Railway systems and their transition
Lecture 3

Railway Assets.

Peter Kummer
EPFL, Autumn Semester 2025
September 23, 2025

Agenda.

1. Intro
2. Pitch «Case Study» from last time
3. Railway Assets - Part 1
   - Heavy Infrastructure Assets
   - Data-driven Infrastructure Management
     - Predictive Maintenance
     - BIM
   - Macroeconomic perspective
   - Conclusion
4. Case Study «Railway Assets - Infrastructure»

Case Study Pitch.

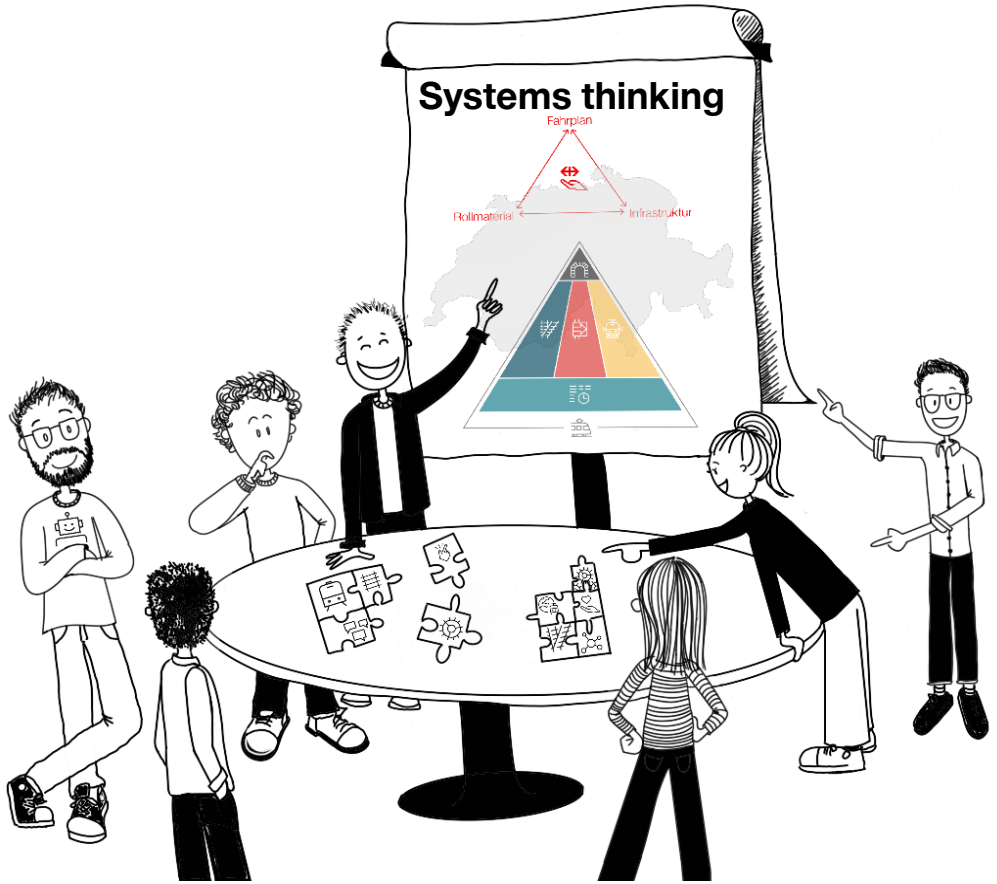
Transport systems and the role of railway.

Case study.

Autumn 2025

Image source © SBB CFF FFS

Information about the Case Study.



Organisation and Preparation

- Group Size: 3-4 members, ideally the same as for the semester report.
- Case Study Selection: Each group selects one case study per semester.
- Preparation Time: Time allocated is preparation during the exercise class plus a maximum of 3 hours outside of class.

Presentation

- Duration: A pitch of a maximum of 5 minutes.
- Format: No formal requirements, but a maximum of 3 slides, with no additional documents or handouts.
- Discussion: Input and discussion facilitated by the professor.

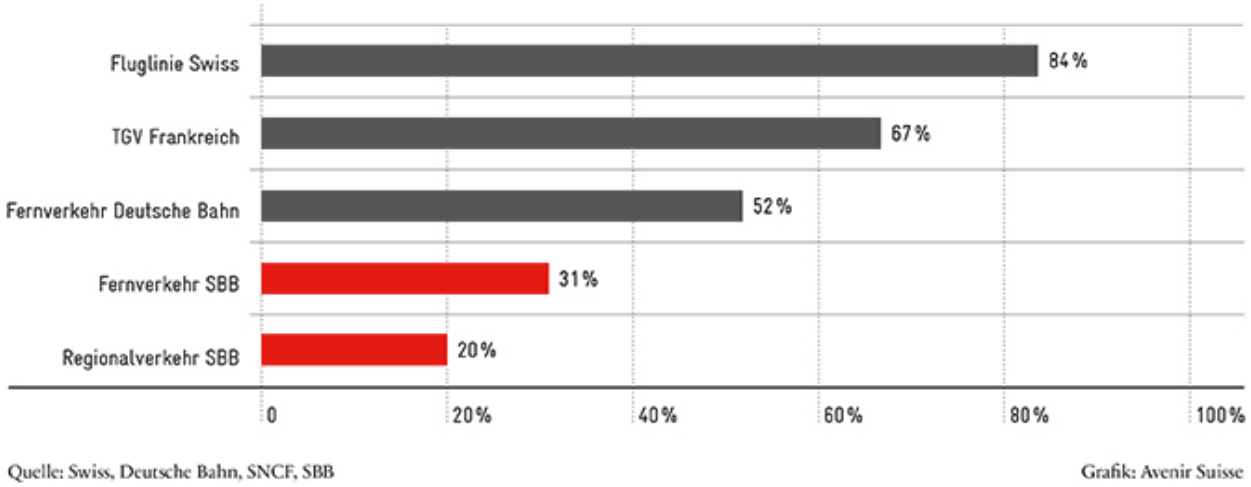
Evaluation

- Non-graded

Case: Efficiency of means of transport.

Today we have dealt with the modal split to compare rail and public transport with other means of transport. For the economic management of a railway, the key figure of utilization is highly relevant.

Seat occupancy rates of selected modes of transport in comparison.



Quelle: Swiss, Deutsche Bahn, SNCF, SBB

Grafik: Avenir Suisse

Premise
- Considerations detached from political framework conditions / restrictions

Your Role
- In-house Consultant, Strategy Expert

Specific questions
- What do the numbers tell us – why are there differences?
- What are the differences between air travel and rail as a public service
- What are possible measures to increase the seat occupancy rate/load factor of the railway?
- Approx. 3 measures including assessment of feasibility and impact.

Additional information
- Link Tagesanzeiger

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Cuiradiatur
Tut. Sveit. Dapertut.
LA POSTA
8203

Railway Assets.
Topic overview.

Part 1
«Heavy Assets»
today

Part 2
«Rolling Stock»
next week

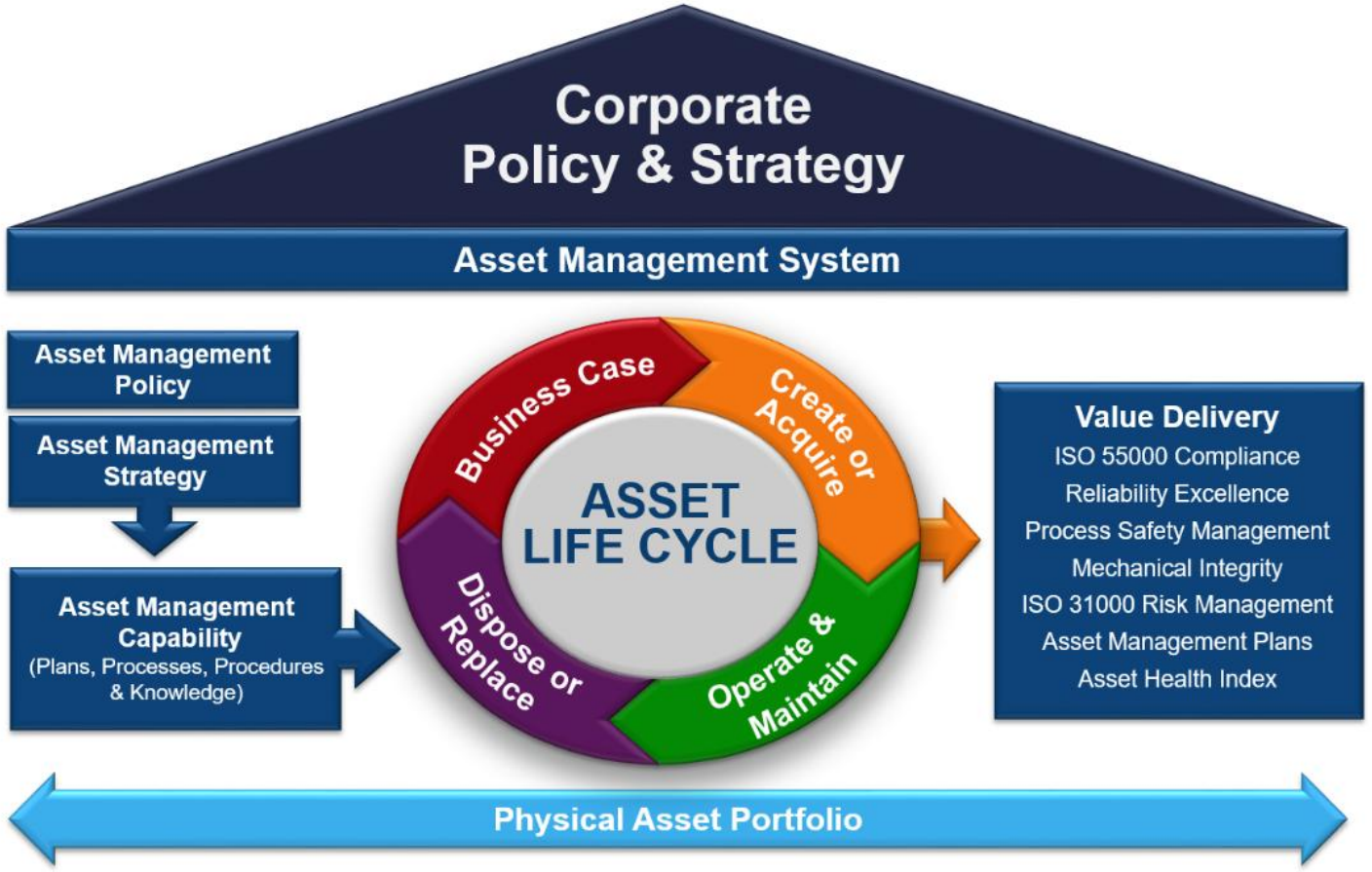
Part 3
«Traffic Management Systems»
In two weeks

Railway Assets.

Part 01 «Heavy Infrastructure Assets».

Railway Assets and Railway Asset Management.

What is an Asset? And what is Asset Management?



Asset Management
According to ISO55000:2014

«The coordinated activity of an organization to generate value from assets»

Asset

«Item, entity or thing that has potential or actual value to an organization.»

Assets as the topic of today.

Asset Management defines an asset by value creation – what is the service it provides?

Basic services include: Train-path use (of the specified quality), including train operating services; ex-catenary power supply; safe and punctual operations, including the telecommunications and IT services required for these operations; use of tracks by the trains in unchanged formation for freight operations; and the provision of platform space for passenger trains, including access to the public amenities.

Source: List of Infrastructure Services

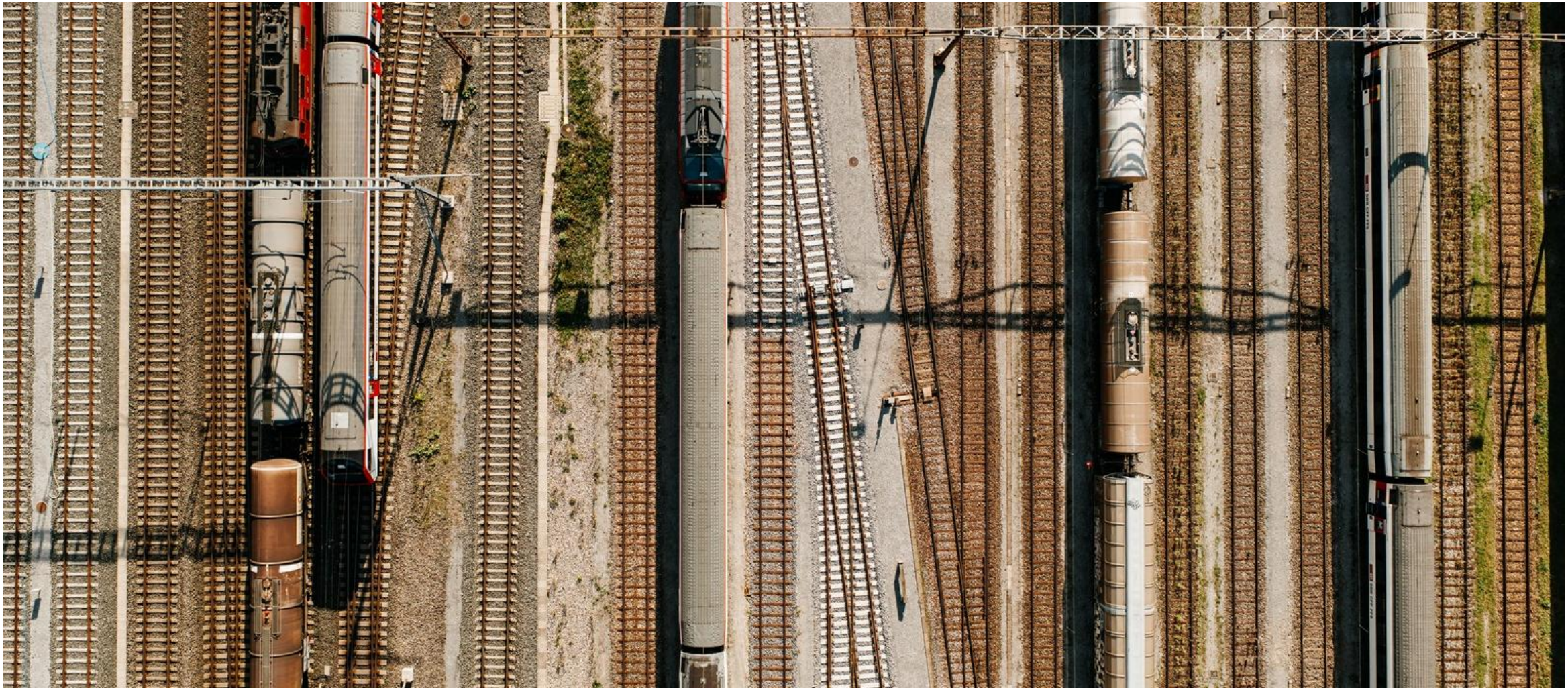
Railway Assets.
Agenda.

Part 1
«Heavy Assets»
today

Part 2
«Rolling Stock»
next week

Part 3
«Traffic Management Systems»
In two weeks

The foundation our trains roll upon – the railway track.

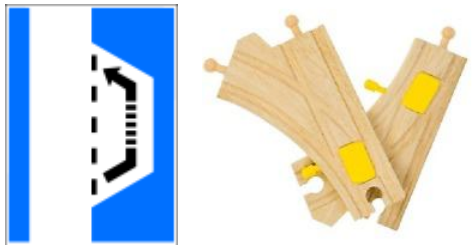


Railway System – not just an «iron road».

Why the technical core of this systems implies a lot of the way it can be used.

Track-bound

Vehicle requirements



Changing tracks

Switches, passover-tracks, crossing tracks

Long braking distance

Effect of the positive aspect «low friction»

81a *Schweizerische Bundesbahnen.*

Motorwagenkurse auf der Strecke

Baar-Zug-Cham-Rothkreuz und umgekehrt.

Fahrplan vom 1. Oct. 1902.

		4170	4172	4176	4178	4180	4182	4184			
Baar . . .	ab	—	—	1005	149	325	357	—	—	—	—
Zug	an	—	—	1012	156	333	402	—	—	—	—
	ab	555	801	1013	—	—	Täglich	530	—	—	—
Kollermühle H. .	-	602	808	1019	—	—		537	—	—	—
Cham	-	609	820	1025	—	—		544	—	—	—
Rothkreuz .	an	624	835	1040	—	—		559	—	—	—

		4173	4175	4177	4179	4181	4183	4187			
Rothkreuz .	ab	713	853	1046	—	-	Täglich	716	—	—	—
Cham	-	730	912	1102	--	—		731	—	—	—
Kollermühle H. .	-	737	919	1109	—	—		738	—	—	—
Zug	an	743	925	1115	—	—		744	—	—	—
	ab	—	954	—	140	315	343	—	—	—	—
Baar . . .	an	—	1002	--	147	323	349	—	—	—	—

Die sämtlichen Züge mit Ausnahme der Züge **4182** und **4183** verkeh
nur an Werktagen und führen nur Wagen III. Kl.

