

INTERNATIONALIZATION OF STUDY PROGRAMS OF DRESDEN UNIVERSITY OF TECHNOLOGY

Wolfgang FENGLER, Jochen TRINCKAUF, Ulrich MASCHEK, Gregor THEEG

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Prof. Dr.-Ing. Wolfgang Fengler, Prof. Dr.-Ing. Jochen Trinckauf, Dr.-Ing. Ulrich Maschek, Dipl.-Ing. Gregor Theeg, Dresden University of Technology, Faculty of Transportation and Traffic Sciences "Friedrich List", Institute for Railway Systems and Public Transport, D-01062 Dresden

GERMANY

Abstract: Dresden University of Technology with a long tradition in education of railway engineers is reforming its study programs and contents. The core is the introduction of a new master course with the preliminary title "Guided Transport Engineering". Graduates shall be able to understand the railways as a whole system as well as having specialized in a specific railway technical field. Besides, the university is internationalizing the teaching contents within the courses, accompanied by publishing a book on international railway signaling and control.

Key words: education, university, studies, railway engineering, master, bologna-process.

1. PROFILE OF RAILWAY ENGINEERS

Railway engineering is a complex field, mainly consisting of the three particular branches mentioned in Figure 1. A railway engineer shall have a basic understanding of railways and other guided transport systems in its complexity. Besides this system knowledge, he/she is specialized in a particular field out of railway engineering. Employers for railway engineers are among others:

- ◆ railway and local public transport companies
- ◆ railway industry
- ◆ consulting engineers
- ◆ supervisory bodies
- ◆ mandating bodies for public transport

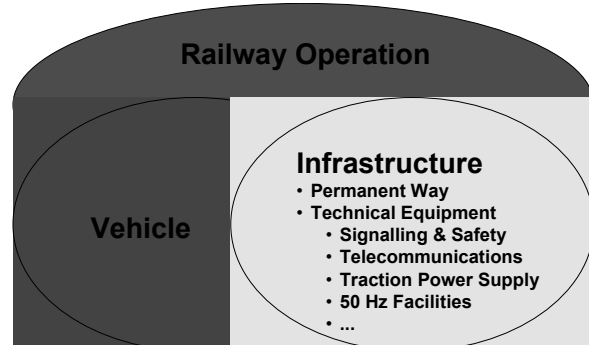


Fig. 1: Railway Engineering as a complex field

2. CURRENT RAIL RELATED STUDY PROGRAMS

Currently, Dresden University of Technology offers a study program in Transport Engineering, leading to the academic grade of "Diplom-Ingenieur" (Dipl.-Ing.) after five years regular duration of the studies. This study program is split into four specialized branches, with several selectable specialized courses each:

- ◆ Transport Planning and Traffic Engineering
- ◆ Transport Systems Engineering and Logistics with the sub-branches:

- ◆ Railway and Public Transport
- ◆ Transport Logistics
- ◆ Aviation
- ◆ Traffic and Transport Telematics
- ◆ Planning and Operation of Electrical Transportation Systems

This concept has basically been formed in the beginning 1990s. The idea was the horizontal integration of the education of transport engineers who are not specialized in one means of transport only, but can, for example, plan the layout for roads, railways and airports. These specializations contain parts of railway engineering each: track layout in Transport Planning and Traffic Engineering, railway operation in Transport Systems Engineering and Logistics etc. The specialization of Planning and Operation of Electrical Transportation Systems deals specifically with the electrical traction and power supply, not with the complex railway system.

Besides the study program of Transport Engineering, rail related specializations within the study programs of Civil Engineering and Mechanical Engineering exist, dealing with

operational process in accordance with the possibilities of technological solutions is as important as the engineer specialized in specific branches of railway engineering.

So the current specialization structure contains potential for improvement to eliminate some insufficiencies:

- ◆ The complex and specific qualification profile of a Railway Engineer is not sufficiently mapped.
- ◆ Access for graduates from other study programs is not enabled to a sufficient scale.
- ◆ The study program is not compatible with international education systems.

