacing different kinds of systems.

Learning outcomes

Knowledge and understanding

For a passing grade the student must:

- have an understanding of the problem to interfacing different systems;
- have an understanding of different rules for different systems

Competences and skills

For a passing grade the student must:

- know the principles of technical solutions for system interfacing;
- have the skills to design technical solutions for system interfacing;
- have knowledge of the maintenance and diagnostics the different systems;
- have an understanding of the technical and design documentation.

Contents

The course focuses on the basic differences in the construction and functionality of different railway systems. Special attention is paid to the capability of integrating national systems into the European Rail Traffic Management System, data transmission methods and additional subsystem construction. The course also covers the technical solutions to develop communication interface between different systems.

Examination details

Assessment: Written exam. Individual technical work of a train traffic management system building.

Subject 5. CTC and Real Time Control of Train Movement on Network

Volume: 3 ECTS

Valid from: 2016/17

Language of instruction: English

Aim:

the aim of the course is to provide students with fundamental knowledge of CTC and real time control of train movement on network. Also, the objective of the course is to provide definitions and concepts for the organisation of remote and automated train movement control.

Learning outcomes

Knowledge and understanding

For a passing grade the student must:

- have an understanding of the tasks and objectives of the CTC systems;
- know the principles of real time control of train movement;
- be able to classify and analyse the different types of CTC and real time control systems.

Competences and skills

For a passing grade the student must:

- have the skills to design CTC and real time control systems;
- have knowledge of systems' maintenance and diagnostics;
- have an understanding of the technical and design documentation.

Contents

The course focuses on the main questions concerning the modern CTC and real time control system construction and the formation of control and signalization commands. The topics covered include safe data transmission questions for dispatcher control and management systems.

Special attention is paid on the railway movement automatic and intellectual control functions such as

- train automatic numeric
- the use of railway movement automatic schedule
- intelligent consultancy system for emergency situations.

Examination details

Assessment: Written exam. Individual technical work of a train traffic management system building.

Module 5, Logistic Management and Operating of Rail Transport, responsible TTK

Methodology

The module will cover 15 credit points (5 subjects, 3 ECTS credit points each)

Proportions of the students' work:

- Lecture 20%
- Practical work (joint classroom work, study visits or discussion seminar) 20%
- Independent work 60%, including:
 - o working with e-learning materials 20%
 - o work on e-learning tasks 20%
 - o problem-based modelling for knowledge and skills control 20%