Timetabling operations

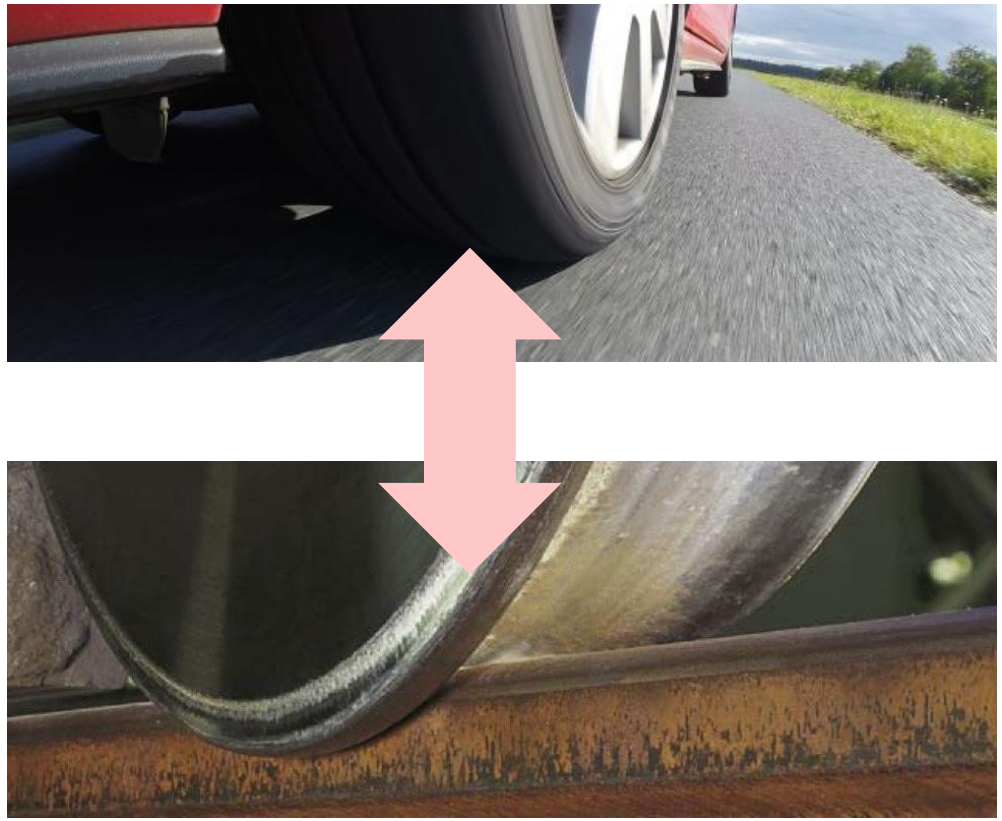
Safety, Capacity

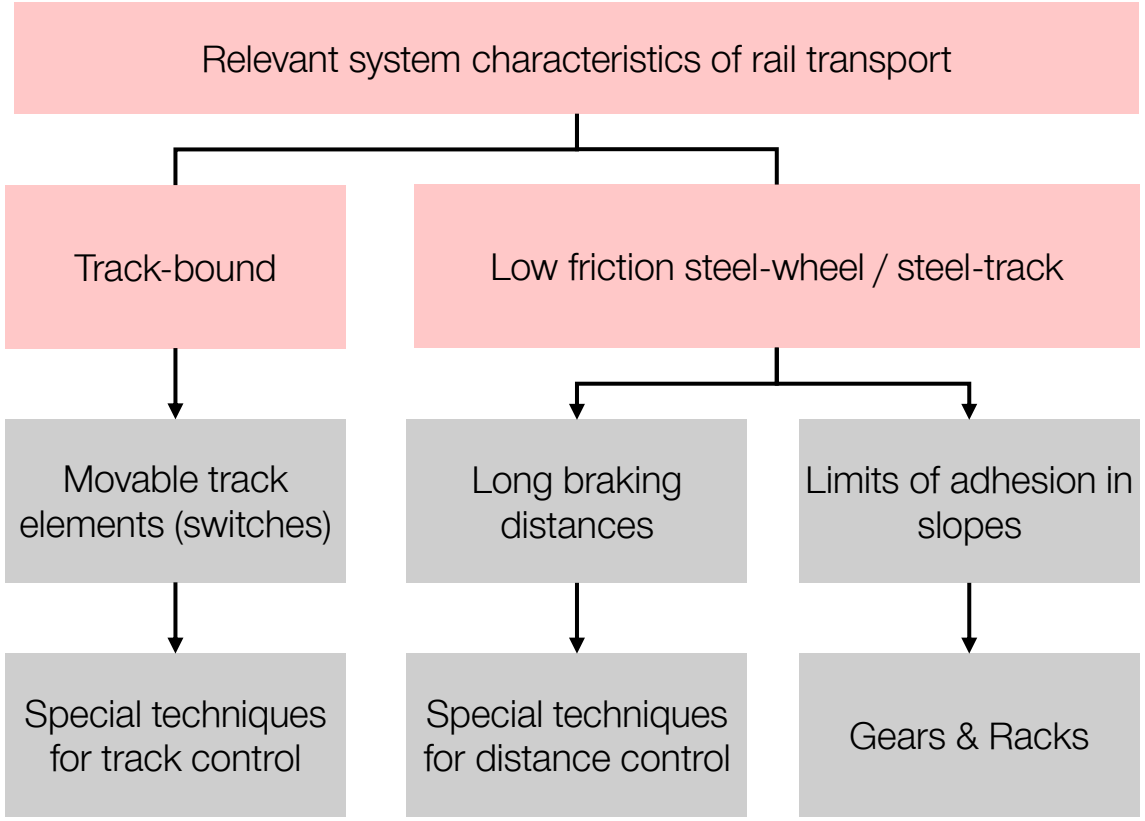
Railway System – not just an «iron road».

Means of mass transport: No rational door-to-door connection.

Railway System – not just an «iron road».

A detailed look on the rail-wheel-interaction.



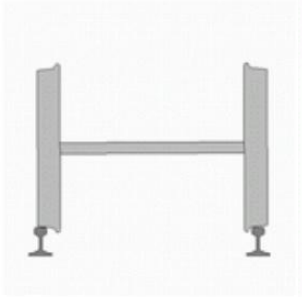


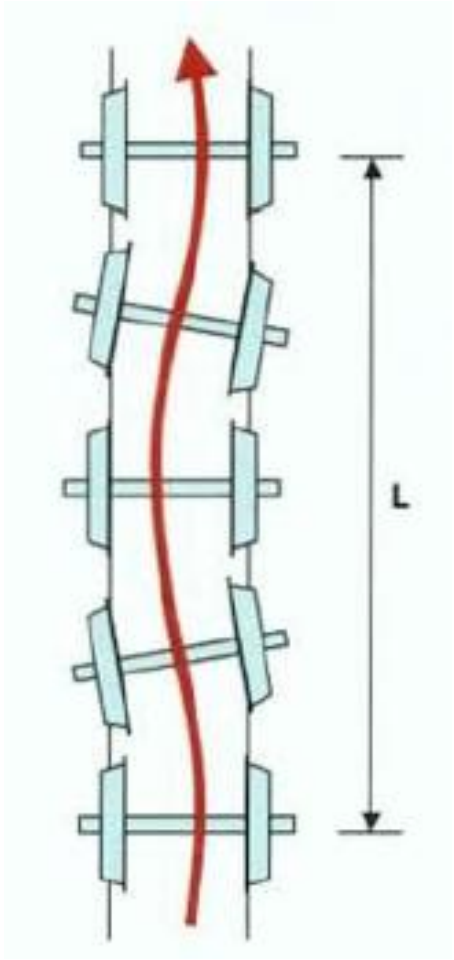
Source: Edited from Pachl J., Systemtechnik des Schienenverkehrs.

Train guidance – wheel-rail, hunting oscillation and gauge.

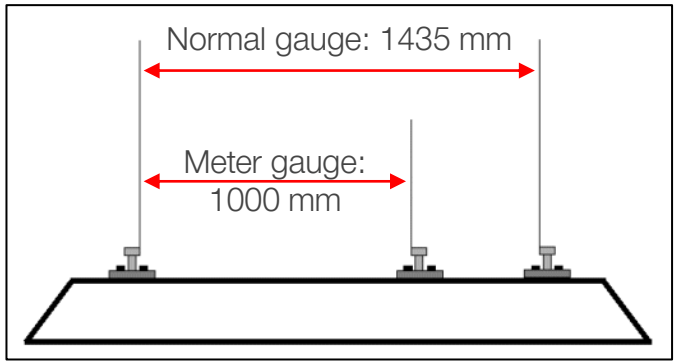
Why does a train not derail?

Source: Bergbauhunt, frühes 18 Jhd, Deutsches Technikmuseum Berlin





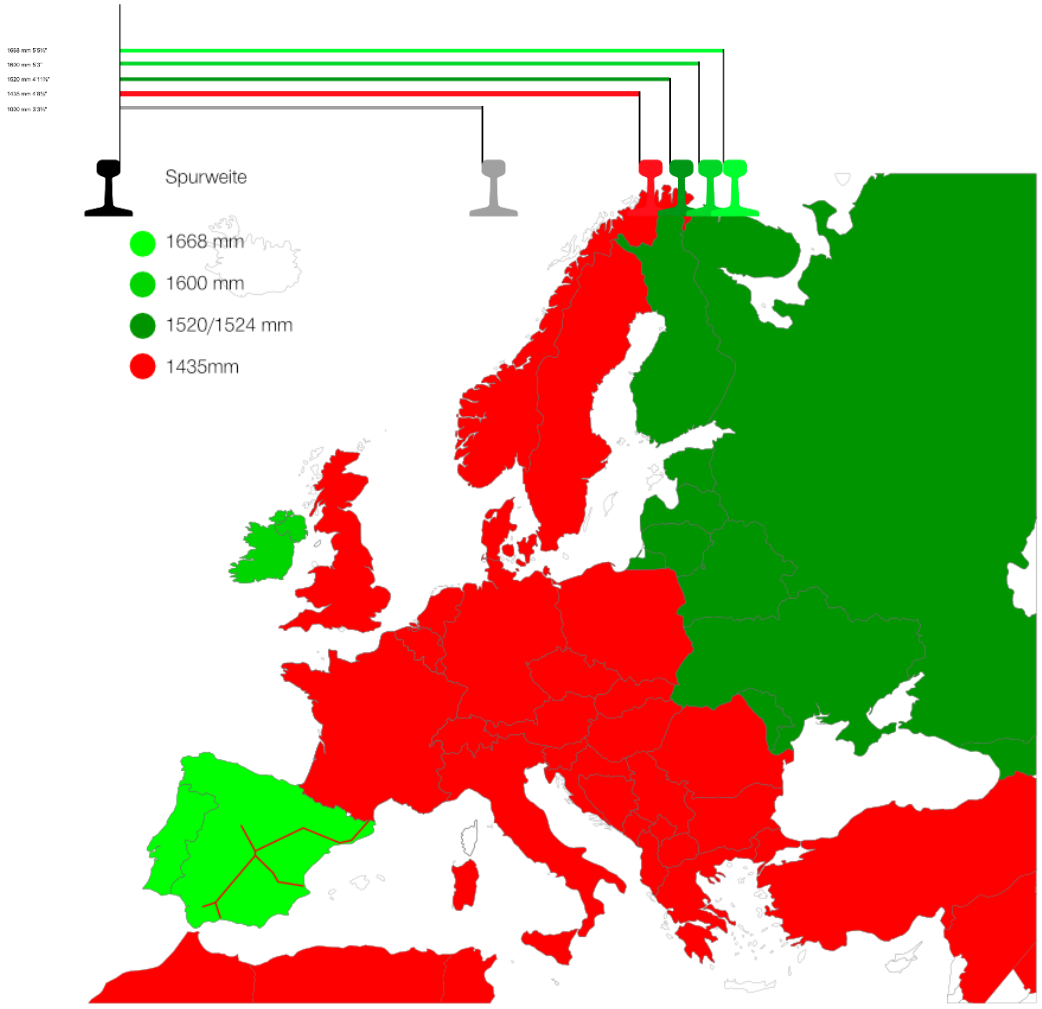
Source: http://de.wikipedia.org/wiki/Sinuslauf
https://en.wikipedia.org/wiki/Hunting_oscillation



Source: Pferdebahn – Wikipedia

The gauge widths in the (inter)national context.

Standardization, built railway networks and the challenges to overcome.



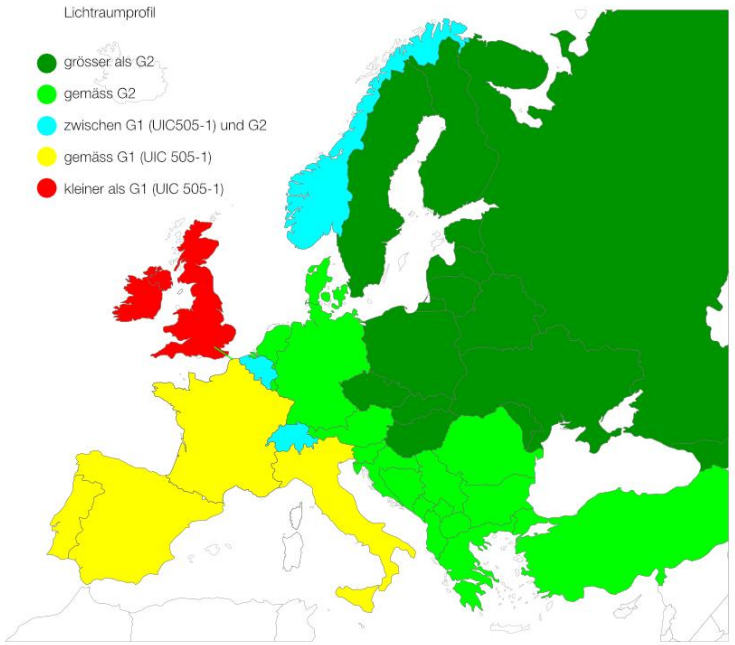
Track width / gauge

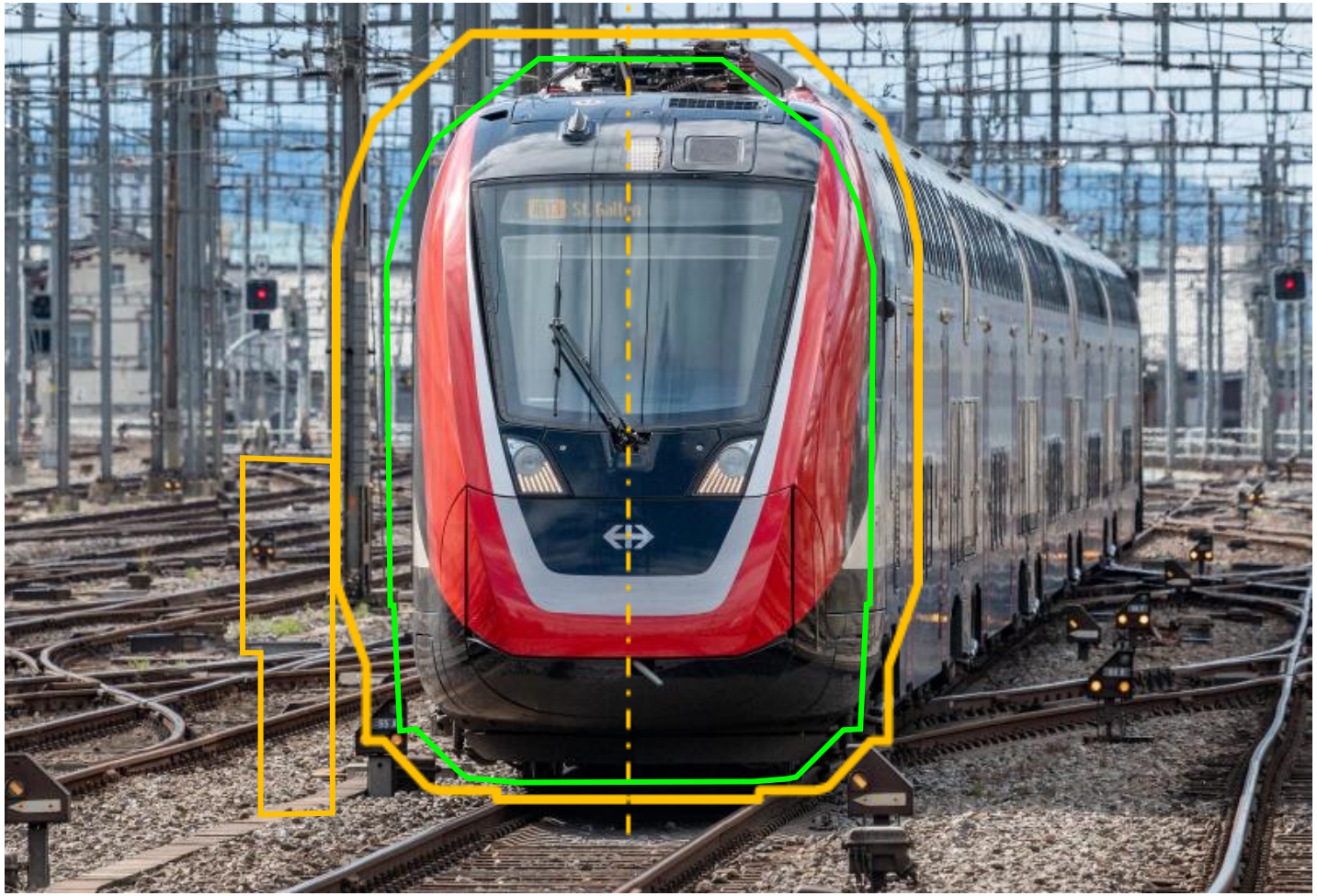
gauge-changing facility metre gauge – standard gauge Zweisimmen

And once a train is on these tracks, what‘s around it?