3. NEW MASTER COURSE "GUIDED TRANSPORT ENGINEERING"

To improve the situation, additionally to the existing study programs a new master course "Guided Transport Engineering" (preliminary title) within the scope of the Bologna process is planned to start in October 2008. This course shall form engineers for railways and other guided transport systems. It will be a study

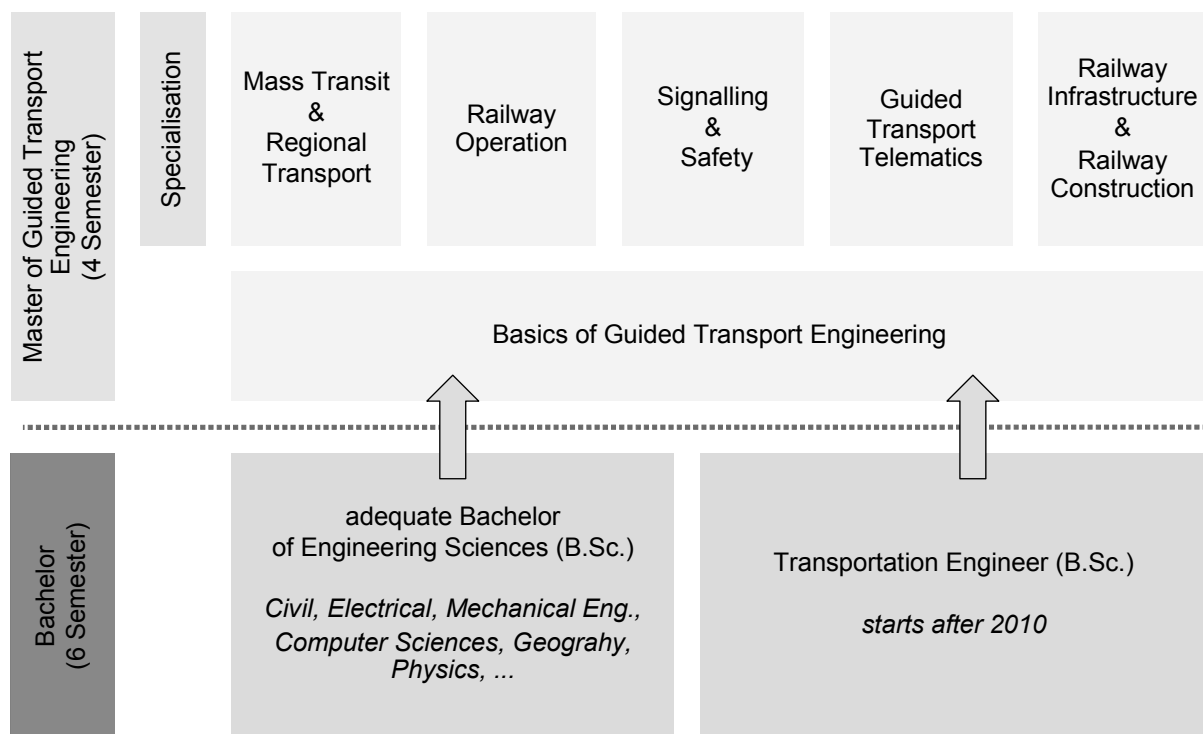


Fig. 1: Railway Engineering as a complex field

railway construction and rail vehicles.

But from the today's point of view, a railway engineer who understands the whole railway

course open to Bachelors of Engineering with different specializations, e.g. Civil, Electrical and Mechanical Engineering, Computer Sciences and Geography (Figure 2). As these students are

technically qualified, but not qualified in the specialties of transportation and railways, part of the study program will be Basics of Guided Transport Engineering. Besides, the student can choose between 5 specializations.

The obligatory part of the study program consists of the Scientific Advanced Basics and the Basics of Guided Transport (Table 1).

