

Semester Project – List of themes

EPFL Lecture Railway systems and their transition, September 2025

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Notes

Some guidance and suggested readings listed for a theme may also be adapted for other themes.

For all themes, we also suggest consulting publicly available documents on the topic from associations such as UIC, VöV and INFRAS, as well as from Federal Offices including SFOE (Energie), FOT (Transport), FOEN (Environment), and FSO (Statistics).

Theme 1. Sustainability of the rail system by 2050

Goal

The aim is to develop a comprehensive understanding of the challenges and opportunities of sustainability in the rail system by 2050. You should take an interdisciplinary point of view and you are also encouraged to think creatively and develop innovative solutions.

Suggestion of subjects

The following subjects are suggested, but you are encouraged to choose another one:

- How can grey emissions in the railway system be minimized?
- The role of renewable energies in future rail operations.

Some guidance

You can investigate the following fields of interest:

- Defining sustainability in the context of the railway system and identifying its relevant dimensions (ecological, economic, and social).
- Examining grey emissions within the railway system and identifying where they occur.
- Analysing national climate goals and their influence on railway planning and development.
- Assessing opportunities and risks for the railway system in the context of sustainability.
- Exploring the integration of renewable energies and innovative technologies into existing rail operations.
- Evaluating the role of sustainable solutions in minimizing environmental impacts.
- Investigating how political, social, and economic framework conditions can support or hinder the implementation of sustainable measures in the railway system.

Suggested readings

S. Conrad et al., Carbotech AG, 'Umweltbilanz Bahninfrastruktur, Inventare Bau Infrastruktur und illustrative Betrachtung Entwicklung', Basel, 2024

Science Based Targets, (n.d.), 'Ambitious corporate climate action', Retrieved September 2, 2025, from <https://sciencebasedtargets.org/>

Information and documents on the website: SBB, (n.d.), 'Energy efficiency', Retrieved September 2, 2025, from <https://company.sbb.ch/en/sbb-as-business-partner/services-rus/energy/sustainable-energy/energy-efficiency.html>

Documents from associations such as UIC, VöV and INFRAS, as well as from Federal Offices: SFOE (Energie), FOT (Transport), FOEN (Environment), and FSO (Statistics)

Theme 2. Energy efficiency in railway systems

Goal

The aim is to investigate energy efficiency in railway systems by focusing notably on the role of energy efficiency, the potential offered by operational and technical innovations and strategies, as well as its impacts, opportunities, and challenges.

Suggestion of subjects

The following subjects are suggested, but you are encouraged to choose another one:

- A recommendation of strategies to improve the energy efficiency of passenger and freight transport.
- An analysis of the role of digital technologies to achieve energy efficiency in rail systems.

Some guidance

You can investigate the following fields of interest:

- Defining energy efficiency in the context of the railway system.
- Identifying the most energy-intensive domains (such as infrastructure, construction, vehicles ...) and elements in railway systems, and assessing their potential for efficiency.
- Exploring technical innovations that significantly reduce energy demand.
- Analysing how digital technologies (e.g., AI, big data, predictive maintenance, traffic management) can improve railway energy efficiency.
- Assessing the contribution of low-tech methods to improving energy efficiency.
- Defining a way to measure energy efficiency and to compare it across different solutions and domains.
- Examining the main barriers (economic, political, technological, social) to implementing energy-efficient measures.
- Evaluating how incentives, regulatory frameworks, and financing models can accelerate the adoption of energy-efficient technologies and practices.
- Investigating the role of behavioural changes (e.g., customer choices, logistics planning) in energy consumption.
- Differentiating between short-term implementable measures and long-term strategies (e.g. a measure is implementable on an existing train, or a new train should be purchased).
- Analysing how energy efficiency contributes to national climate goals.
- Determining the role of modal shift in achieving greater energy efficiency.