Another gauge is the loading gauge: „Lichtraumprofil“.

Lichtraumprofil

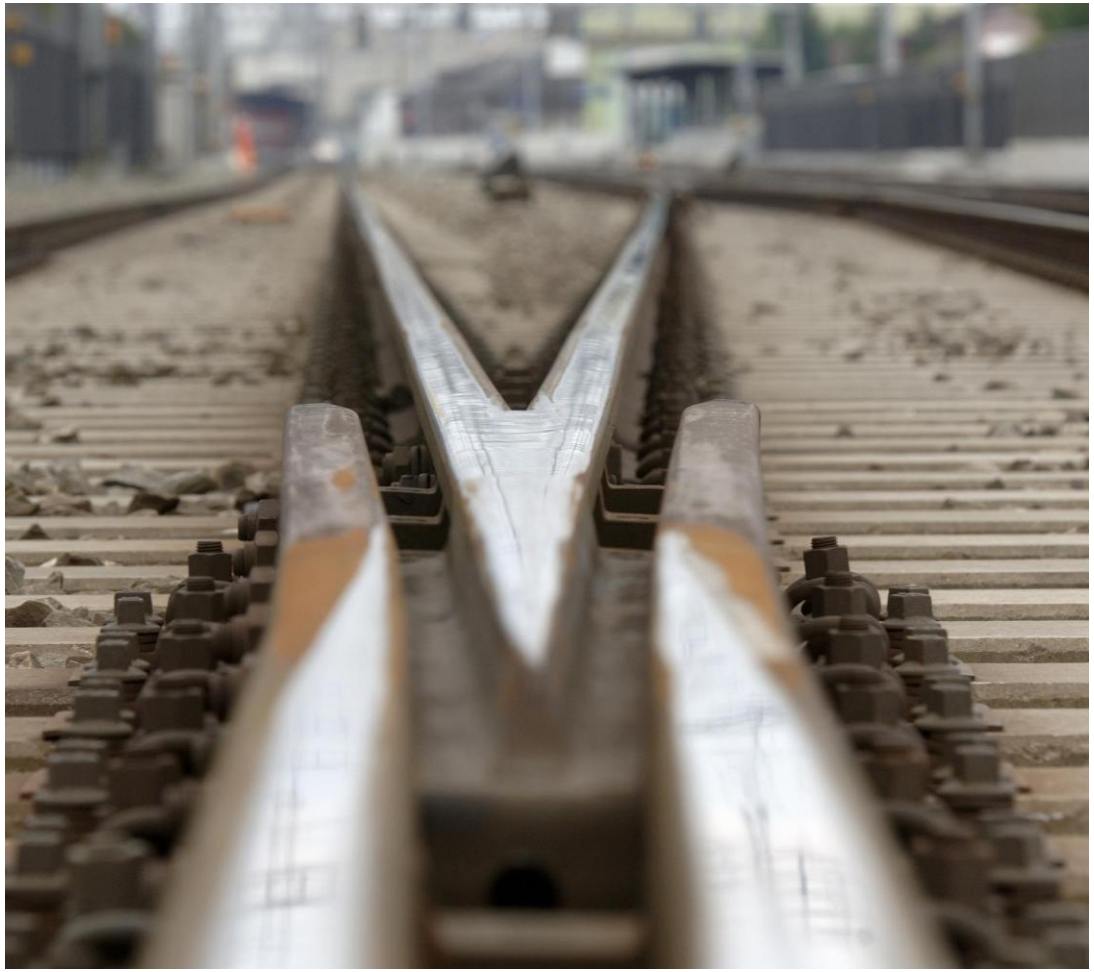


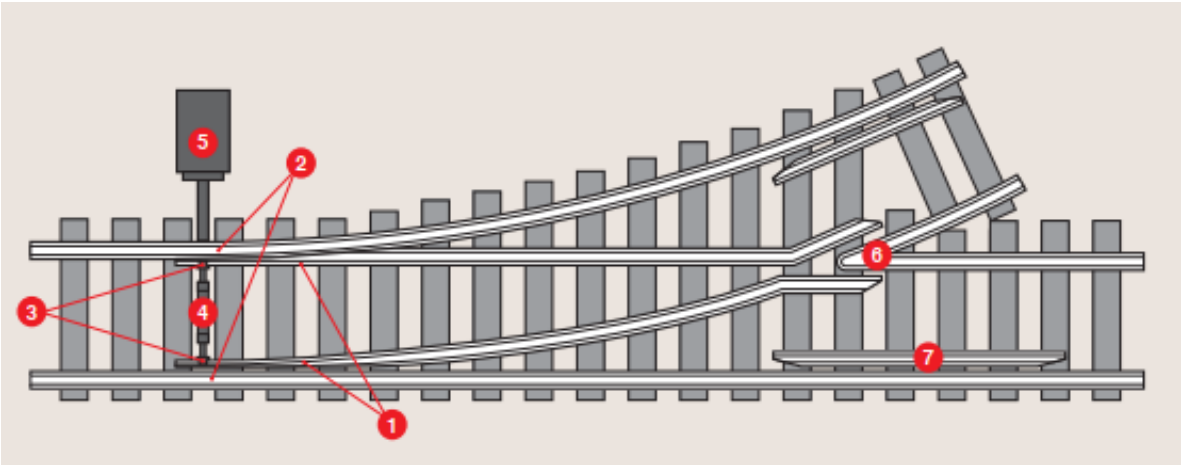


Virtual boundary for vehicles as well as infra assets and safety «zones» (for personell)

Changing tracks – „the“ railway choke point.

Switches and crossings as a fundamental piece of railway infrastructure.





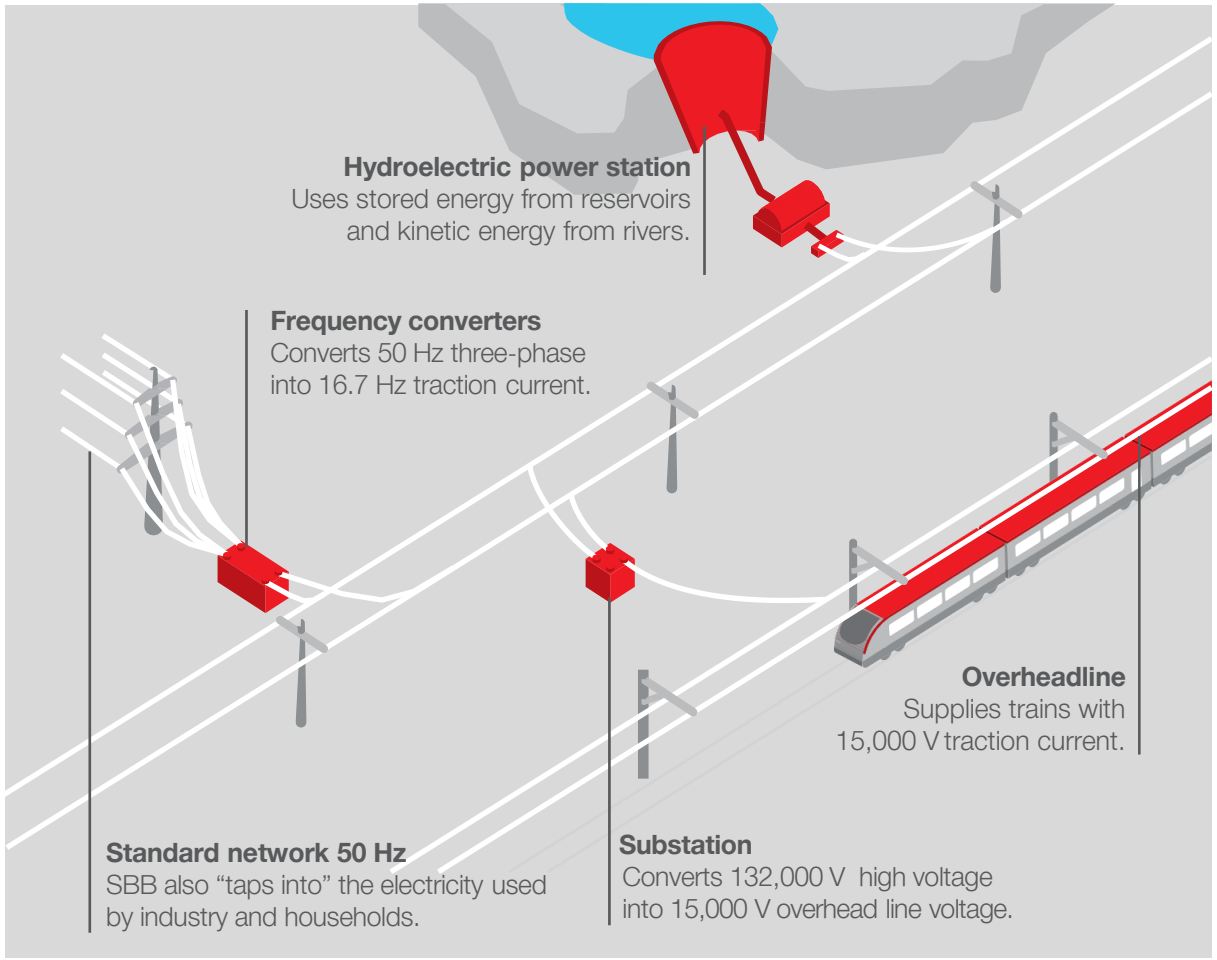
(1) switch blades / switch points (2) stock rail (3) locking
(4) switch rod / tie bar (5) machine (6) crossing / frog (7) guard rail

- Not the train (driver) decides where to head.
- The directions are set by these crucial elements.
- The logical structure we will cover in the “Traffic Management Systems” part of our railway asset lecture.

Powering the trains – Energy Supply.

Powering the trains – Energy Supply.

From water drop in alpine lakes to the catenary overhead a train.



Yearly Swiss Rail electricity demand
(SBB and other Swiss Rail)

– 16.7Hz Rail traction current 2‘500 GWh

– Plus 50Hz „normal“ electricity 300 GWh

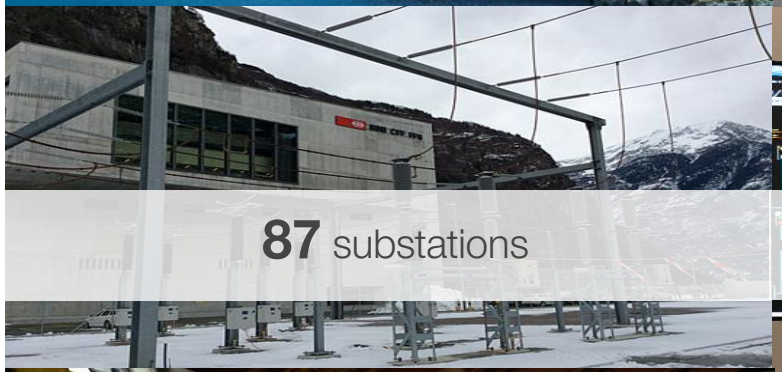
As a comparison: Winterthur City 500 GWh
(as the 6th largest Swiss city)

Powering the trains – the Assets at SBB Energy.

8 own hydroelectric power plants

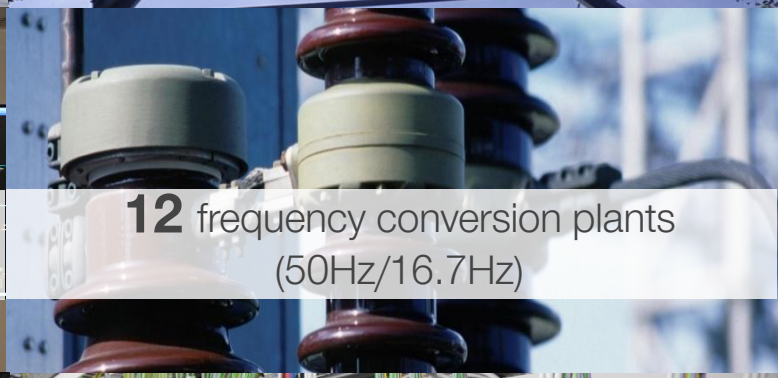
5 joint usage power plants

1924 km transmission line



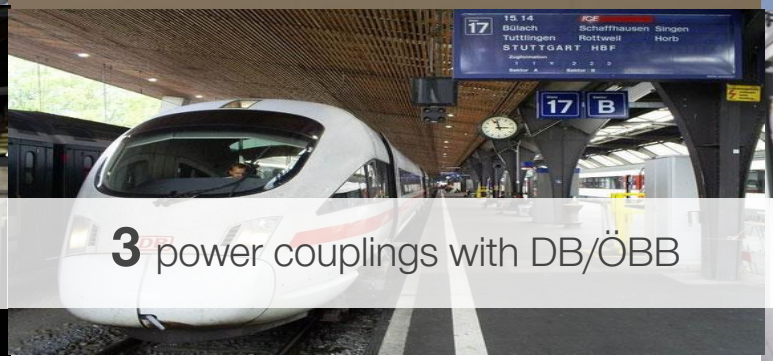
87 substations

1 central network control centre

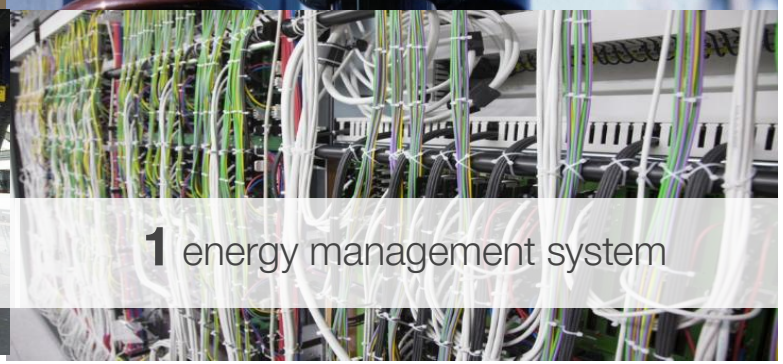


12 frequency conversion plants (50Hz/16.7Hz)

404 employees (FTE)



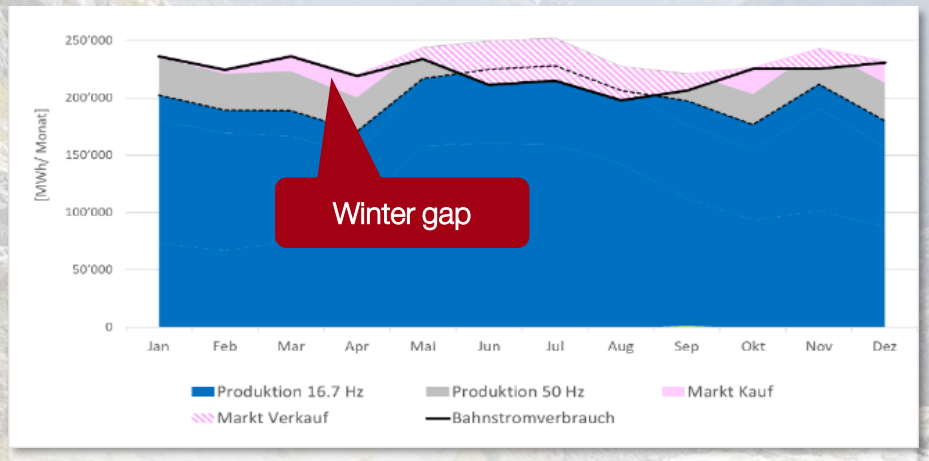
3 power couplings with DB/ÖBB

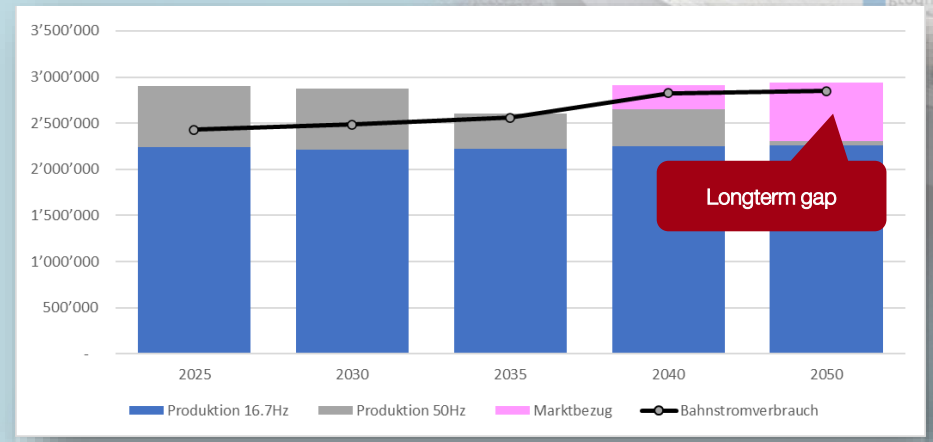


1 energy management system

Powering the trains – the Assets at SBB Energy

Demand and production.

