

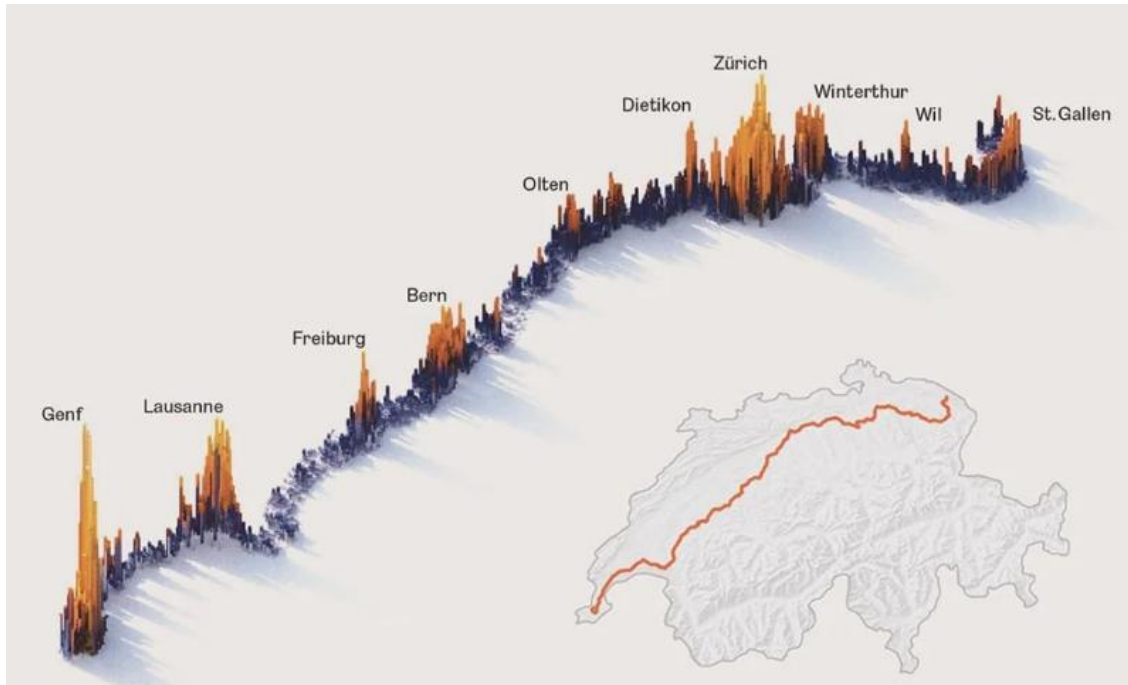
Railway systems and their transition.

Semester Overview 08.09.2025 – 16.12.2025

Peter Kummer

EPFL, Autumn Semester 2025

Railway systems and their transition – Lecture plan.



You will get a **basic knowledge** of transport and rail systems and **learn** about their **strengths and weaknesses**. The goal is to obtain an understanding of railways' **contribution to the mobility sector**.

Topics of the course include:

- Railway Past – Present – Future
- Transport systems and role of railway
- Railway assets
- Customers
- Planning and development
- Safety and Security
- Financial and regulatory landscape
- Sustainability and climate goals

Content of this course.

Railways: Past - Present –
Future

Transport systems and role of
railway

Railway assets

Customers

Planning and development

Safety and security

Financial and regulatory
landscape

Sustainability and climate goals

From railroad tycoons to “Taktfahrplan” and today’s challenges.

Evolution of railway in Switzerland and internationally also considering upcoming automobiles and trucks, climate challenge, ...

Key strengths and weaknesses: Why is railway efficient in land- and energy-usage and limitations due to infrastructure / rolling stocks, transportation hubs etc.

Learn about **fundamental technologies required for a railway system** such as track, power supply, signalling, rolling stock. How to manage these assets focusing on life-cycle costs.

Changing needs and demands, including the future of „ticketing“ (mobility as a service). Understand cargo and real estate customers.

Understand the **basics of planning and developing** the transportation offer, infrastructure and rolling stock considering customer needs and capacity optimisation. Also learn about capacity usage and mixed-traffic capacity.

Threats from the outside for our system and our system as a threat to the outside & users. Challenges, strategies and solutions.

Efficiency in a **complex system** and how to generate revenue. The role of **public funds** for regional offers as well development and maintenance of infrastructure.