Suggested readings

Information and documents on the website: SBB, (n.d.), 'Energy efficiency', Retrieved September 2, 2025, from <https://company.sbb.ch/en/sbb-as-business-partner/services-rus/energy/sustainable-energy/energy-efficiency.html>

Documents from associations such as UIC, VöV and INFRAS, as well as from Federal Offices: SFOE (Energie), FOT (Transport), FOEN (Environment), and FSO (Statistics)

Theme 3. City logistics and (rail) freight

Goal

The goal of this subject is to give a better understanding of the entire logistics chain by assessing city logistics in the context of freight and analysing the role of rail transport within it.

Suggestion of subjects

The following subjects are suggested, but you are encouraged to choose another one:

- Recommendations on the future logistics chains so that all the population can be supplied sustainably and efficiently.
- Innovative approaches to delivering construction materials and heavy goods into dense city centres.

Some guidance

Motorised road traffic is being pushed back in many cities. New (and urgently needed) green spaces and communal spaces are being created for the growing population at the expense of lorries and cars. While alternatives for inner-city passenger transport have been tried and tested and are ready to be implemented, alternatives to lorries have so far been little known and are only being implemented selectively as part of research concepts.

You can investigate the following fields of interest:

- Identifying opportunities for managing traffic-intensive flows of goods such as construction logistics, retail supply, and parcel services in a resource-, space-, and noise-efficient way.
- Analysing the main freight demands and their drivers and requirements.
- Studying how to change the logistics chains to address the new challenges and requirements in urban freight, and what are these challenges and requirements.
- Defining potential future transition points between rail and other modes of transport.
- Determining new requirements and markets for rail in urban logistics.
- Evaluating political instruments and regulatory frameworks to encourage rail-supported city logistics (e.g., emission zones, subsidies, urban freight strategies).
- Assessing technologies that can support sustainable and efficient city logistics.
- Reviewing successful city logistics projects integrating rail and deriving lessons learned.
- Identifying urban planning and infrastructure adjustments needed (e.g. land allocation, loading/unloading zones, urban rail freight terminals).

Suggested readings

W. Raimund, I. Beyer Bartana, S. Kranzl, A. Angelini, M. Staudner, and H. Heinfellner, 'Urbane Logistik: Kurzstudie im Rahmen des Projekts 'Nachhaltige Mobilitätswende' (NaMoW)', in Diverse Publikationen / Umweltbundesamt, no. DP-171, Wien: Umweltbundesamt, 2023

Documents on the website: Union des villes suisses, (n.d.), 'Dossier : Logistique urbaine', Retrieved September 2, 2025, from <https://uniondesvilles.ch/fr/detail/dossier-logistique-urbaine?share=1>

SBB, (n.d.), 'Neue Flächen für City-Logistik', Retrieved September 9, 2025, from <https://sbb-immobilien.ch/story/neue-flaechen-fuer-city-logistik/>

Theme 4. Rail freight transport in Switzerland

Goal

The objective of this assignment is to explore freight transport on railways in Switzerland. You will analyse the current state, constraints and prospects of freight transport and propose strategies covering the interactions between operational, infrastructural, rolling stock and political aspects.

Suggestion of subjects

The following subjects are suggested, but you are encouraged to choose another one:

- What are the underlying reasons why rail freight transport seems to “work better” when comparing with the USA or Australian mines for example? How do framework conditions, politics and planning differ?
- What would be the impact of a proposal like Cargo Sous Terrain? Which problems would it create or solve? How would the usage of existing modes of logistics change and which implications would these changes have?