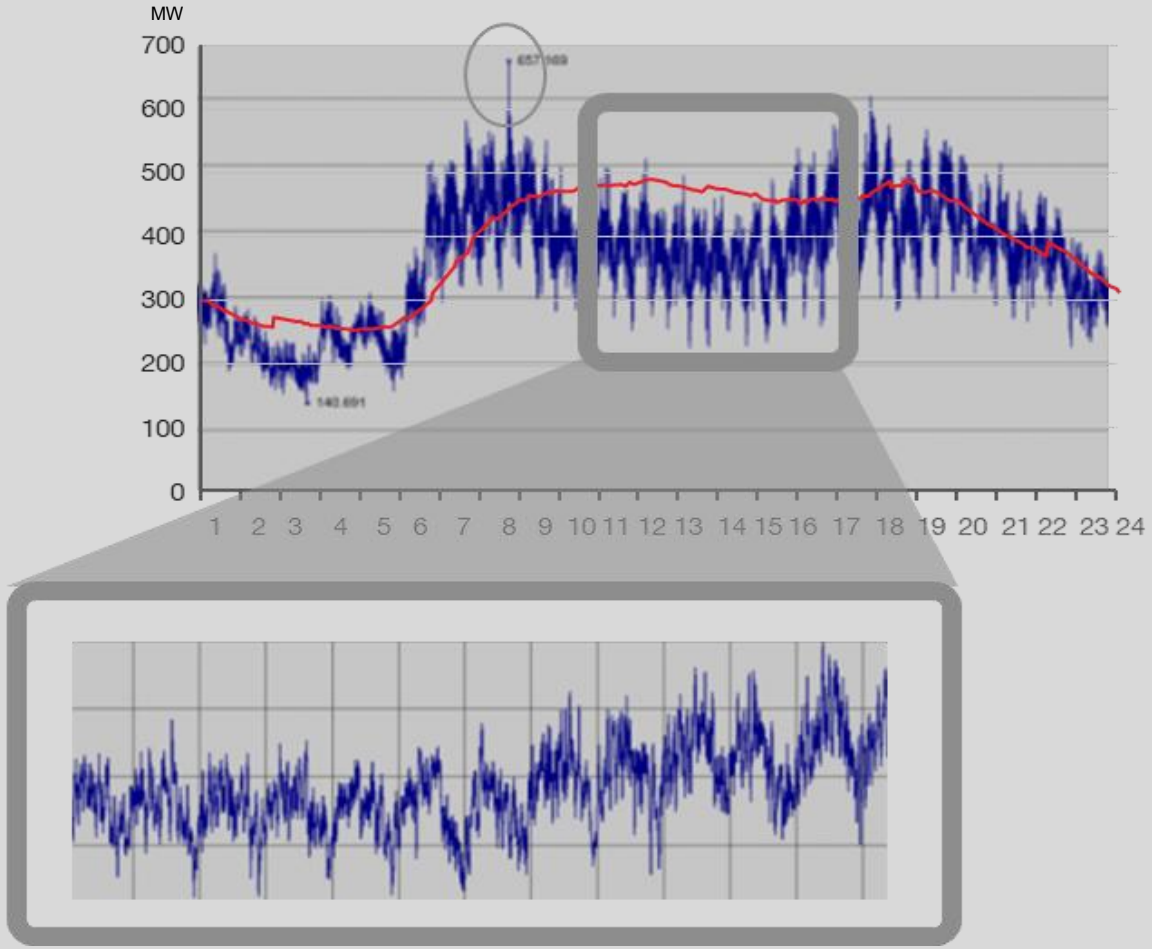


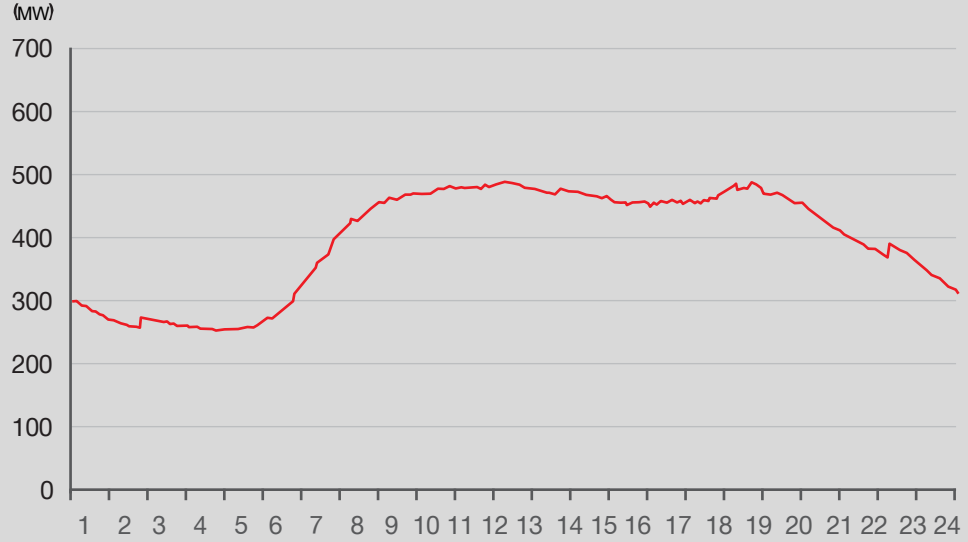


- Energy demand exceeds in-house production in the medium term
- Two possible solutions:
  1. Save electricity
  2. Produce more

Railways energy network is highly dynamic.

The „Taktfahrplan“ brings some headaches to the party.



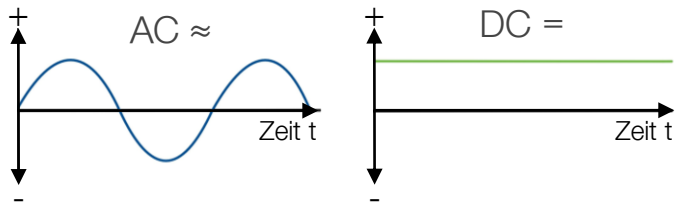


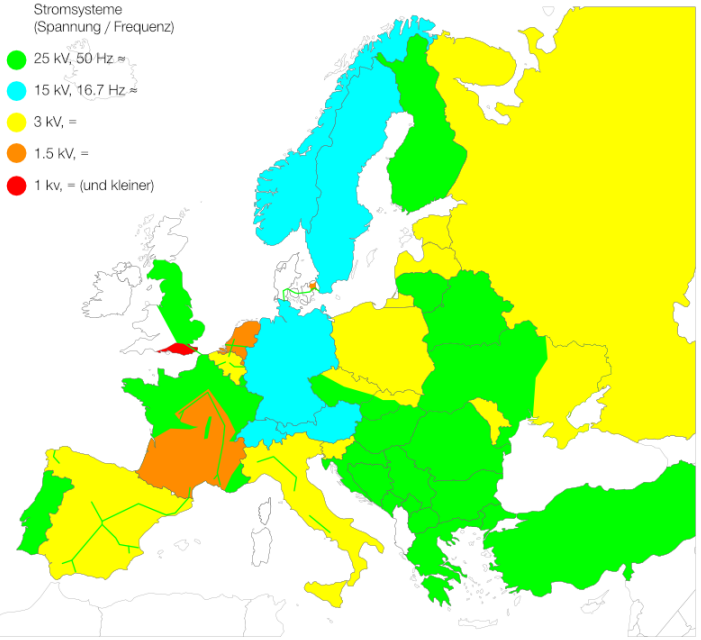
Dynamic of network loads	SBB	City of Zurich
Daily	Up to 500 MW	Up to 250 MW
Within 15 Minutes	Up to 300 MW *50% of maximal load*	Up to 35 MW *7% of maximal load*

Electric power for trains – international perspective.

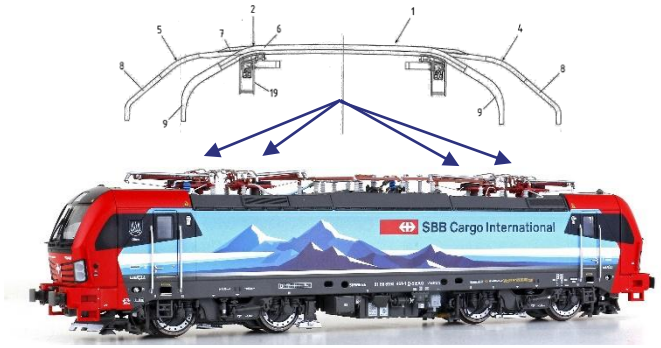
The different voltage, current and physical assets needed.

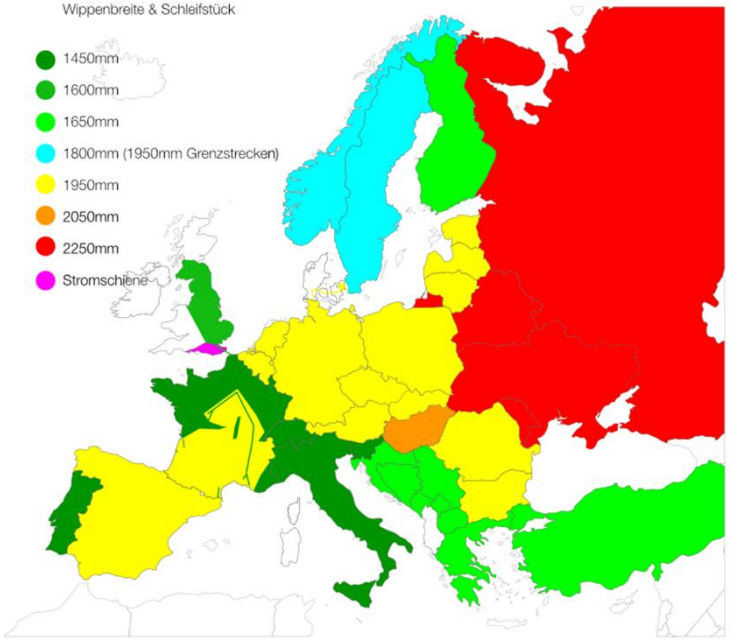
Electric system





Pantograph collector width





- Railway electrification was a local or national project and evolved together with innovations and progressing technologies.
- Modern electronics eases the transfer of a train in between different electric systems.
- The “physical hurdle” that’s left is pantograph and the catenary “zigg-zagg”.

Real estate.

From the old „Bahnhofsbuffet“ and station buildings to urban development.

Real estate.

From the old „Bahnhofsbuffet“ and station buildings to urban development.

Production facilities for railway operations

Employee satisfaction in offices, workshops & depots.

Railway stations

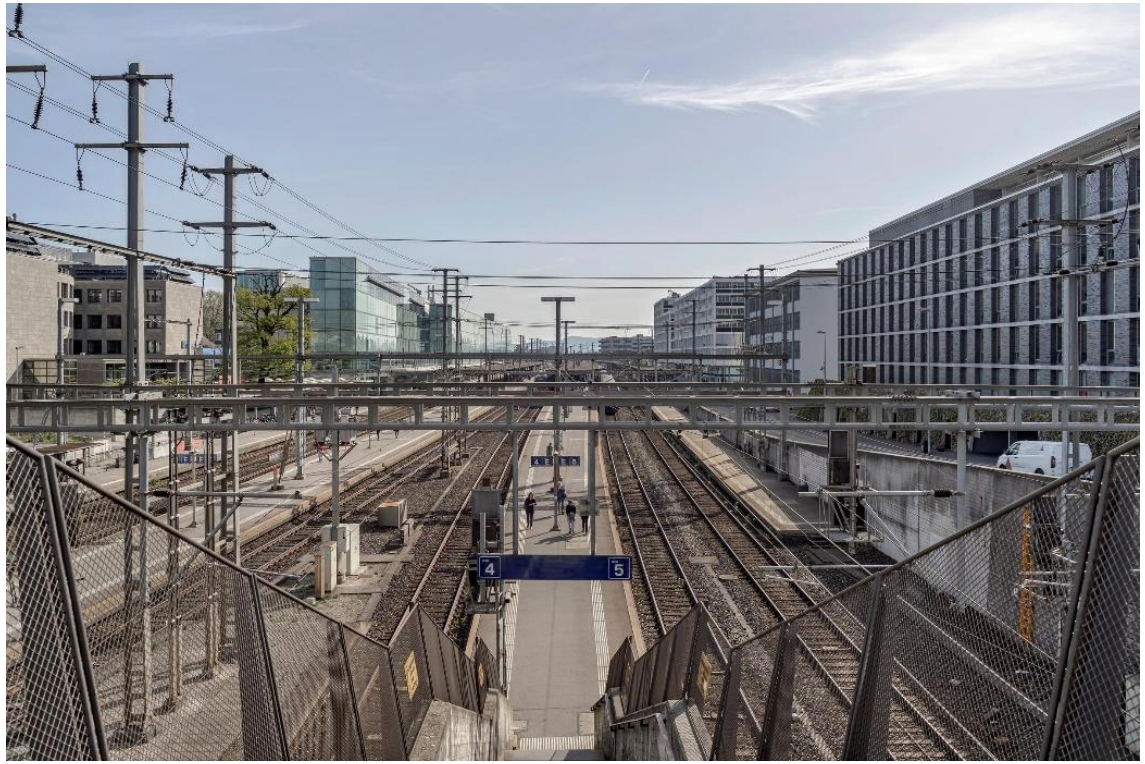
Safe, clean and comfortable stations and access paths.

Station surroundings and former railway areas

Spatial development and portfolio diversification.

Stations.

Where the infrastructure meets the passenger directly.



Bahnhof Aarau, SBB

Getting the people into trains requires a lot of heavy assets.

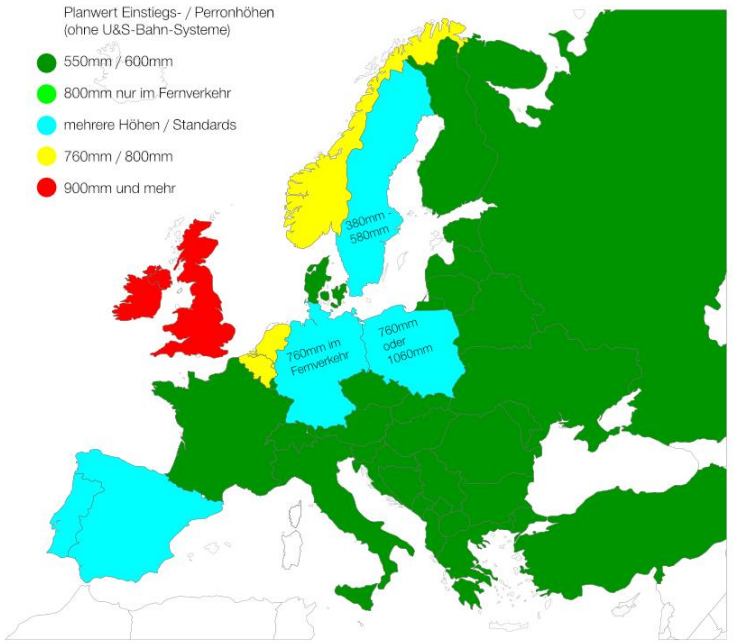
Bahnhof Papiermühle, Source Flux

And they are more than «just» railway stations – they are the key for intermodality.

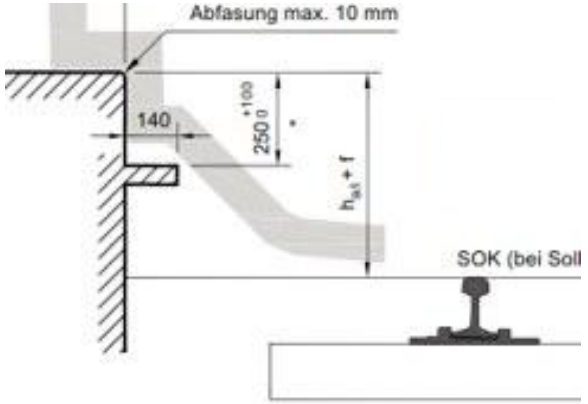
Railway network at passenger stations.

The point where train and infrastructure should get very close but never touch though.

Platform height



Renens Perronhöhen 55cm SBB / 95cm TL m1



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Nächster Halt Schieflage – die schrägsten Bahnhöfe der Schweiz

Perrons im Kurvenbereich Zwei SBB-Haltestellen im Norden des Kantons Zürich gehören landesweit zu den Spitzenreitern punkto Gleisüberhöhung. Für Passagiere im Rollstuhl ist das eine Herausforderung.