Railway and the role of transport, today and outlook on hydroelectric power, independent energy production, efficiency, net-zero, circular economy, embodied (grey) energy and more.



Semester Overview Railway Systems and their Transition

Lecture 08.09.	Railways: Past - Present – Future	
Lecture 16.09.	Transport systems and role of railway	Semester report topics
Lecture 23.09.	Railway assets – Heavy assets	Topic discussion
Lecture 30.09.	Railway assets – Rolling Stock	Topic discussion
Field Trip 07.10.	Operational Asset Management live (Renens, see separate slide with infos)	
Lecture 14.10.	Railway assets – Traffic Management Systems	Topic & Table of content due
Lecture 28.10.	Customers Part 1	
Lecture 04.11.	Customers Part 2	
Lecture 11.11.	Planning and development – long term	
Lecture 18.11.	Planning and development – medium term	
Lecture 25.11.	Safety and security	
Field Trip 02.12.	Planning and development – short term / operations (Renens, see slide)	
Lecture 09.12.	Financial and regulatory landscape	
Lecture 16.12.	Sustainability and climate goals	Semester report deadline

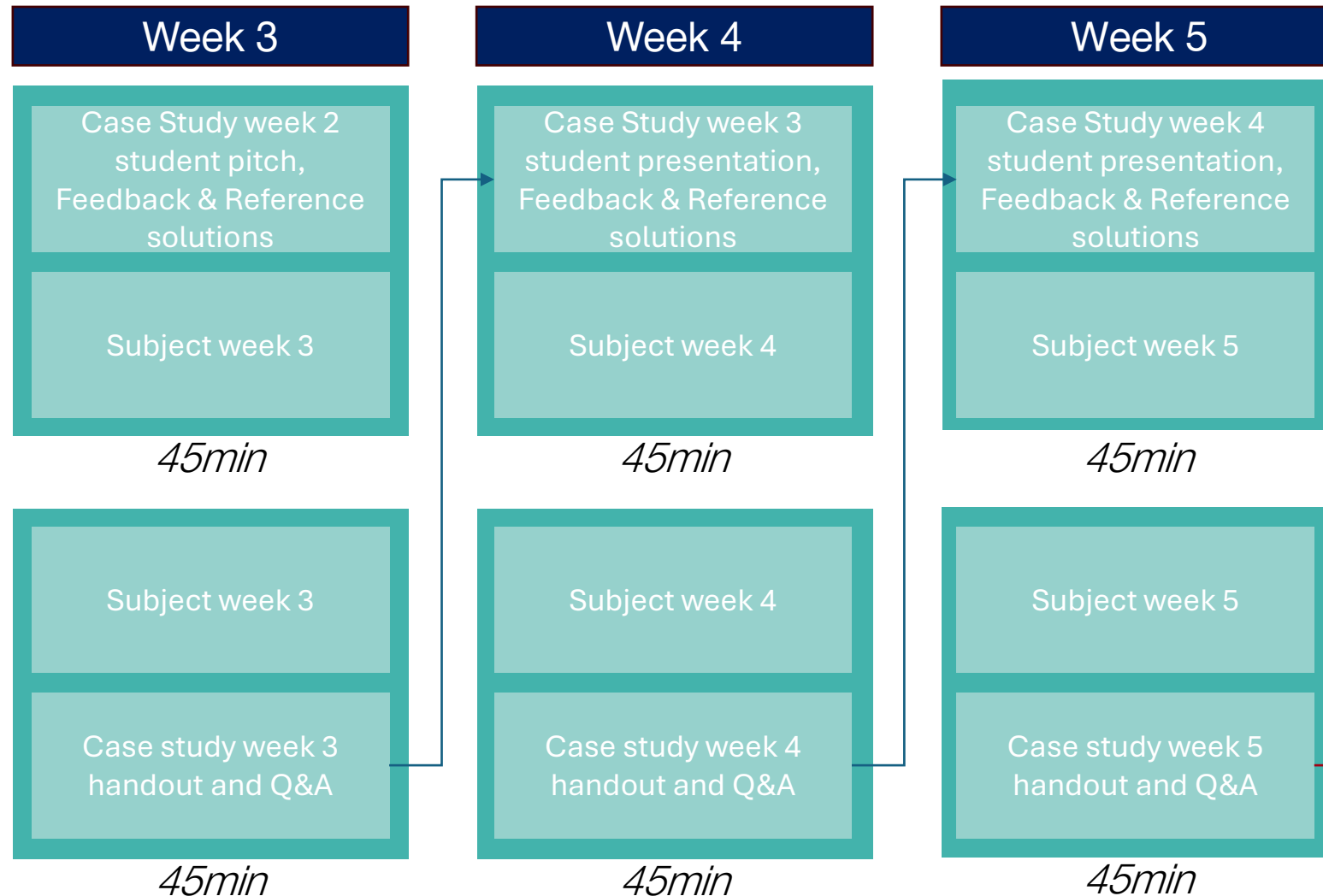


Semester Overview Railway Systems and their Transition

Lecture 08.09.	No presentation