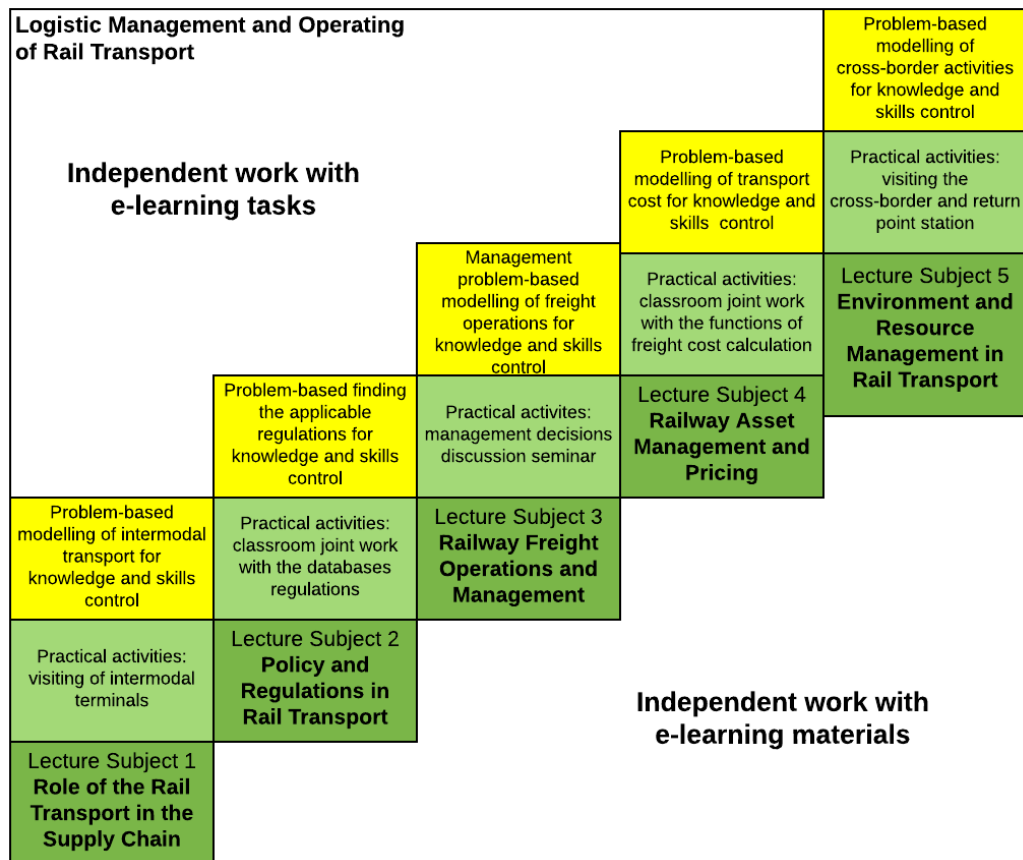


Figure 1. Timing of students' work

The auditory part in all the five subjects are lectures. Independent work with e-learning materials will take place in parallel with the lectures. The teaching process of subjects of the module follow the recommended stream line. The learning process of the next subject will start after having passed the theoretical part of the previous subject of the module.

Practical activities depend on the subject content. Railway transport part in the logistic transport chain and cross border activities will be learned in practical part in the working environment. Regulation and pricing of freight transportation is learned in the classroom during the problem-solving tasks. Freight transport organization and management processes will be learned in the course of discussions, problem-based learning in seminars.

Independent work with e-learning tasks takes place after the completion of the auditorium or the practical activities in the company.

Evaluation is carried out based on the independent work problem-task solution file integrity, and the basis of the result of the defence in front of fellow students.

General objectives of the module

This module is centred on the transportation systems as a whole and on the role of rail freight systems and their components. The module provides the knowledge and skills in fields of logistics management and in the field of railway technology and management.

General outcomes

After completing the module, the students have the systematic knowledge of the logistics and transport systems and operating of rail transport.

Short overall description of the content of the module

This module provides a common understanding of the railway system, freight transport operations, management and technology required for sustainable and intelligent rail freight system design. The developed module within the learning material is used for formal and continuing education for all partners of this project.

Subjects (themes) of module 5:

- Subject 1 The Role of Rail Transport in Supply Chain
- Subject 2 Policy and Regulations in Rail Transport
- Subject 3 Railway Freight Operations and Management
- Subject 4 Railway Asset Management and Pricing
- Subject 5 Rail Environment and Crew Management

Subject 1. The Role of Rail Transport in Supply Chain

Time management:

20% Lecture on Subject 1: The Role of Rail Transport in Supply Chain

20% Independent work with e-learning materials

20% Practical activities: visiting of intermodal terminals

20% Independent work with e-learning tasks

20% Problem-based modelling of intermodal transport for knowledge and skills control

General objective of the subject:

to integrate regularities of general logistics and rail-specific process.

Learning outcomes (achieved knowledge and skills)

The learner:

- knows the principles of functioning of rail systems;
- is able to evaluate the advantages and disadvantages inherent in the rail mode of transport choice;
- is able to understand the difference between an organizational rail logistics concept to other modes of transport;
- knows the role of railways in the global transport system.

The role of railway in transport system:

- role of transport in the whole economy;
- role of rail transport in supply chain management;
- comparison of transport modes;
- rail transport and railway system;
- cost-benefit analysis of transport modes.

The role of railway transport in the intermodal chain:

- transport technology for the co-modal chain;
- multi- and intermodal transportation;
- intermodal shipments documentation and freight forwarding;
- technology of intermodal transport.

Real-time path coordination, tracking, and information systems

- information and path coordination system;
- real-time monitoring systems for freight (tracking and tracing);
- documentation and billing systems.

Standards

- standards for rolling stock;
- standards for transport services;
- environmental standards.

Subject 2. Implementation of Policy and Regulations in Rail Transport

Time management

20% Lecture on subject 2 - Policy and Regulations in Rail Transport

20% Independent work with e-learning materials

20% Practical activities: joint classroom work with the databases regulations

20% Independent work with e-learning tasks

20% Problem-based finding the applicable regulations for knowledge and skill control

General objective of the subject

is to orientate in international legislative and technical regulations and in their national applications

Learning outcomes (achieved knowledge and skills)

The learner:

- knows the international trends in rail transport;
- knows process of creating international law and the fundamentals of national applications;
- knows international legal and recommended regulations;
- is able to find the limits imposed in railway transport.