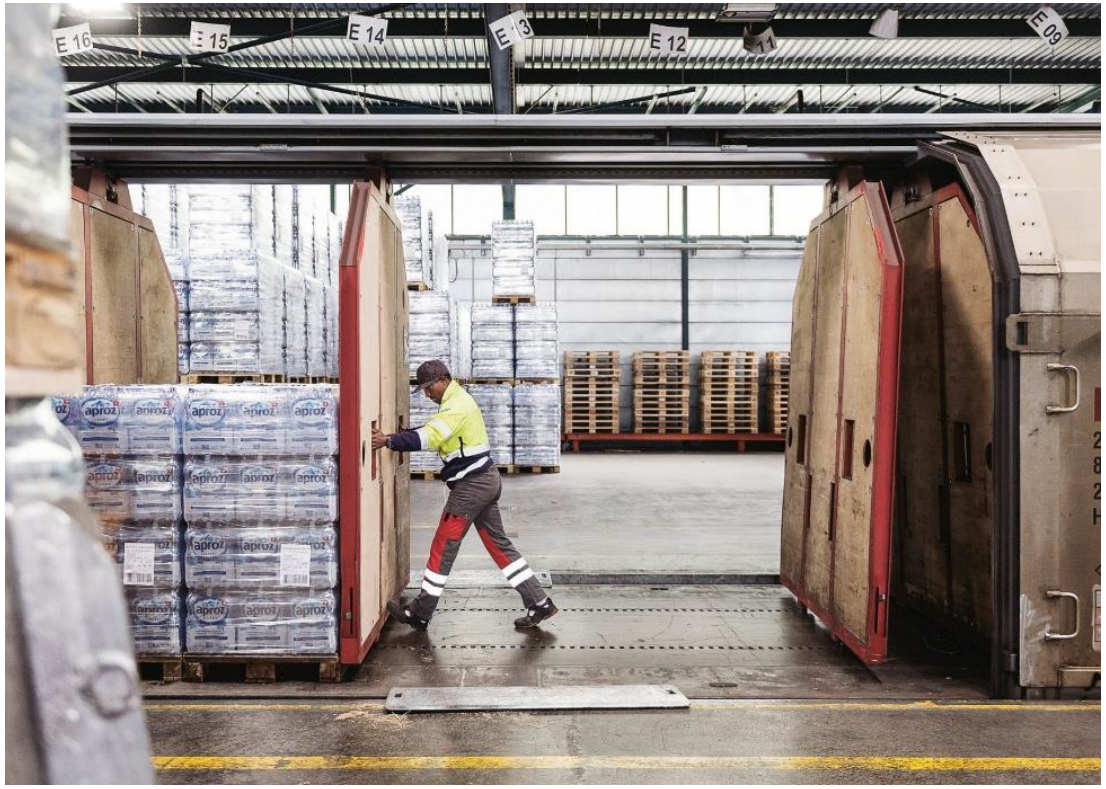
S-Bahn mit Schlagseite: Am Bahnhof Langwiesen in Feuerthalen neigt sich der Zug merklich. Foto: Goran Basic

Conflict of stopping vs. through trains

Freight „stations“ – sidings and terminals.

We know how people get into our trains. But how does the freight get on board?

The same station as before: Aarau – but this time the freight side.



Or the direct loading facility in a supermarket logistic facility nearby.

Freight „stations“ for connecting in-between trains.

People change between trains on their own – the goods don’t.

Source: lacote.vd / Tatiana Huf

- **Freight train operations** remains to need a **lot of tracks**. As the freight doesn’t change trains by itself – the wagons change in between trains.
- The reasons and effects we are going to cover in the customers lecture.
- This example of Lausanne Triage is just around the corner and the third largest of our five freight shunting yards in Switzerland.

Civil engineering structures.

The assets that last very long.

Since the beginning of rail – this huge structures were a key element.
Like the Landwasser viaduct bridge from RhB.

Or the alpine tunnel crossing the Gotthard massif since 1882.
Both extraordinary pieces of skill and political will.

Bridges – in between statics and railway dynamic forces.

Like almost all civil engineering assets not standardised and very individual assets.

Bridge types[1]	adif	BANE NOR	DB NETZE	INFRABEL Right On Track	Infraestruturas de Portugal	SBB CFF FFS	SNCF RÉSEAU
	8.934[2] Rail Bridges	2.821 Rail Bridges	25.713 Rail Bridges[3]	3.496 Rail Bridges	1.717 Bridges[4]	6.186 Bridges[5]	32.258 Rail Bridges
 Masonry	21 %	12 %	23 %	33 %	30 %	12 %	44 %
 Concrete	73 %	49 %	29 %	45 %	50 %	58 %	43 %
 Steel	5%	39 %	16 %	7 %	18 %	6 %	13 %
 Other / Hybrid	<1 %	<1 %	32 %[6]	14 %	2 %[7]	23 %	<1 %

1) In case of mixed materials, deck type material was used for categorization 2) Total of railway bridges over 2 metre span serviced and maintained by Adif 3) Source: DB Netze Network Condition Report 2021, p. 172 4) PRIME 2021 Data for ID 157 5) Source: SBB Anlagentyp-Gruppenbericht 2022, p. 15 6) Including bridges with mixed materials and frame bridges 7) Considering the use of two or more structural materials, such as concrete and steel. 8) PRIME ID for number of bridges to be found in annex

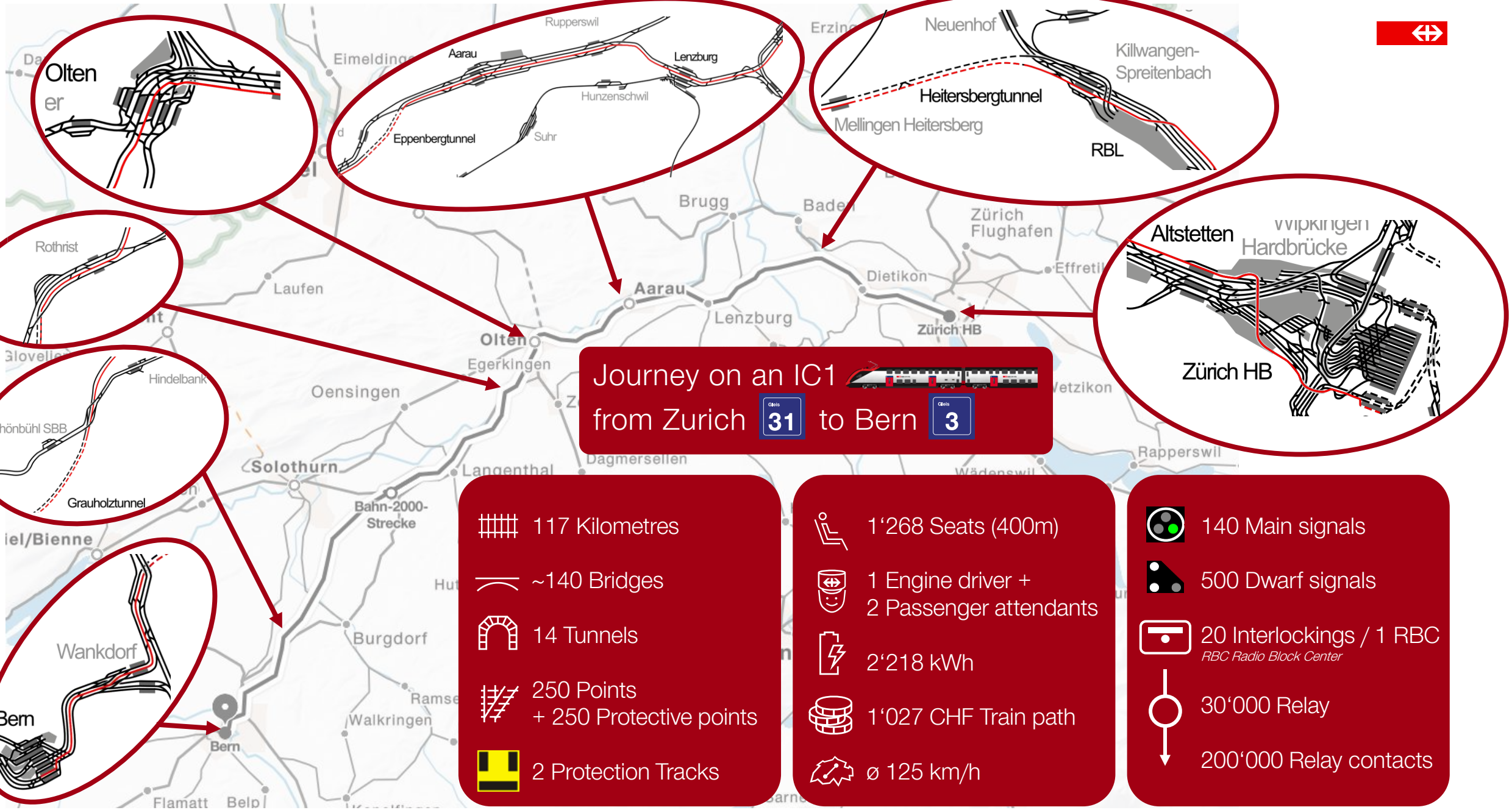
Source: civity, final report, PRIME Thematic Deep Dive Network Condition 01.11.2023

Tunnels – from purely civil engineering to modern smart pieces.

From bricks, track and a little bit of electric installations to modern electronic installation.

An «old» tunnel is mostly engineering work with the catenary, communication and interlocking being a small part of the asset.

A modern tunnel consists of many electronic systems and a main challenge is the maintenance and renewal of this short-lived assets.



Journey on an IC1 from Zurich Gleis 31 to Bern Gleis 3

- 117 Kilometres
- ~140 Bridges
- 14 Tunnels
- 250 Points + 250 Protective points
- 2 Protection Tracks

- 1‘268 Seats (400m)
- 1 Engine driver + 2 Passenger attendants
- 2‘218 kWh
- 1‘027 CHF Train path
- ø 125 km/h

- 140 Main signals
- 500 Dwarf signals
- 20 Interlockings / 1 RBC
  RBC Radio Block Center
- 30‘000 Relay
- 200‘000 Relay contacts

An aggregated view: The network condition.

Categorization of assets.

Expensive to replace and to maintain.

RTE 29900

9 ASSET CATEGORIES

ASSET CATEGORIES

Buildings and land	Engineering structures	Permanent way	Traction current systems	Signalling installations	Low-voltage and telecom systems	Public facilities	Infrastructure vehicles	Production equipment and miscellaneous
								

9 MAIN ASSET TYPES

MAIN ASSET TYPES

	Bridges	Tunnels	Tracks	Points	Overhead contact lines	Interlockings and train control systems	low voltage consumers	Platforms and access points	Rail vehicles Infrastructure
RV CHF millions	13 061	17 184	16 965	5373	6205	6539	3549	6986	1963
% of the RV (RV = Replacement value)	10	13	13	4	5	5	2	5	2
Each	6215	435	6727 km	12 696	8419 km	467	366 071	10 428	2461

- About 130 billion Swiss Francs in replacement value.
- We are spending about 2 billion a year to operate, maintain and keep the substance of our assets and another billion a year for extensions.

The network condition report.

A standardized instrument to constantly measure and report the condition of the whole system.

ZUSTANDS-KLASSEN	BESCHREIBUNG	MASSNAHMEN	KLASSENÜBERGÄNGE	
ZK1 «neuwertig»	Neue oder neuwertige Anlage, welche **keine oder unbedeutende substanzbasierte Abweichungen** aufweist (verschleiss-getriebener Schaden / Abnützung).	Keine	< 1,75	«neuwertig»
			1,75–2,24	«neuwertig bis gut»
ZK2 «gut»	Die Anlage weist substanzbasierte **Abweichungen** auf, welche in absehbarer Zeit **keine Beeinträchtigung für den Betrieb** darstellen.	Keine	2,25–2,74	«gut»
			2,75–3,24	«gut bis ausreichend»
ZK3 «ausreichend»	Die Anlage weist substanzbasierte **Abweichungen** auf, welche den **Betrieb potentiell beeinträchtigen** können und / oder bei Nichtbeheben **Folgekosten** verursachen werden.	Keine	3,25–3,74	«ausreichend»
			3,75–4,24	«ausreichend bis schlecht»
ZK4 «schlecht»	Die Anlage weist substanzbasierte **Abweichungen** auf, welche den **Betrieb beeinträchtigen** können und / oder bei Nichtbeheben **hohe Folgekosten** verursachen werden.	Planung und Ausführung von ordentlichen Erneuerungsarbeiten	4,25–4,74	«schlecht»
			4,75–4,99	«schlecht bis ungenügend»
ZK5 «ungenügend»	Die Anlage weist substanzbasierte **Abweichungen** auf, welche den **Betrieb unmittelbar beeinflussen** können und Massnahmen bedingen, damit der uneingeschränkte Betrieb gewährleistet ist.	Terminierte Massnahmen oder ggf. Sofort-massnahmen	5,00	«ungenügend»

Abb. 1: Beschreibung der Zustandsklassen gemäss RTE 29900.

2024 SBB Infrastructure Network Condition.

With a 2.8 rating – the condition is still in the range “good – to sufficient”.

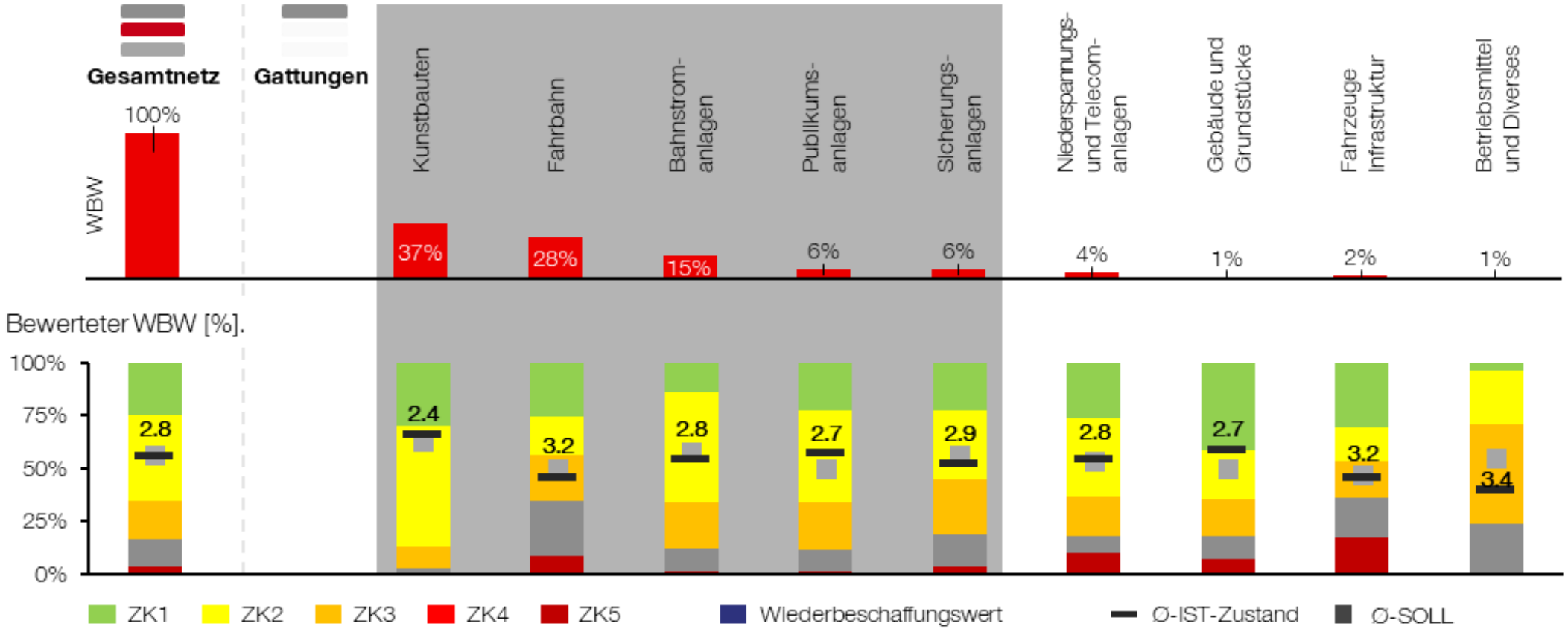


Abb. 35: Zustand Gesamtnetz-, Gattungs- und Wiederbeschaffungswertverteilung.

Mapping the track condition scores on the network.

Permanent way scores per route weighted by the replacement value.