Lecture 16.09.	No presentation
Lecture 23.09.	Presenting: Oreste Challandes, Nicolas Yannis Dimou, Tsukasa Dowd, Alexander Lepper
Lecture 30.09.	Presenting: Luca Liuzzi; Amélie Menoud; Pedro Rodrigues Da Costa Savini
Field Trip 07.10.	No presentation
Lecture 14.10.	Presenting: Paul Giamberini; Rocco Massimo Antonio Giannotti; Héloïse Calixte Marie Marquès; Emilien Paul Erik Ulrich
Lecture 28.10.	Presenting: Maximilian Conrad; Friedrich Wilhelm Hiemenz; Philip Ojas Ramabadran; Maxime Steiner
Lecture 04.11.	Presenting: Peter Oehme; Elias Rafoul; Loïc Sansonnens
Lecture 11.11.	Presenting: Jan Mikolaj Janczak; Mohamed Ilias Jari; Chaimaa Ouchicha; Arthur Frans Etienne Van Den Broeck
Lecture 18.11.	Presenting: Jean Louis Marie Ségolène Devergnies; Felipe Ferrero Fandiño; Chiara Freneix
Lecture 25.11.	No presentation
Field Trip 02.12.	No presentation
Lecture 09.12.	No presentation
Lecture 16.12.	No presentation

Lecture structure.

Case studies will allow a hands-on discussion about challenges in railways.



Case study methodology:

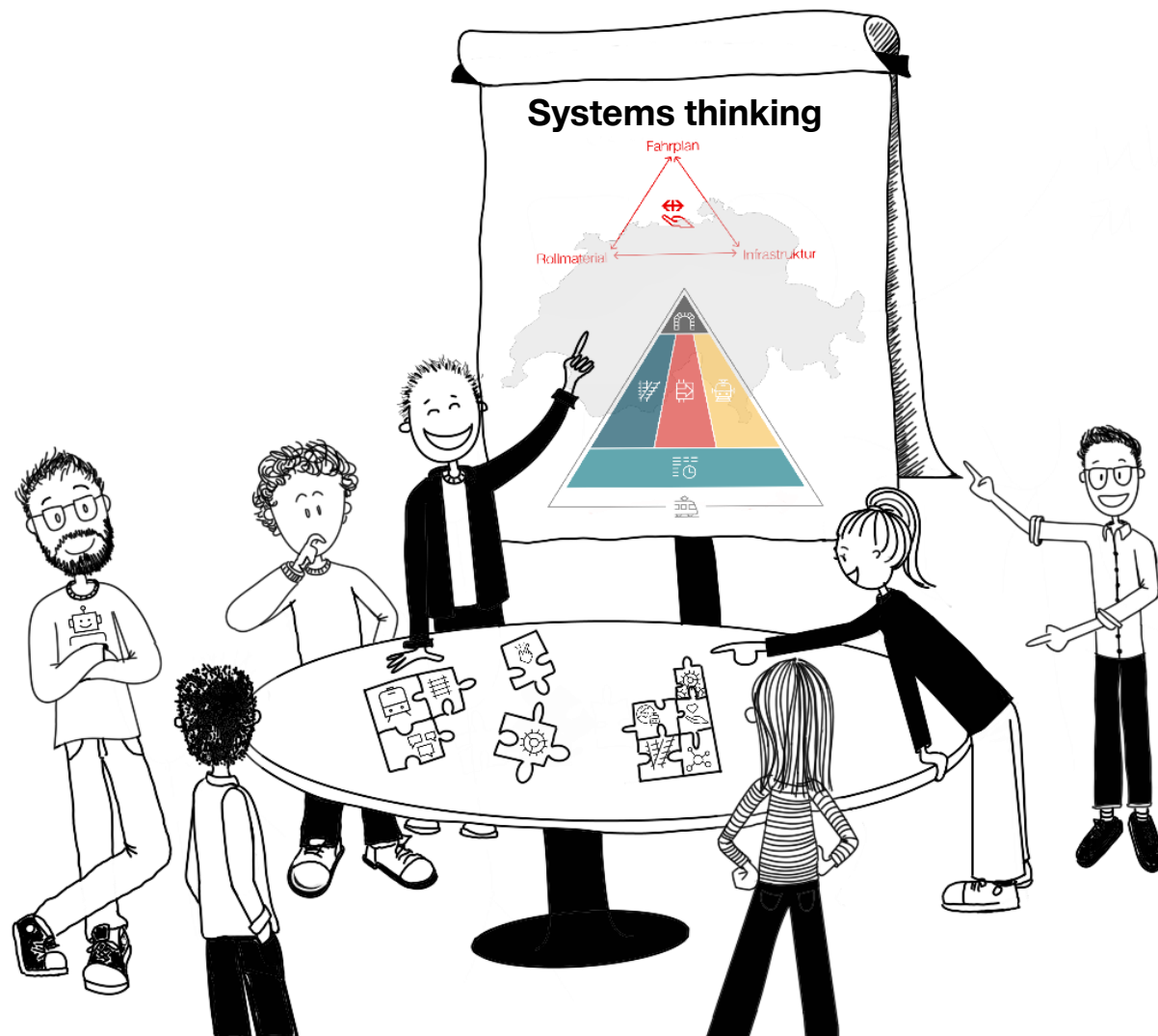
Each week some students will make a short pitch about their solution ideas to the case study of the week before.