Some guidance

You can investigate the following fields of interest:

- Assessing the current state of freight transport on rail versus the competition.
- Assessing the current state of rail freight transport versus rail passenger transport.
- Identifying the current strengths and bottlenecks of rail freight transport.
- Exploring the different modes of rail freight transport (e.g. conventional and combined transport, wagonload train and unit train, national and international transport) identifying their characteristics, requirements, challenges and advantages.
- Exploring the logistics of various sectors reliant on rail transport (e.g., supermarket supply chains, postal services, construction materials) and their requirements.
- Investigating target conflicts in rail freight transportation (e.g., environmental concerns vs. economic efficiency).
- Evaluating political instruments that incentivize the shift to rail freight.
- Studying the stakeholders such as government bodies, logistics companies, and transport authorities to understand their perspectives and challenges.
- Considering the role of technology in optimizing rail logistics and enhancing capacity.
- Defining areas with an impact on rail freight transport that require improvement to support it (e.g. railway infrastructure, freight company resource planning, rolling stock, interoperability with Europe, terminals ...) and proposing measures.
- Analysing the interoperability with Europe and its impact.
- Analysing case studies illustrating successful transitions to rail freight.

Suggested readings

- BAV, Grundlagenstudie Güterverkehrsanlagen der Zukunft Sönke von Wieding, Ferdinand Mikolasch, Marco Aebi, Januar 2025
- SBB Infrastruktur, ‘What If Cargo Sous Terrain’, 2019
- SBB Infrastruktur, ‘What If Schienengüterverkehr plus 100%’, 2019
- Cargo sous terrain, Project information page, retrieved september 16, 2025 <https://www.cst.ch/>

Theme 5. Maintaining the railway network 2050

Goal

The aim is to analyse the complex interrelationships between use, network maintenance, network expansion, life cycle costs and political decision-makers to ensure the quality of the railway network for 2050.

Suggestion of subjects

The following subjects are suggested, but you are encouraged to choose another one:

- Recommendations for action and communication strategies to actively influence the political discourse on the future of rail infrastructure.
- Recommendations to enhance planning and execution of works for railway systems.

Some guidance

You can investigate the following fields of interest:

- Analysing regulatory, financing, resource management, and communication strategies for maintaining the railway network and assessing their consequences.
- Modelling essential relationships and levers across the railway life cycle.
- Identifying influencing factors such as network length, service life, and maintenance cycles, and evaluating their effects on long-term costs, condition, and infrastructure availability.
- Examining corporate communication strategies of railway companies.
- Analysing how to manage political discourse and public expectations by defining target groups, key messages, communication objectives, etc.
- Specifying long-term requirements for the railway network in the context of 2050.
- What are the learnings from the Deutsche Bahn.
- Exploring different infrastructure maintenance strategies and their impacts.
- Exploring different strategies for the execution of the work and their impacts.
- Determining acceptable cost increases and strategies for achieving broad acceptance.

Suggested readings

SBB Infrastruktur, 'SBB Network status report 2023', 2024 (Englisch last translation 2022)

ÖBB-Infrastruktur AG - GB Asset Management und Strategische Planung, 'ÖBB Network status report 2023', 2024

DB InfraGO AG , 'DB Network and passenger stations status report 2023', 2024

S. M. Ribar and V. Ducrot, SBB, 'Einstieg: im Hier und Jetzt führen, an das Morgen und Übermorgen denken.', 2024

Theme 6. Swiss-European connection

Goal

The objective is to assess Switzerland's rail connectivity to European destinations, notably by examining technical, dependency, operational, political, and social factors.

Suggestion of subjects

The following subjects are suggested, but you are encouraged to choose another one:

- Recommendations for actions and communication to shift passenger from air to rail.
- Comparative analysis of different mobility solutions for a journey between chosen metropolitan areas in Europe.