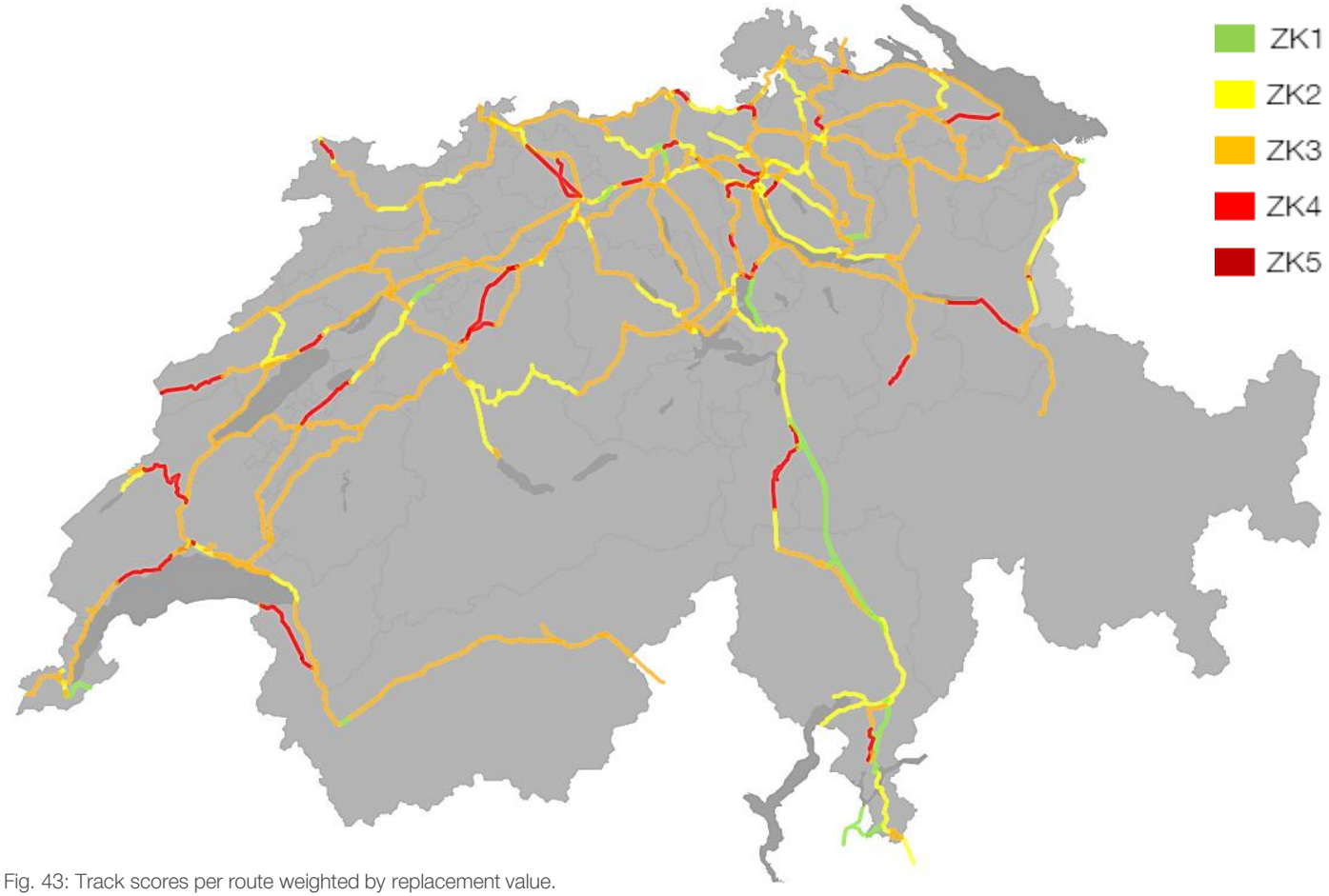


Fig. 43: Track scores per route weighted by replacement value.

2024 SBB Infrastructure Network Condition.

2024

Condition development Substance: Consistent

2,8
Substance note

- Overall condition of three networks is "good to sufficient". Securing the targeted condition grade of 2.7 requires the implementation of the planned preservation of the substance.
- Slightly "outdated" asset structure.
- Backlog CHF 8.4 billion (increase of CHF 383 million)
- The condition of the track assets with a grade of 3.2 is "good to sufficient" and stable.

3,2

Track condition «good to sufficient»

Attention to

- **Track**
  0,2 below target
  Unit costs track renewal
- **Traction power assets**
  0,1 below target
- **Signalling installations**
  0,2 below target

Overview

Backlog factor	**6,8**	year before 6,7 up
Replacement value	**130,4 bn. CHF**	yb 126,3 bn. CHF
Ø asset age	**44 years**	target: 40 years
Track renewal	**199 km**	yb 197 km
Unit cost track renewal per meter	**3525 CHF**	yb 3031 CHF
Renewal / Maintenance (LV)	**1803 / 792 MCHF**	yb 1726 / 798 MCHF

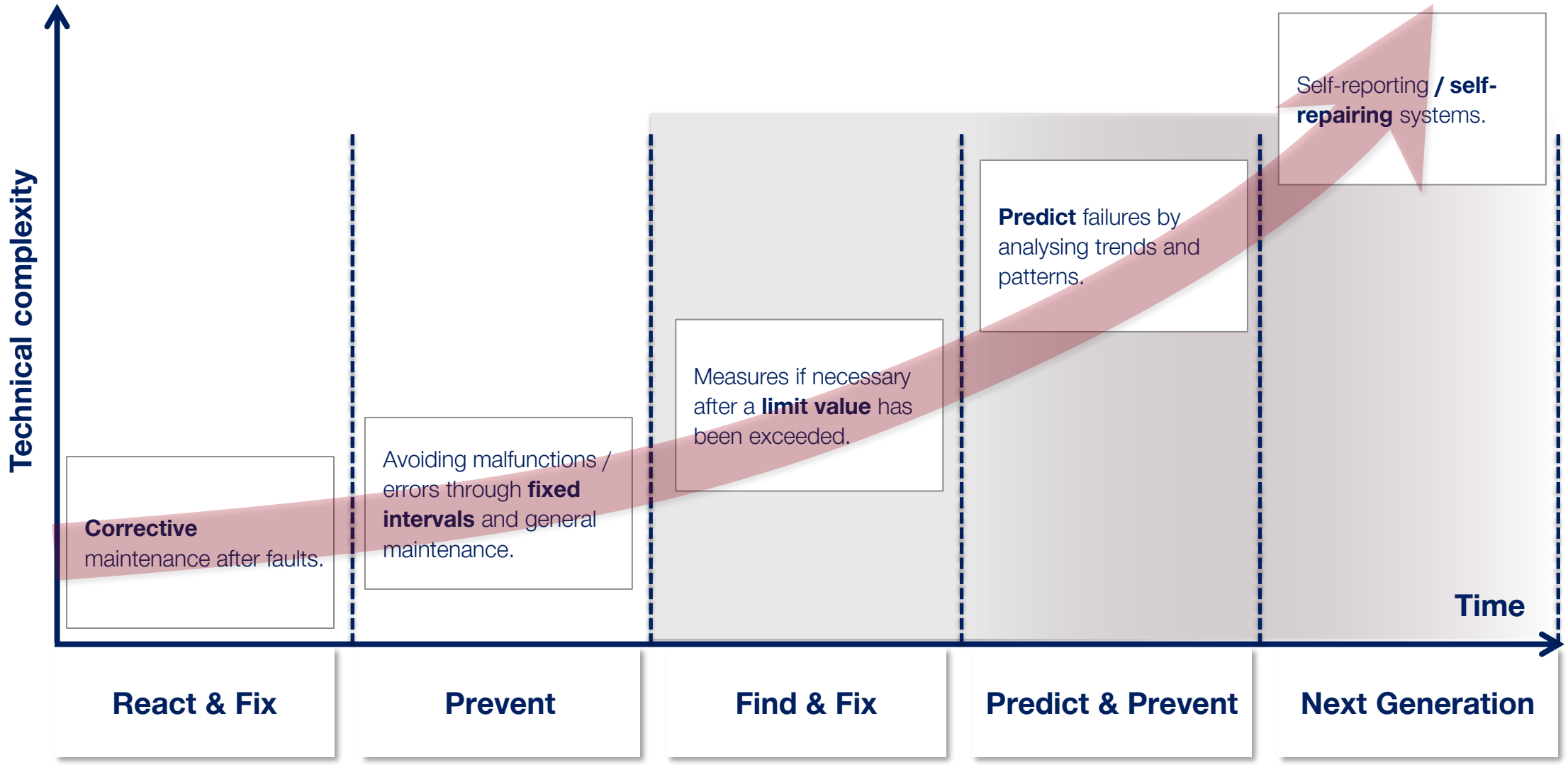
Data-driven infrastructure management.

Predictive maintenance
BIM

Predictive maintenance.

Predictive Maintenance – a progressive view.

Tracks have been inspected and fixed since the beginning of the railway age.



Inspect to ensure a safe rail infrastructure.

Looking at 250 types of defects.

Overhead wire installations

Signals

Track geometry

Embankment & vegetation

Train safety installations

Sleepers & ballast

Rail

Fasteners

Condition data production SBB Infrastructure.
Diagnostic vehicle DFZ.

Data

800 Mb/km

4 GB/km
(tunnel inspection)

10 Terabyte annually

Environmental information

Environmental video in both driving directions TVS

Overheadline contact wire condition

Overhead contact wire measurement OLWMS
Overhead line video OLVS

Track condition information

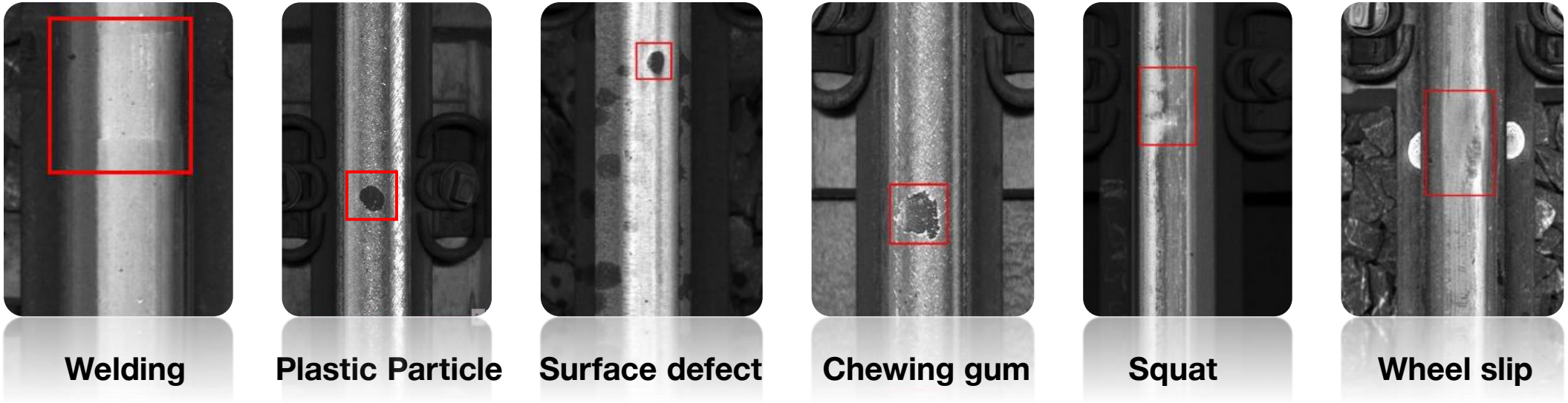
Track geometry measurement TGMS
Rail profile measurement RPMS
Track surface inspection TSIS
Rail head inspection RHIS
Switch measurement SMS

Balise checking

ETCS balise diagnostics DETCS
Balise measurement SIMS

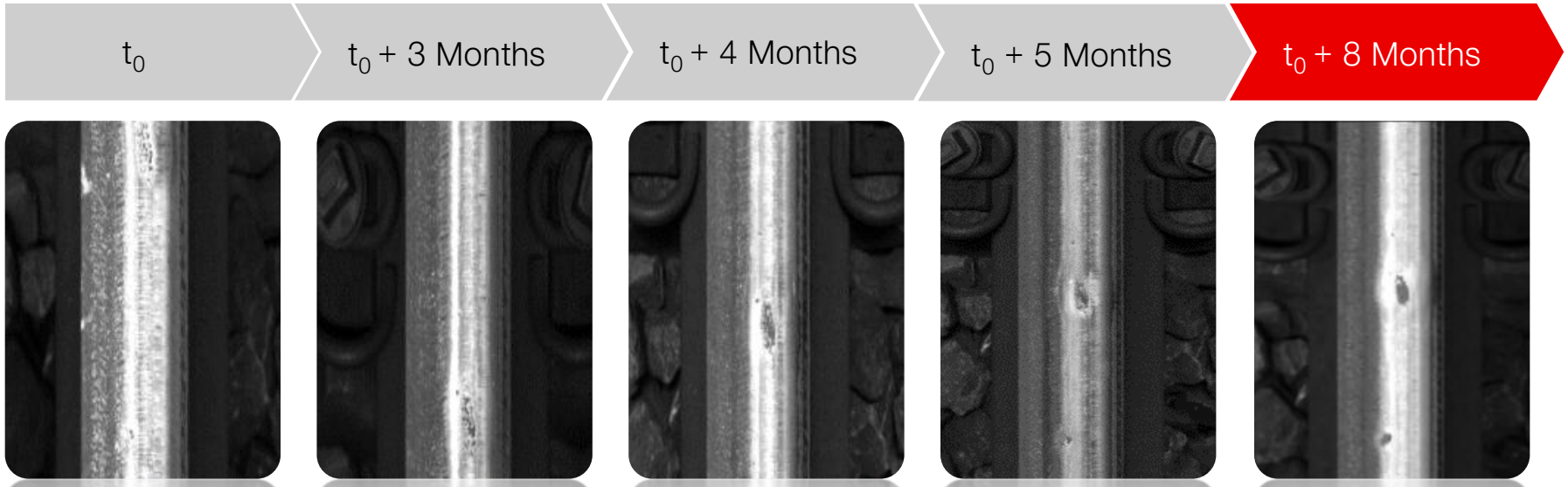
Classification.

Not everything that looks like a defect is actually serious.



Evolution of a Defect.

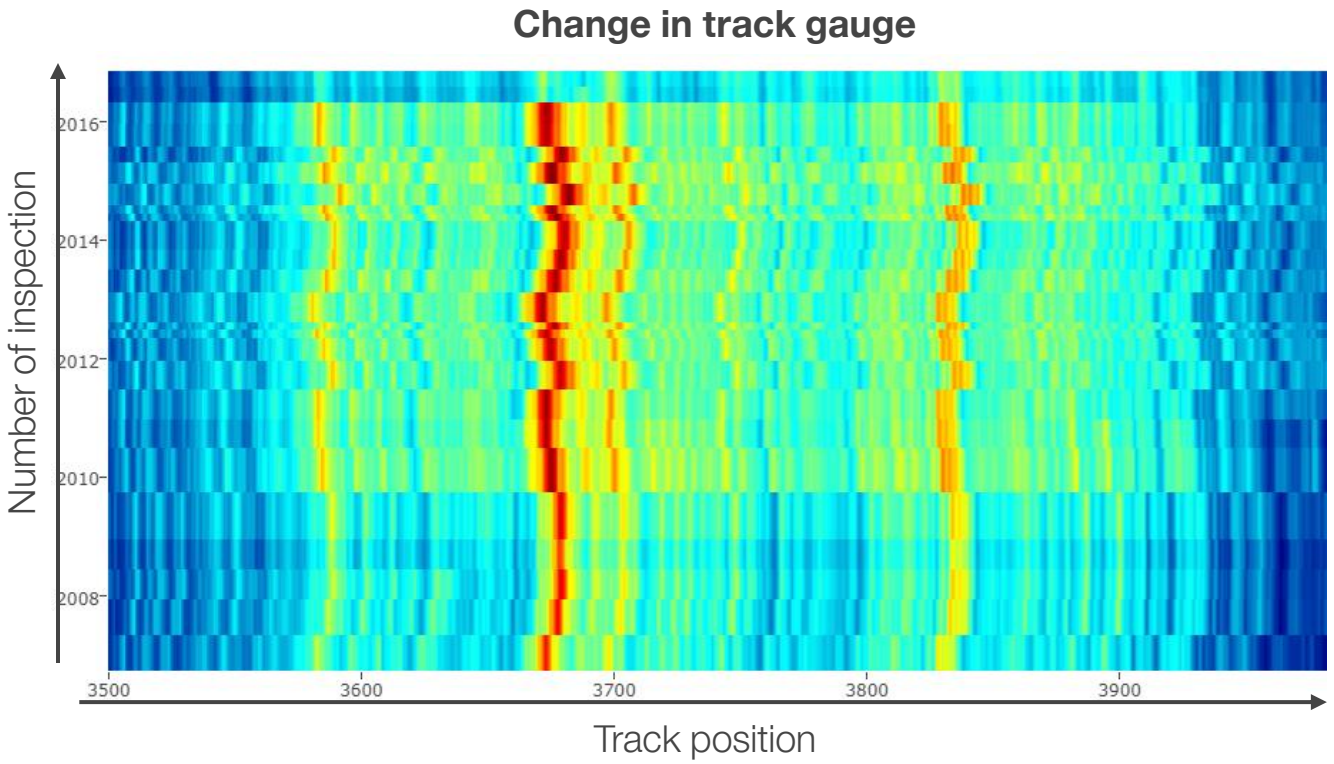
One step closer to predictive maintenance.



Changes in state become visible over time and we become aware of them in understanding the system.

Data time series laid the base layer for predictions.

Precise location of the measurement is crucial for an algorithm.