We will provide feedback on their solutions and talk about real-case solutions we implemented within SBB for these problems.

After presentation of the new topic each week there will be a new case study question handed out and some time for Q&A.

The exercise lesson can be used for the preparation.

Student evaluation.



The evaluation will consist of multiple parts: a group project over the course of the whole semester and an individual exam.

Group project (40%)

- 3 to 4 students
- written report

Individual oral exam (60%)

- In the winter exam period
- Will also refer to the group project

Please refer to the moodle information sheet!



Information on group project.

- Study a specific question related to transport systems and produce a final report of 15 pages.
 - The groups will consist of 3 to 4 students each.
 - We will provide topics and possible questions.
 - No more than two groups can work on the same topic.
 - There is no presentation of your work. But questions regarding your report will be part of the final oral exam.
- **Tuesday 16.09.2025 Discussion of research questions possible during the exercise hour.**
 - **Tuesday 23.09.2025: Groups sign up on Moodle with defined research topic question.**
 - **Tuesday ~~07.10.2025~~ 14.10.2025: Deadline for the validation of the table of content.**
 - **Tuesday 16.12.2025: Final report delivery.**

Please refer to the moodle information sheet!



Group project – List of Themes



Semester Project – List of themes

EPFL Lecture Railway systems and their transition, September 2025

Themes

- Theme 1. Sustainability of the rail system by 2050**2
- Theme 2. Energy efficiency in railway systems**3
- Theme 3. City logistics and (rail) freight**4
- Theme 4. Rail freight transport in Switzerland**5
- Theme 5. Maintaining the railway network 2050**6
- Theme 6. Swiss-European connection**7
- Theme 7. Domestic and international night train travel**8
- Theme 8. Development of the passenger market in rail transport**9
- Theme 9. Safety and security: continuous rail operations**10
- Theme 10. Lausanne-Genève options**12

Please refer to the moodle information sheet!



Individual oral exam in the January exam period. 20'



The oral exam will be an interview in the style of for example:

1. In a job interview for a senior management position at a Railway Company, you will discuss current challenges, opportunities, risks, and mitigation strategies, focusing on trade-offs rather than detailed technical expertise.
2. As a subject matter expert, you need to present information to a non-expert audience, such as in a public session, a media briefing or something similar.
3. You will evaluate an innovative idea for the railway system, analysing its relevance through a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis.

Excursion on October 7th 2025.

Operational Asset Management live.



Location / Meeting point
Rue de la Gare de Triage 5 - Google Maps

What

- Experience a live inspection of concrete sleepers on a SBB track specifically closed for this event.
- Learn more about the connection between manual and machine inspection of the rails and the impact on asset management.

Where

- First, some theory in building A3 of SBB Simplonpark in Renens.
- Then, a field-trip to SBB track 925 just before Renens station.