Some guidance

You can investigate the following fields of interest:

- Assessing rail potentials for routes between Switzerland and major European cities, as well as the competitive landscape.
- Analysing demand for international rail travel and its key requirements.
- Identifying the factors (e.g. infrastructure, journey time, cooperation, policy) that impact rail competitiveness across borders.
- Examining the dependences of Switzerland with Europe.
- Analysing collaboration models for rail operators to enable international connections (interoperability, data interchange, rolling stock compatibility, staffing, tariffs), while addressing stakeholder management challenges (differences of regulation framework, culture, politics ...)
- Examining financial, political, and regulatory barriers to developing cross-border rail.
- Assessing the role of subsidies, taxation (e.g., kerosene tax, carbon pricing), and policy incentives in shifting international travel demand to rail.
- Quantifying and communicating the ecological benefits of trains, compared to competitive landscape.
- Evaluating the role of night train.
- Exploring how digital solutions can improve the attractiveness of international rail travel.
- Investigating how customer experience factors (comfort, Wi-Fi, food services, working spaces) can make international train travels more attractive.
- Segmenting customer groups and identifying the different needs.

Suggested readings

- Thomas Sauter, ZHAW, 'Vortrag am SwissRail Mobility Day', 22.05.2025
- SBB Internationaler Personenverkehr IPV, 'Zielbild IPV im Horizont 2035'
- SBB Internationaler Personenverkehr IPV, 'Challenge am Bahnnetz-Hackathon', Januar 2025

Theme 7. Domestic and international night train travel

Goal

The objective is to study existing and new night travel connections for short, medium and long distances in the context of balancing passenger transport needs, infrastructure requirements, and freight transport, while ensuring operations remain efficient and reliable.

Suggestion of subjects

The following subjects are suggested, but you are encouraged to choose another one:

- How to balance passenger expectations and maintenance needs for nightly timetables?
- Potential of nightly travel chains across regions: Which weekdays and at what frequency should options be offered to ensure viability for the train company, the infrastructure requirements and the freight transport, while achieving attractiveness for customers.

Some guidance

You can investigate the following fields of interest:

- Identifying the types of demand for domestic and/or international night travel connections, their requirements and implications for designing night trains.
- Identify key factors to make the night train attractive from the customer's perspective.
- Identify key factors to make a 24/7 rail connection attractive as part of a regional network.
- Evaluating the challenges faced by passenger transport in offering attractive night services while ensuring operational efficiency.
- Examining the benefits of night train travels for short, medium and long distances.
- Analysing the economic viability of night trains.
- Considering the various stakeholders involved (passenger transport, infrastructure management, freight transport), their conflicting interests and respective solutions.
- Investigating requirements for construction and maintenance work during night hours to support sustainable infrastructure and their impacts on night trains.
- Exploring conflicts between passenger and freight transport during night hours.
- Analysing case studies illustrating successful nightly train travel chains.
- Analysing how innovative practices and technologies can enhance night travel connections.
- Identifying the potentials and future perspectives of night trains (e.g. integration into first/last mile solutions, eco-tourism ...).

Suggested readings

- SBB, 'Hackathon: Reiseketten in der Nacht', 09.01.2025
- SBB, 'Glossar für Bahnnetz-Hackathon 2025', 09.01.2025

Theme 8. Development of the passenger market in rail transport

Goal

The aim is to increase the modal split and the attractiveness of rail public transport by using levers such as pricing plans, customer interaction and the integration of additional mobility offers (first and last mile). The task is to be understood without expanding the rail transport service offer.

Suggestion of subjects

The following subjects are suggested, but you are encouraged to choose another one:

- Recommendations for passenger railway companies to attract customers with new integrated mobility offers (first and last mile).
- How can tariff systems balance attractiveness for passengers with financial sustainability for railway companies?

Some guidance

You can investigate the following fields of interest:

- Defining and analysing the key factors in the choice of passengers for a mode of transport.
- Examining marketing and communication that can increase rail ridership.
- Studying the main factors that impact the passenger experience.
- Analysis of the interaction with the customer (e.g. mobile app, services at the station ...).
- Exploring customer engagement strategies such as personalization and gamification to enhance satisfaction and increase demand.
- Exploring strategies of pricing such as dynamic pricing, subscription models, or loyalty programs to enhance satisfaction and demand.
- Investigating how integrated mobility offers (multimodal tickets, park-and-ride, bike-sharing) support a shift toward rail.
- Analysing the impact of product strategy on the customer (e.g. free seats vs. reservations, timetable design, flexibility, train interior, etc.) and exploring potentials.
- Assessing the role of regulatory and policy measures in promoting rail transport.
- Defining specific passenger groups (commuters, students, tourists, leisure travellers, business travellers) and analysing how they differ in expectations and needs.
- Identifying current customer pain points and addressing them with targeted solutions.