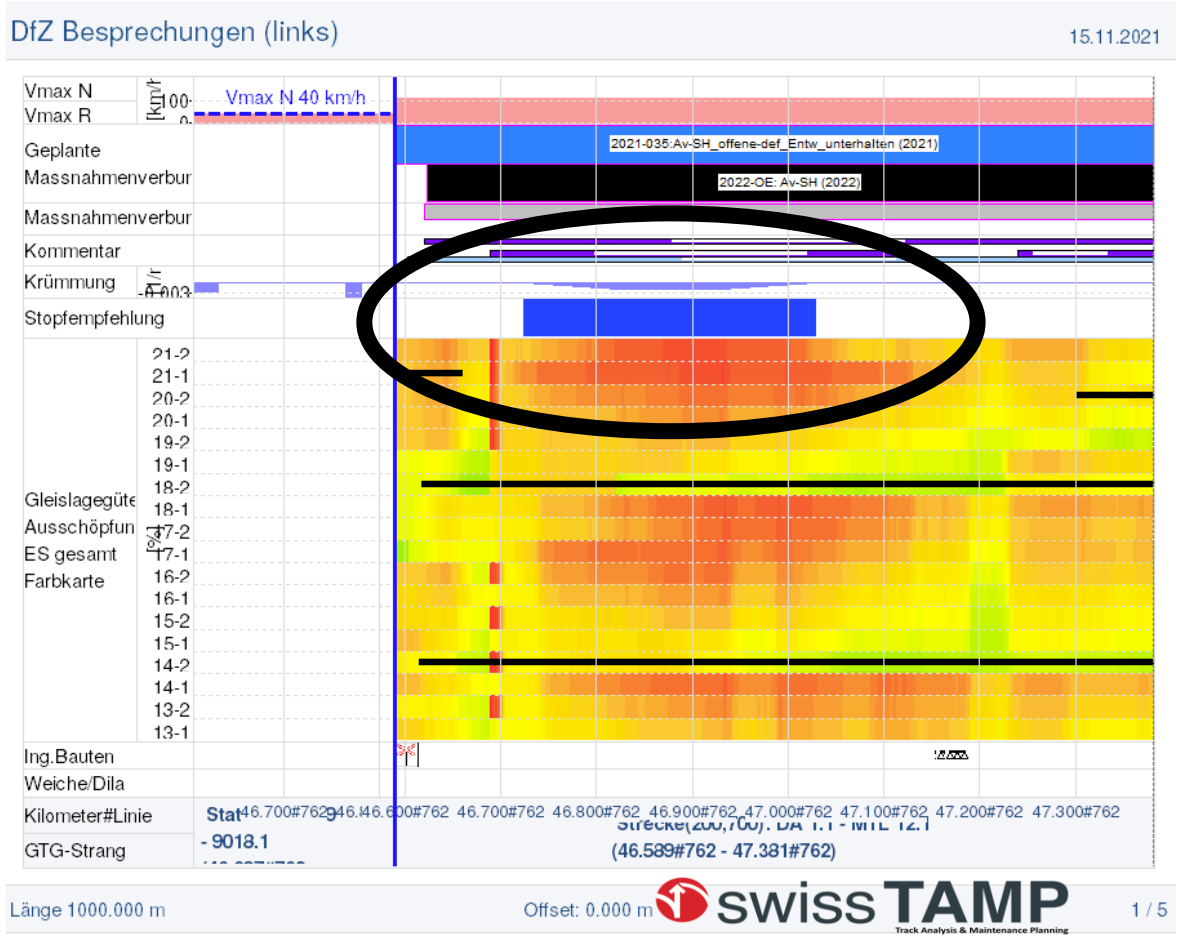


What do you see in the colour map?

- At the top is a slightly shifted pattern; **each row is a measurement run** (x-axis = track position, y-axis = inspections – ca twice per year).
- In the **top row** you can see there was an **intervention** — the defect is “fixed.
- With **precise geolocation** a tool can also evaluate how this defect evolves over time (from bottom to top, increasingly red = worse).

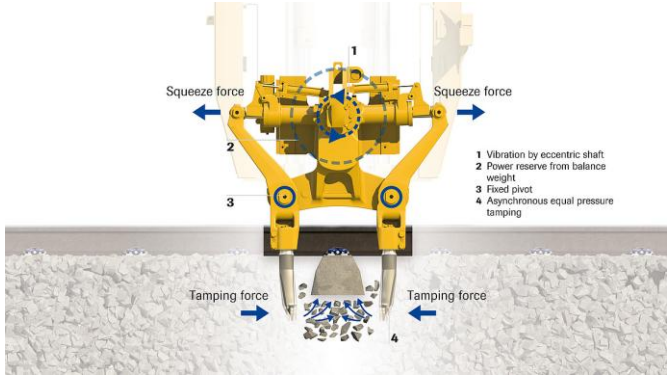
Gaining trust for the prediction algorithms.

Tamping predictions and the same reference data for strategy and maintenance.



Blue bar:

- “**Tamping recommendation**” — a first step towards predictive maintenance.
- The tamping recommendation issues a suggestion based on the measured values — essentially “I recommend you fix this now, otherwise you will run into this later” (a transition from find-and-fix to predictive).

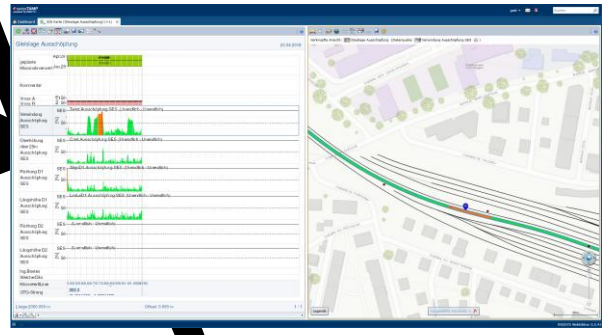


Managing tracks – wrap up.

Extending condition monitoring towards predictive maintenance.

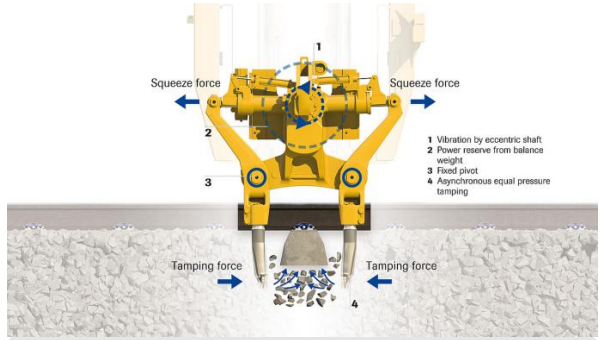
Condition

Manual Inspection



Analytics and Prognostics

Cost (prediction)



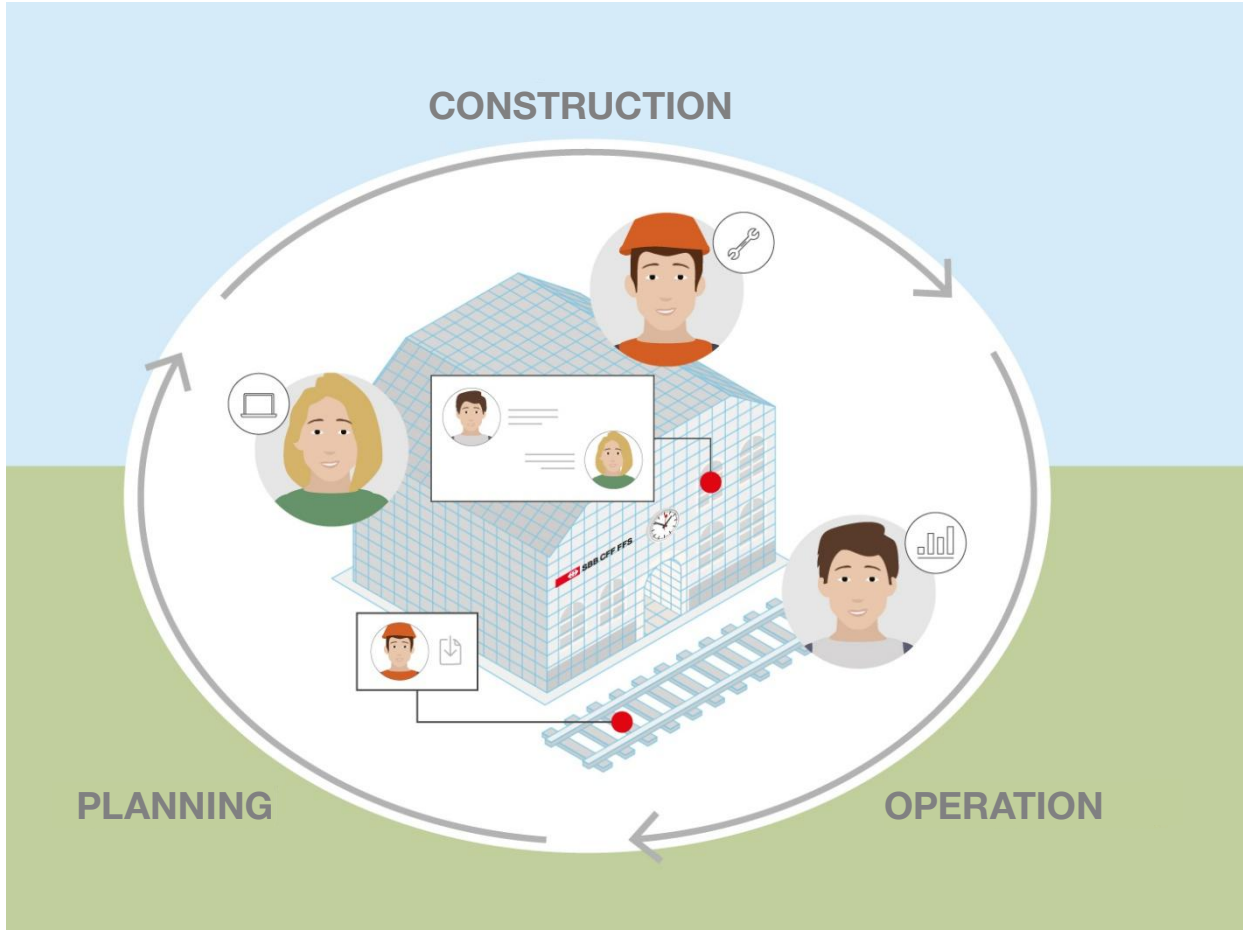
Maintenance Planning

Diagnostics

Smarter (re)construction – BIM Building Information Modelling.

Building Information Modelling (BIM).

BIM is a digital method for planning, constructing and managing built assets.



Central digital model

– All physical and functional information is represented in a shared model.

Interdisciplinary collaboration

– Enhances communication between architects, engineers, contractors and operators through transparent data structures.

Life cycle orientation

– The model supports the asset from design and construction through to operation and eventual decommissioning.

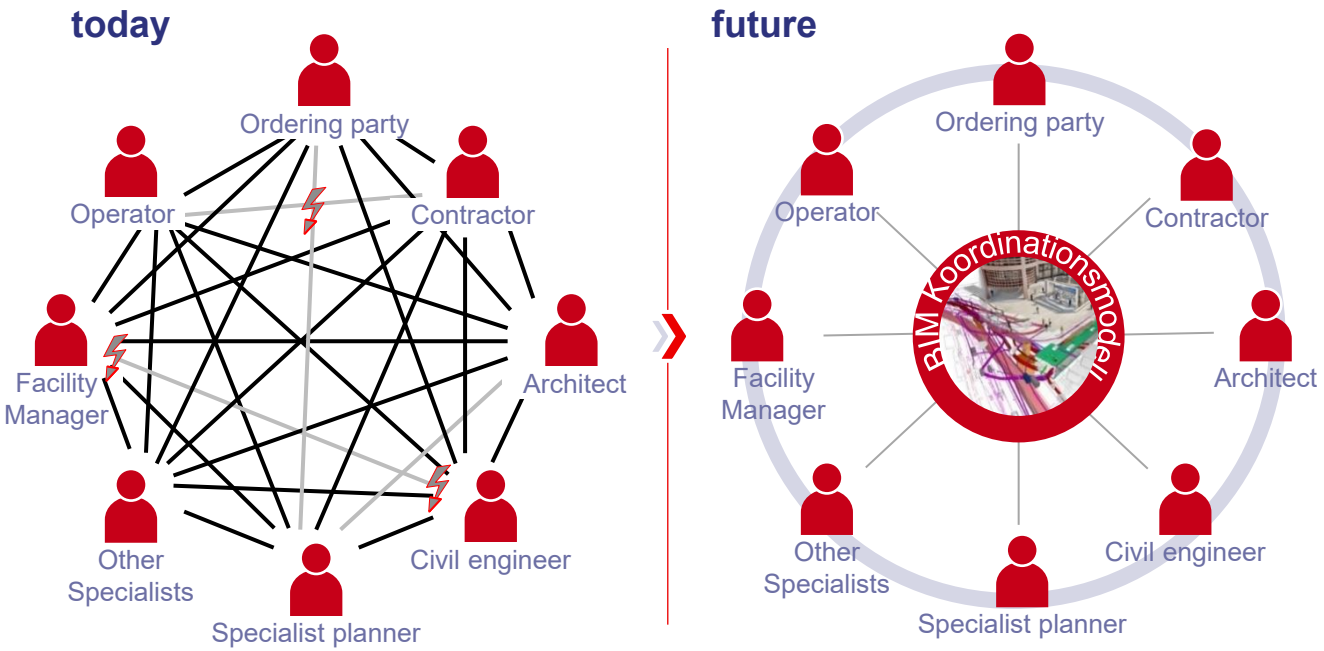
Information integration

– Beyond geometry, BIM incorporates time (4D), cost (5D), sustainability (6D) and operation/facility management (7D).

Improved decision-making

Building Information Modelling (BIM).

More than just a digital model – it‘s a change in collaboration!



- From 2D documents to integrated models
- From sequential to collaborative workflows
- From static to dynamic information
- From project to life cycle perspective
- From intuition-driven to data-driven decisions

Building Information Modelling (BIM).

BIM will be examined in greater depth during the spring semester.

Main Benefits of BIM

- Higher efficiency and quality

- Better and earlier decision-making

- Life-cycle value creation

Main Challenges / Drawbacks of BIM

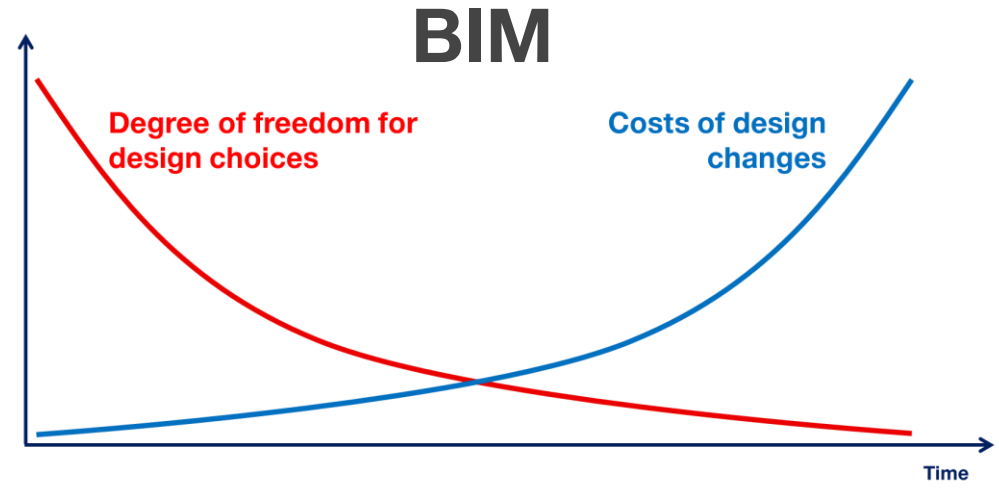
- High initial investment

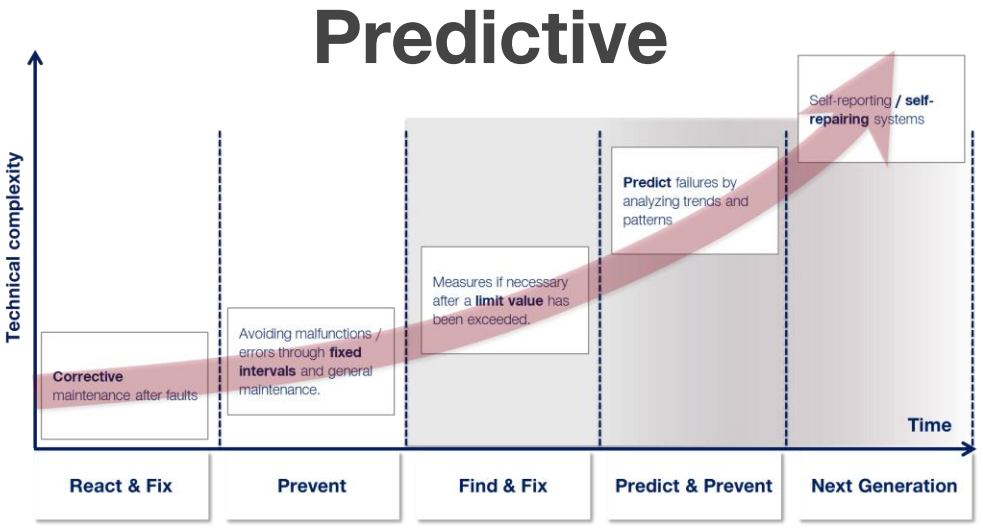
- Process and cultural change

- Data Quality and interoperability is key

New capabilities ahead!

Design while it‘s cheap to change. Predict before assets fail.





- Both approaches **require a higher initial investment** and both need **cultural changes**!

- It’s not just a tool or method – they **change the processes and working culture** (shifting from reactive to proactive mindsets).

Important: **Data as Strategic asset**!
Both approaches transform information from scattered records into valuable assets. Quality data becomes the foundation for better planning, maintenance, and operational decisions.

A Macroeconomic Perspective.

Asset Management: A Macroeconomic Perspective.

What has been built must be maintained and renewed.

Abbildung der Substanznoten Gleise auf dem Streckenraster der SBB.