When

- On 7 October 2025, **13:00**-16:00, instead of lecture.

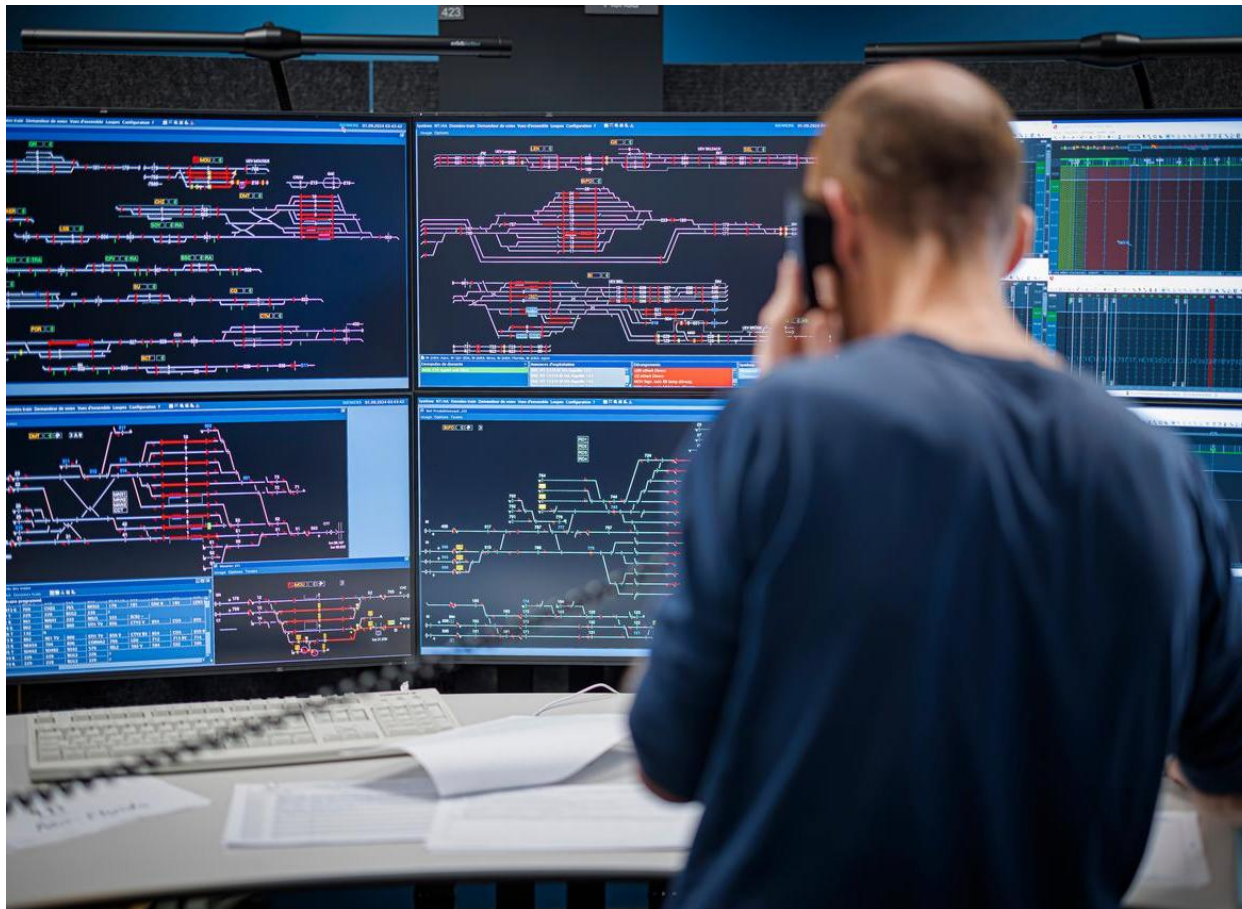
Specifics

- Sturdy footwear must be worn while out on the tracks.
- Before the trip, everyone is provided with a high-visibility vest and a helmet, which must be worn at all times.



Excursion on December 2nd 2025.

Train-control centre – from theory to real life application.



What

- You will get a unique opportunity to gain insights into real life railway operation and management.
- First hand experience of how the daily management of trains works.

When / Where

- December 2, from 13:30 until 16:00 instead of lecture, meet at Renens train station.

Remarks

- Use this opportunity to address questions to experts.
- Mandatory participation.