Suggested readings

- Alliance SwissPass, (n.d.), 'Handbuch zur Alliance SwissPass', Retrieved September 9, 2025, from <https://www.allianceswisspass.ch/de/mediencorner/Publikationen/handbuch>
- Alliance SwissPass, (n.d.), 'Übersicht der Tarife und Vorschriften', Retrieved September 9, 2025, from <https://www.allianceswisspass.ch/de/tarife-vorschriften/uebersicht>
- Various SBB internet links:
 - Price plans/assortment: [Tickets & offers](#), [Travelcard](#), [For tourists](#), [Seat reservations](#)
 - Customer interaction: [SBB Mobile](#), [SBB Tickets](#), [Ticket machines](#), [Services at the station](#), [SBB Business Customers for SME](#)
 - Integrated mobility: [Park your car and hop on the train](#), [Our stations](#)
- V. Pérez Miranda, J. Ostwald, J. Botella and all, UIC, 'Happy passengers travel more: How to measure and improve Customer Experience by Rail', 2024

Theme 9. Safety and security: continuous rail operations

Goal

The goal of this assignment is to create integrated strategies for managing business continuity and crisis communication in the context of a public transport or railway company. You will analyze critical business processes and develop plans to enhance resilience and ensure effective communication during security-related incidents.

Suggestion of 3 subjects

The following three subjects are suggested, but you may also choose another one:

- Subject 1:
Integrated Business Continuity Plan (BCP) for the Failure of a Critical Core Process:
A public transport or railway company wants to increase and ensure its resilience and continuity in the event of a failure of a core process (e.g., IT/OT infrastructure, logistics processes, operations processes, sales processes, call center operations).
- Subject 2:
Culture: Security Awareness & Behavior Change:
Campaign to Reduce the Phishing Victim Rate: The organization repeatedly experiences successful phishing attacks, including via the use of QR codes. QR codes are used, among other things, to quickly send distress calls to emergency services. The goal is to design a conceptual campaign to reduce the victim rate through awareness measures combined with organizational changes.
- Subject 3:
Crisis Communication & Stakeholder Management for a Safety-Relevant Incident:
A safety-relevant incident (operational disruption and cyberattack with data loss, as well as a serious workplace accident attracting media interest) requires coordinated internal and external communication. The thesis should develop a communication and stakeholder management concept.

Some guidance

Subject 1

- Analyze a critical business process (Business Impact Analysis / BIA) based on a process description using own assumptions or the company's own documentation.
- Define Recovery Time Objectives (RTO) and Recovery Point Objectives (RPO) for the most important processes.
- Develop a BCM strategy for the selected process.
- Prepare a BCP draft with measures for prevention, response and recovery (e.g., alternative sites, backup concepts, cloud backups, prioritization of services).
- Develop a testing concept including a plan for the BCP (exercise formats, frequency, success criteria).
- Expected deliverables:
 - BIA results matrix, RTO/RPO definitions, BCP document (emergency organization, communication channels, recovery measures), test plan.
- Methodology / sources:
 - ISO 22301, ISO 27031, good-practice BIA methods; templates for BCP structures.
 - Additional sources as found in research.