The purpose of the Specific Advanced Basics is to supplement and upgrade the knowledge from the bachelor studies and to bring students who have attended different bachelor programs to the same level in fields which are important as basics for the studies in railway engineering. The Specific Advanced Basics consist of the following four modules with 5 credit points each:

- ◆ Advanced Mathematics with statistical and numerical methods
- ◆ Business Administration with Accountancy, Bookkeeping, Capital Expenditure Budgeting and Project Management
- ◆ Theory of Transport Systems with Basics of Modeling, Simulation and Optimization
- ◆ Computer Sciences for Engineers with CAD, Programming and Tools including their Integration and Customizing

The purpose of the Basics of Guided Transport Systems is to teach a general knowledge of railway systems in its complexity. The following 6 modules with 5 CP each are included:

- ◆ Basics of Railway Infrastructure and Construction
- ◆ Basics of Signaling & Safety
- ◆ Basics of Guided Transport Telematics

- ◆ Basics of Railway Operations
- ◆ Operations Planning in Transportation Systems
- ◆ Basics of Railway Vehicles and Power Supply

4. SPECIALISATIONS WITHIN THE NEW MASTER PROGRAM

Based on this basic knowledge of the railway system, the student can select between five specializations of railway engineering. Besides the main specialization subjects, for each specialization specific specialization supplements are necessary, which are additional fields being not necessarily rail related, but are an important basis for the respective specialization. Besides, the student can choose an additional specialization or advanced economics (Fig. 2). This structure is highly flexible for the student to choose specialized fields according to his/her interests.

In the following, the contents of the specializations and supplements are listed:

- ◆ Specialization Supplements for "**Railway Infrastructure**":
 - ◆ Planning Law, Ecological Aspects of Transport
 - ◆ Modeling & CAD for Railway Infrastructure Applications
 - ◆ Planning of Signaling and Control Systems and Power Supply
- ◆ Specialization "**Railway Infrastructure**":
 - ◆ Planning and Design of Railway Infrastructure

contents	sem.		Infra-structure	Signalling & Safety	Tele-matics	Railway Operation	Mass Transit & RT
<i>Scientific Advanced Basics</i>	7+8	Mod.	4				
		CP	20				
<i>Basics of Guided Transport</i>	7+8	Mod.	6				
		CP	30				
Specialisation Supplement	8	Mod.	2	2		2	
		CP	10	10		10	
Major Specialisation	8+9	Mod.	3	3	3	3	3
		CP	15	15	15	15	15
Additional Specialisation or Adv. Microeconomics	9	Mod.	1	1	1	1	1
		CP	5	5	5	5	5
Interdisciplinary Project	9	CP	10				
Master Thesis	10	CP	30				

Table1: Scheme of the proposed master course

- ◆ Construction and Maintenance of the Permanent Way
- ◆ Practical Project Course, model supported
- ◆ Specialization Supplement for "**Railway Signaling**" and "**Guided Transport Telematics**":
 - ◆ Reliability and Availability
 - ◆ Project and Quality Management
 - ◆ Safe Circuitry, Data Processing and Transmission
- ◆ Specialization "**Railway Signaling**":
 - ◆ Safety Sciences
 - ◆ Interlocking Requirements and Principles
 - ◆ Operation Control
 - ◆ Planning and Design of Signaling & Control Equipment
 - ◆ Specific Questions & Analyses in Railway Signaling & Control
- ◆ Specialization "**Guided Transport Telematics**":
 - ◆ Automation Systems in Guided Transport
 - ◆ Positioning and Navigation
 - ◆ Advanced Modeling & Simulation
 - ◆ Special Questions and Analyses in Guided Transport Telematics
- ◆ Specialization Supplement for "**Railway Operation**" and "**Mass Transit and Regional Transport**":
 - ◆ Transport Planning
 - ◆ Transport Logistics
- ◆ Specialization "**Railway Operation**":
 - ◆ Railway Operation Planning and Control
 - ◆ Design of Process Chains in Public Transport
 - ◆ Capacity Research in Railway Operation
- ◆ Specialization "**Mass Transit and Regional Transport**":
 - ◆ Public Transport Operation Planning
 - ◆ Design of Process Chains in Public Transport
 - ◆ Public Transport Operation and Control

5. INTERNATIONALISATION OF EDUCATION CONTENTS

The goal of the reform process in studies at Dresden University of Technology is not only to adapt the course structure to the requirements of

railway engineering and to participate in the Bologna process with introduction of the Bachelor/Master structure, but also to bring the teaching contents within each module to an international level.