New generation of rail vehicles and smart infrastructure

The influence of regulations in rail transportation

- cross-border enabling;
- shared best practices;
- transitional difficulties

Legal basis

- directives;
- EU regulations;
- national law

Technical specifications for interoperability

- infrastructure;
- resources for organization of the transportation, freight;
- communication

Agreements

- COTIF freight area;
- SMGS freight area;
- compatibility and exceptions in agreements

Legislation and Supervision

- law-making;
- statistics and reporting obligations;
- supervision

Subject 3. Railway Freight Operations and Management

Time management:

20% Lecture on subject 3 Railway Freight Operations and Management

20% Independent work with e-learning materials

20% Practical activities: management decisions discussion seminar

20% Independent work with e-learning tasks

20% Management problem-based modelling of freight operations for knowledge and skill control

The general objective of the subject

aims to provide an overview of the cooperation of railway companies in organizing rail freight

Learning outcomes (achieved knowledge and skills)

The learner:

- knows the railway companies, the nature and foundations of cooperation;
- knows the design bases for the service and quality assurance processes;
- knows the international rail transport logistic processes;
- knows the safety of railway traffic and railway freight transportation;
- able to carry out risk analysis, develop preventive systems of hazardous situations and compile process descriptions for contingencies.

Railway System

- the railway Companies (Undertakers -RU);
- railway infrastructure managers (IM);
- supporting entrepreneurship for railway

Services and quality

- basic and supporting services;
- service level and quality;
- open market and competition.

Planning of international transportation operations

- international transportation line planning and scheduling;
- international co-operation;
- border crossing operations management

Safety and security of Transportation operations

- the requirements for Loading and Gauges;
- transport management of dangerous goods;
- accident processing

Subject 4. Railway Asset Management and Pricing

Time management:

20% Lecture on subject 4 - Railway Asset Management and Pricing

20% Independent work with e-learning materials

20% Practical activities: joint classroom work with the functions of freight cost calculation

20% Independent work with e-learning tasks

20% Problem-based modelling of transport cost for knowledge and skills control

General objective of the subject:

- to give an overview of asset management and pricing;

Learning outcomes (achieved knowledge and skills)

The learner:

- understands the common management model of railway assets;
- understands the acquisition process and use of resources for asset management, taking into account the life-cycle costs, quality of service, rail traffic safety and the impact on the surrounding environment;
- has been acquainted with the legal environment of railways, including cross-border agreements, can implement them in his vocational and professional activities.

Rail management

- rail transport;
- assets of a railway undertaking
- organizing of railway assets

Pricing

- Cost accounting
 - o classification of railway transport costs;
 - o the obligation to accounting organization in railway undertakings;
 - o cost accounting system in railway undertakings
- Calculation of prices
 - o basics for pricing formation;
 - o railway infrastructure access fee for basic services;
 - o charges of other infrastructure services;
 - o freight charge and tariffs applied;
 - o commercial service fees of administration of the railways

Subject 5. Environment and Cross-Border Resource Management in Rail Transport

Time management:

20% Lecture on Subject 5 - Rail Environment and Crew Management

20% Independent work with e-learning materials

20% Practical activities: visiting the cross-border and return point station

20% Independent work with e-learning tasks

20% Problem-based modelling of cross-border activities for knowledge and skill control

General objective of the subject

is to provide an overview of the railway transport from the environmental point of view and resource organization for cross-border activities.

Learning outcomes (achieved knowledge and skills)

Learner:

- knows the environmental problems and possible solutions in the rail transport;
- knows stock selection criteria and management principles;
- knows train on-board personnel requirements;
- knows the organization of cross-border hauling resources.

Cross-border resource management in rail transport

Rolling stock selection

- locomotives;
- wagons;
- rolling stock and infrastructure interoperability with real-time systems

Training of employees

- professional requirements;
- health requirements;
- co-operation and information transmitting capability

Rolling stock rotation

- maintenance and repair schedules;
- Scheduling of regular services;
- fuel and energy consumption

Crew rotation

- work and rest time;
- turning point workflow management;
- border crossing management

Green & sustainable rail transportation

- environmental requirements for railway infrastructure;
- environmental requirements of railway rolling stock;
- environmental requirements for rail freight (dangerous goods)

5. List of Reference Reports

Deliverable 2.1.1 Steering Group Suggestions (Internal document). Outcome of the First Steering Group Meeting, Tallinn 10.11.2015

Deliverable 2.2.1. Scope of Module Areas; Internal Working Document

Deliverable 2.3.1. Regional study. Summary; Internal Working Document

Deliverable 2.4.1. Comparative Study; Selection of best practices of teaching railway engineering and study modules

Deliverable 2.5.1. Outline of modules by subject lists, Internal working document

Deliverable 3.1.1. Detailing Subjects and Working out teaching methodology. Internal Working Document