Subject 2

- Analyze typical phishing scenarios and identify core weaknesses (technical, procedural & human).
- Design a multi-stage awareness campaign (online training, phishing simulations, posters, micro-learning modules) including target groups and scheduling.
- Complement with organizational measures (e.g., technical filters, process changes for payment procedures).
- Consider an integrated approach: what other options exist to obtain rapid help without using QR codes.
- Measurement concept to evaluate effectiveness (metrics, baseline, KPIs, evaluation period).
- High-level budget estimate and role allocation for implementation.
- Expected deliverables:
 - Campaign concept, implementation steps, KPIs and organizational complements.
- Methodology / sources:
 - ISO 27001 / ISO 27002 / NIST awareness guidance, SANS Security Awareness, experience with phishing simulation platforms.
 - Additional sources as identified by research.

Subject 3

- Prepare a stakeholder analysis (internal/external: employees, customers, supervisory authority, media, suppliers, partners, etc.).
- Develop a communication strategy for different escalation levels (initial notification, ongoing updates, final report).
- Determine the content of briefings for media, employees and authorities (spokesperson selection, key messages, FAQs).
- Define a decision-making and message-approval process (roles, escalation matrix).
- Propose an exercise to validate the crisis communication process.
- Expected deliverables:
 - Stakeholder map, communication strategy, communication basics/guidelines, approval and process flow diagram, exercise concept.
- Methodology / sources:
 - ISO 22361 (Crisis management – Guidance on crisis communications), PR and crisis communication literature.
 - Additional sources as identified by research.

Business Continuity (BC) management procedure of the SBB:



Theme 10. Lausanne-Geneva options

Goal

The aim is to identify operational and planning measures for a short-, medium-, and long-term horizon between Lausanne–Geneva, unique in Switzerland by its heavy use and lack of alternative.

Suggestion of subjects

The following subjects are suggested, but you are encouraged to choose another one:

- Which infrastructure and operational constraints (e.g., end-of-life interlockings, legacy systems, limited renewal rates) most threaten connections on the Genève–Lausanne axis, and what prioritized interventions (technical or timetable) would most reduce service loss?
- Which options do you see to make room for more capacity on this corridor in the next 15 to 30 years regarding planning and construction timelines for new infrastructure?

Some guidance

You can investigate the following fields of interest:

- Assessing corridor bottlenecks and their likely evolution under different renewal policies.
- Mapping critical nodes and their sensitivity to service disruptions.
- Evaluating capacity trade-offs between maintenance intervals and regular service patterns.
- Profiling passenger segments most impacted by reduced capacity and their modal shift elasticity.
- Comparing the effectiveness of short, frequent interventions versus long, concentrated closures for line capacity.
- Estimating lifecycle cost implications of deferring renewals versus accelerating maintenance of the infrastructure (*Substanzerhalt* in German).
- Estimating resilience of international timetables to prolonged single-track operation.
- Identifying technical interoperability barriers that constrain cross-border services.
- Quantifying impacts of reduced line speeds on travel time competitiveness with other modes of transport.
- Exploring timetable design options to maximize throughput in constrained operations.
- Assessing the role of signalling upgrades (e.g., ETCS perimeter extensions) in unlocking additional capacity.
- Evaluating substitute transport strategies (bus, reroutes...) and their consequences.
- Determining coordination mechanisms needed across corridor zones and stakeholders.
- Identifying communication and customer-management approaches to maintain ridership during long renewal works.

Suggested readings

- SBB, 'Konkret. Planungspyramide: Handlungsspielräume Lausanne–Genève', 2024
- RailCare, (n.d.), 'Ist die Schweiz nicht zu klein um Güter auf die Schiene zu verlagern?', Retr. September 10, 2025, from <https://www.railcare.ch/de/schweiz-ist-zu-klein/>
- SBB, (n.d.), 'Morges-Perroy: new double railway line', Retr. September 10, 2025, from <https://company.sbb.ch/de/ueber-die-sbb/projekte/romandie-wallis/leman-2030/projekte/morges-perroy.html>
- Citrap Vaud, Ligne nouvelle Lausanne–Genève, Retr. September 16, 2025, <https://www.citrap-vaud.ch/nos-groupes-de-travail/gt-plan-rail-2050/ligne-nouvelle-geneve-lausanne/>