During the history of railways, several features for vehicles have been harmonized to enable international exchange of wagons. But in wayside infrastructure, the technical equipment has developed into different directions in each country. Today, markets for transportation and for railway technical equipment are becoming international to a large scale and changing the locomotives at each national border is not desired. Therefore, the incompatible technical systems for signaling, train protection, power supply and others as well as the different operation rules are a major obstacle for railways to compete with other means of transport, where technical incompatibilities do not exist to that extend.

Not only the technical systems are incompatible, but also experts do not know about the technical systems in the neighboring country and the background on which they were developed, which leads to misunderstandings in international cooperation. Spreading that knowledge among experts is one important step to reduce these incompatibilities. This is an important task for universities. In the recent years, Dresden University of Technology is internationalizing its teaching contents.

In railway signaling, the traditional approach in teaching was to describe the techniques which are present in Germany in detail, mentioning the purpose a particular feature serves for. The new approach is to describe railway signaling and interlocking top-down in the following steps:

- ◆ The **requirements** a system, sub-system or component has to fulfill.
- ◆ The **functional principles** as the basis for the working of systems, sub-systems and components.
- ◆ The **specific technical solution** which is exchangeable and described in form of examples.

With this new structure, the student is enabled to understand newly appearing techniques as well as functional principles and techniques found in other countries. Taking into consideration that most graduates will mainly work in Germany, in relation to national specialties, the following structure of teaching contents is strived for:

- ◆ Generic parts which are independent from national specialties
- ◆ German applications and specialties in detail
- ◆ International applications and specialties as an overview

To support these internationalized teaching contents, Dresden University of Technology, together with other international universities and experts, is preparing a textbook entitled "International Railway Signaling and Interlocking", where the principles and systems will be described and classified on an international level. The book will deal with the following specific topics of railway signaling:

- ◆ Basic Characteristics + Requirements
- ◆ System Safety and Reliability
- ◆ Railway Operation Processes
- ◆ Interlocking Principles
- ◆ Detection

- ◆ Movable Track Elements
- ◆ Signals
- ◆ Train Protection
- ◆ Interlocking Machines
- ◆ Line Block Systems
- ◆ Remote Control and Operation Technology
- ◆ Safety and Control of Shunting Yards
- ◆ Level Crossings
- ◆ Hazard Alert Systems

6. CONCLUSIONS

The increasing European integration requires integration of the railway systems. For this purpose, railway engineers have to be skilled on an international level. Dresden University of Technology supports this process by educating these engineers.

ИНТЕРНАЦИОНАЛИЗИРАНЕ НА УЧЕБНИТЕ ПРОГРАМИ НА ДРЕЗДЕНСКИЯ ТЕХНИЧЕСКИ УНИВЕРСИТЕТ

Волфганг Фенглер, Йохен Тринкауф, Улрих Масчек, Грегор Шеег

*Проф. д-р инж. Волфганг Фенглер, Проф. д-р инж. Йохен Тринкауф, д-р инж.р Улрих Масчек,
инж. Грегор Шеег, Технически университет, Дрезден
Факултет по транспорт и транспортни науки "Фридрих Лист"
Институт за железопътни системи и обществен транспорт*

ГЕРМАНИЯ

Резюме: Дрезденският Технически университет, който има дългогодишни традиции в обучението на железопътни инженери, реформира своите учебни програми и съдържанието им. Същността му е въвеждането на нов магистърски курс с предварителното наименование «Ръководно транспортно инженерство». Завършилите ще могат да разглеждат железниците като цялостна система, както и ще имат специализация в определена техническа област на железниците. Наред с това университетът интернационализира учебното съдържание в рамките на курсовете заедно с публикуването на учебник за международна осигурителна техника и контрол.

Ключови думи: образование, университет, обучение, железопътно инженерство, магистратура, болонски процес.