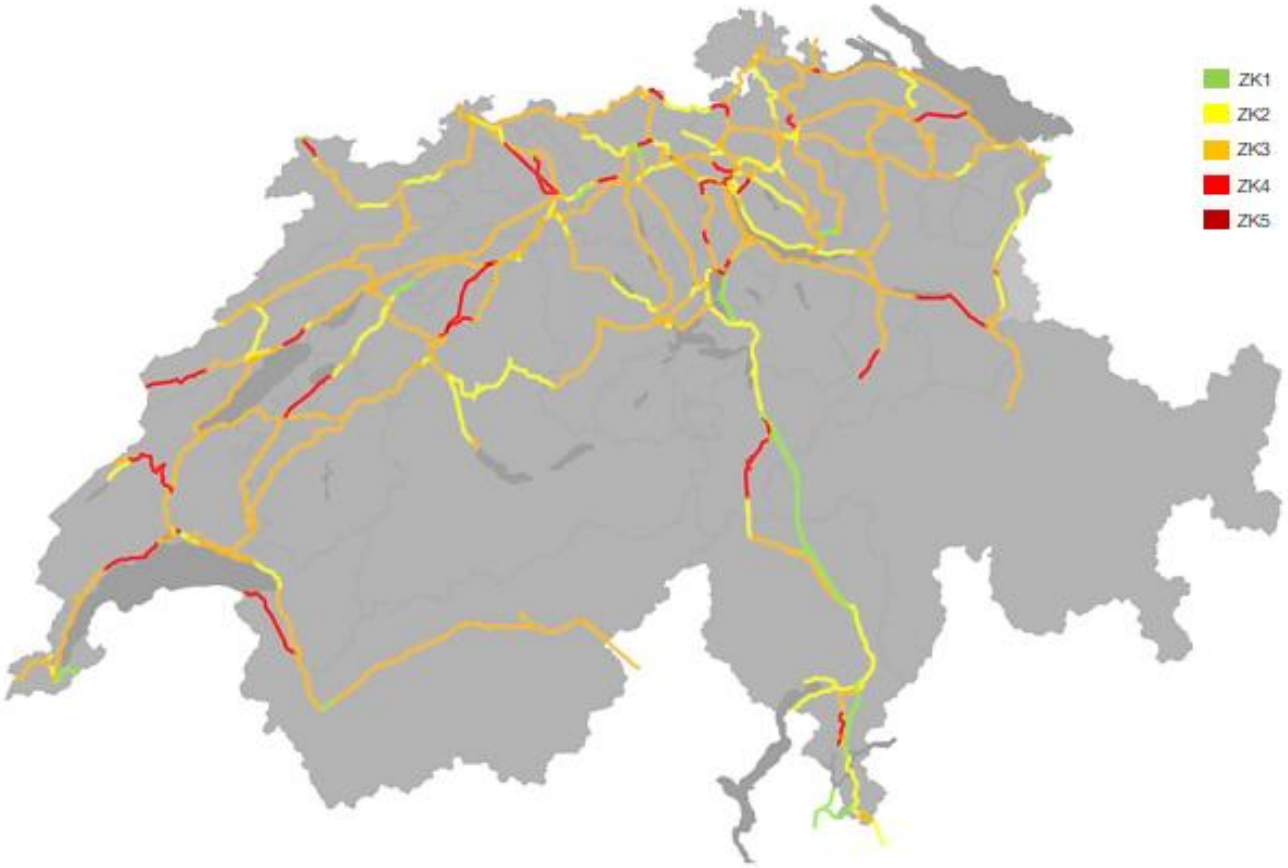


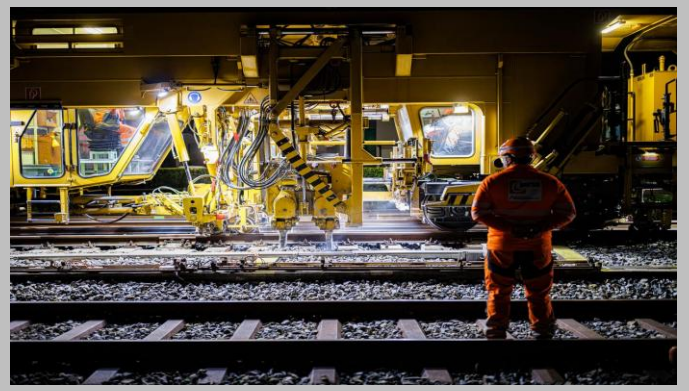
Abb. 43: Substanznoten der Gleise pro Strecke gewichtet mit dem Wiederbeschaffungswert.

The lifecycle of railway assets is financed by the Rail Infrastructure Fund.

Expansion

New systems for new services

Asset maintenance



Maintenance
Preventive | curative | life-prolonging

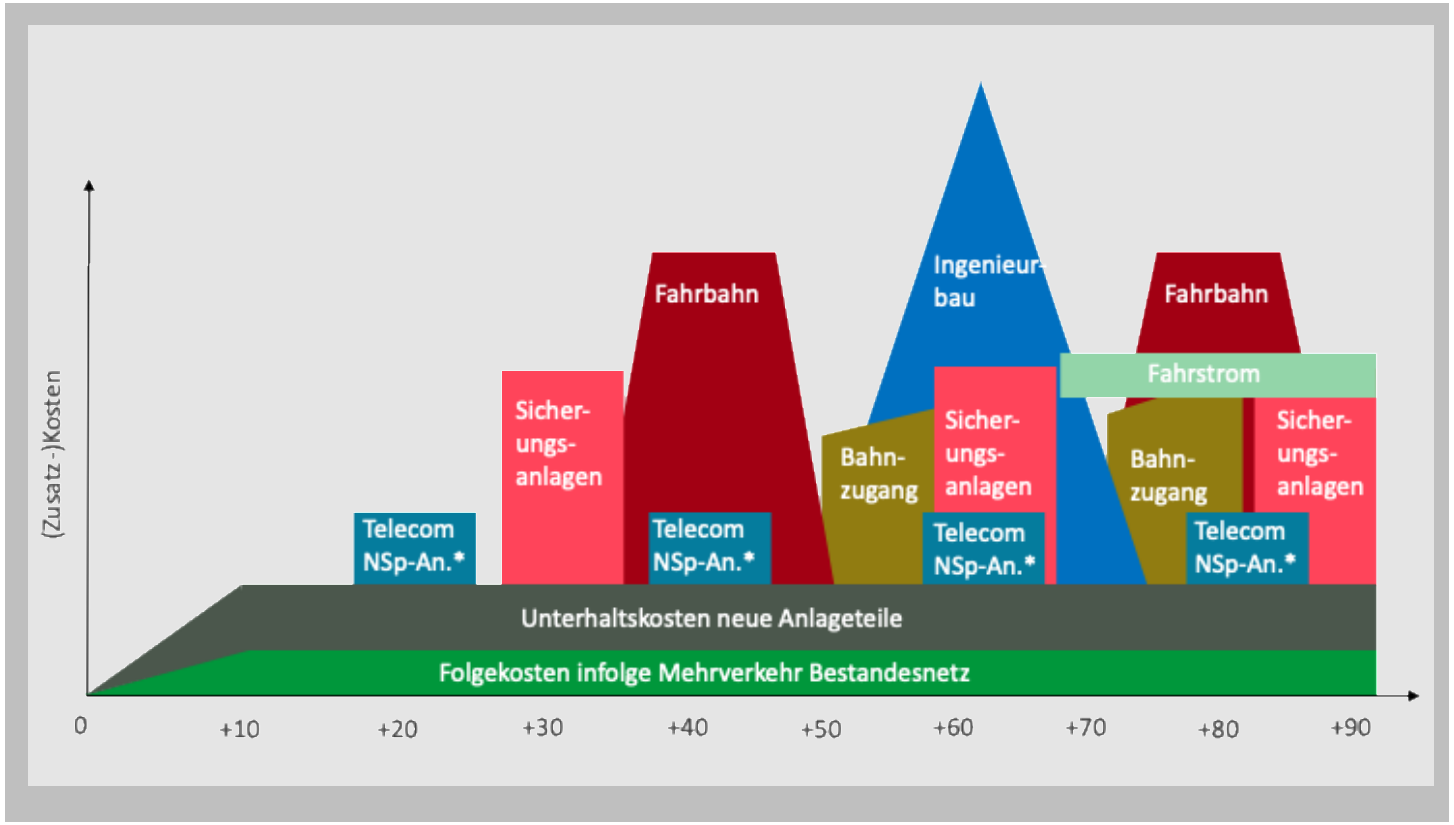
Renewal
Replacement at the end of economic life

Implementation Agreement ~ 1/3

Service Agreement ~ 2/3

Rail Infrastructure Fund
(Bahninfrastrukturfonds BIF)

Follow-up costs using an expansion step as an example: different renewal cycles depending on the asset category.



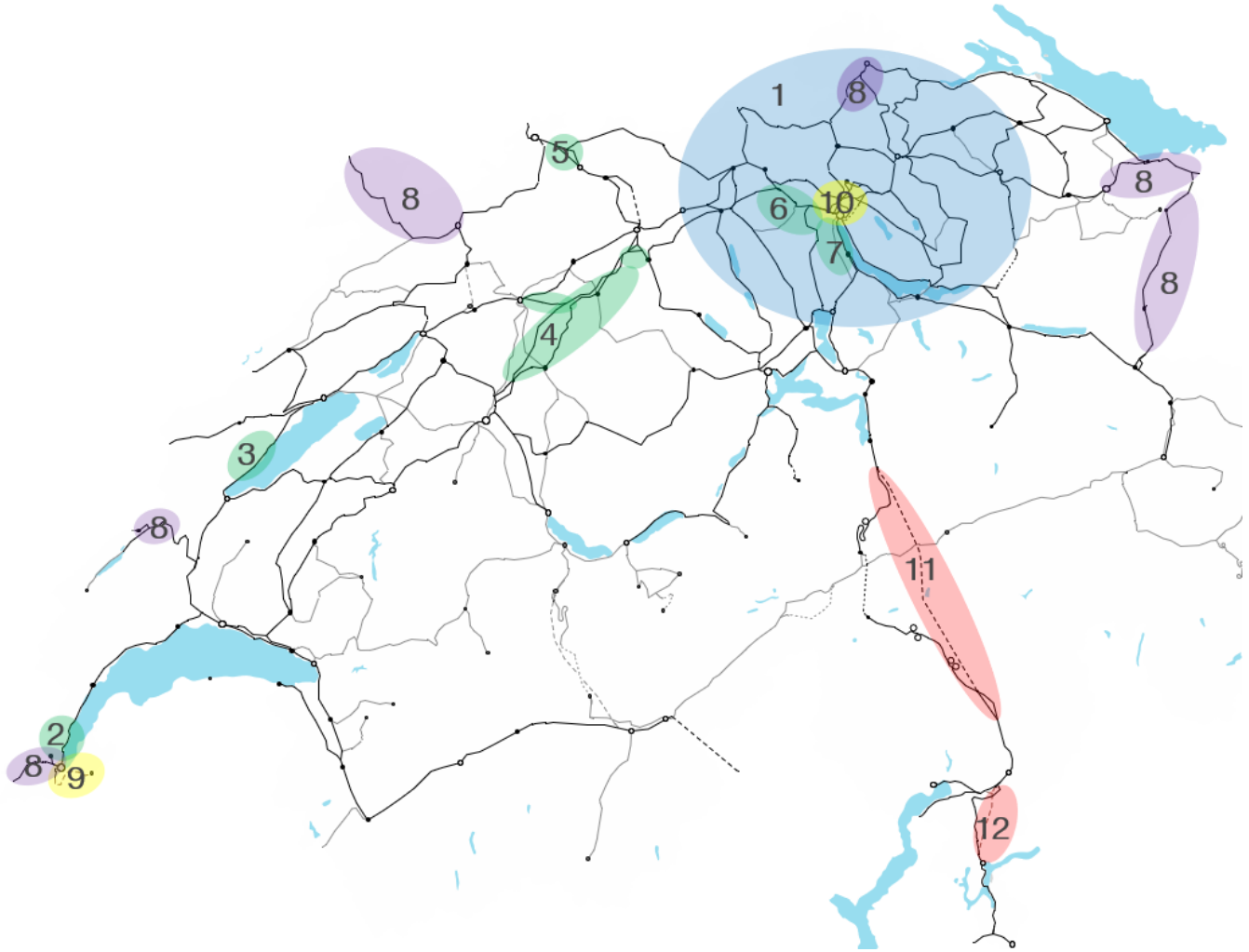
Maintenance costs

- Maintenance costs are incurred from the time the expansion project is put into operation.
- The annual follow-up maintenance costs amount to approximately **1.0%** of the investment made in the expansion project.

Renewals

- Renewals will take place in a staggered manner, depending on the service life of the assets.
- The average annual follow-up renewal costs amount to approximately **2.0%** of the investment made in the expansion project.

Major projects commissioned from 1990 onwards are entering the renewal cycle.



No. 1: Zurich S-Bahn including 4 partial additions (commissioned 1990-2018)

No. 2 to 7: Bahn 2000 (commissioned 2001-2004)

No. 8: HGV connections (commissioned 2011-2020)

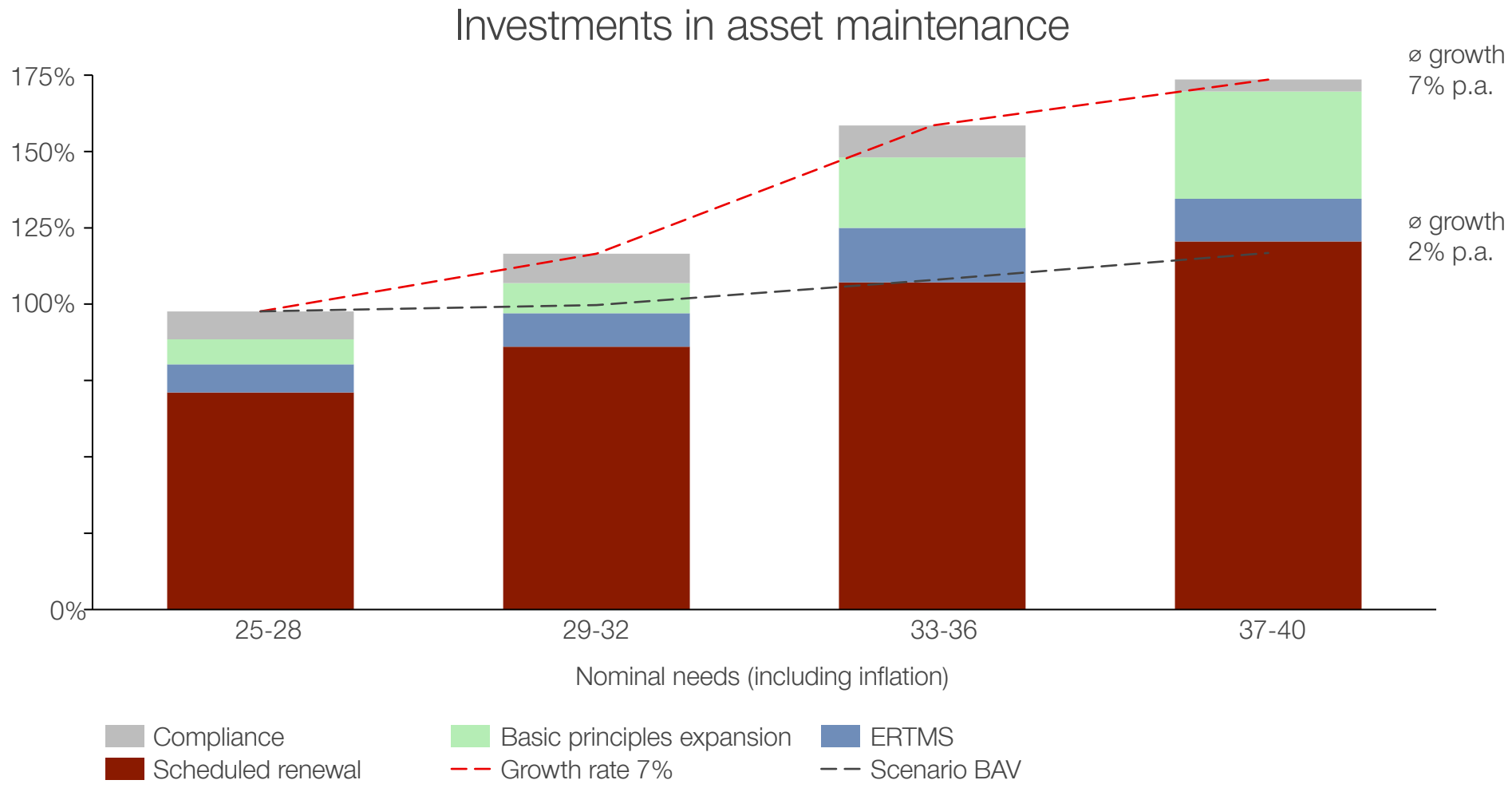
No. 9 and 10: Railway Infrastructure Fund Projects (commissioned 2014/2019)

No. 11 and 12: NEAT Gotthard axis (commissioned 2016 / 2020

Not shown: 4m corridor (commissioned 2020, 720 million)

Total 26 billion

The need for asset maintenance (renewal) requires a higher growth rate.



Feasibility, operability, and financial viability as limiting factors.

Feasibility

Refers to the ability to implement the infrastructure projects planned for expansion, renewal and maintenance in terms of production technology and on schedule. Feasible planning takes into account the available resources, including personnel, materials and machinery.

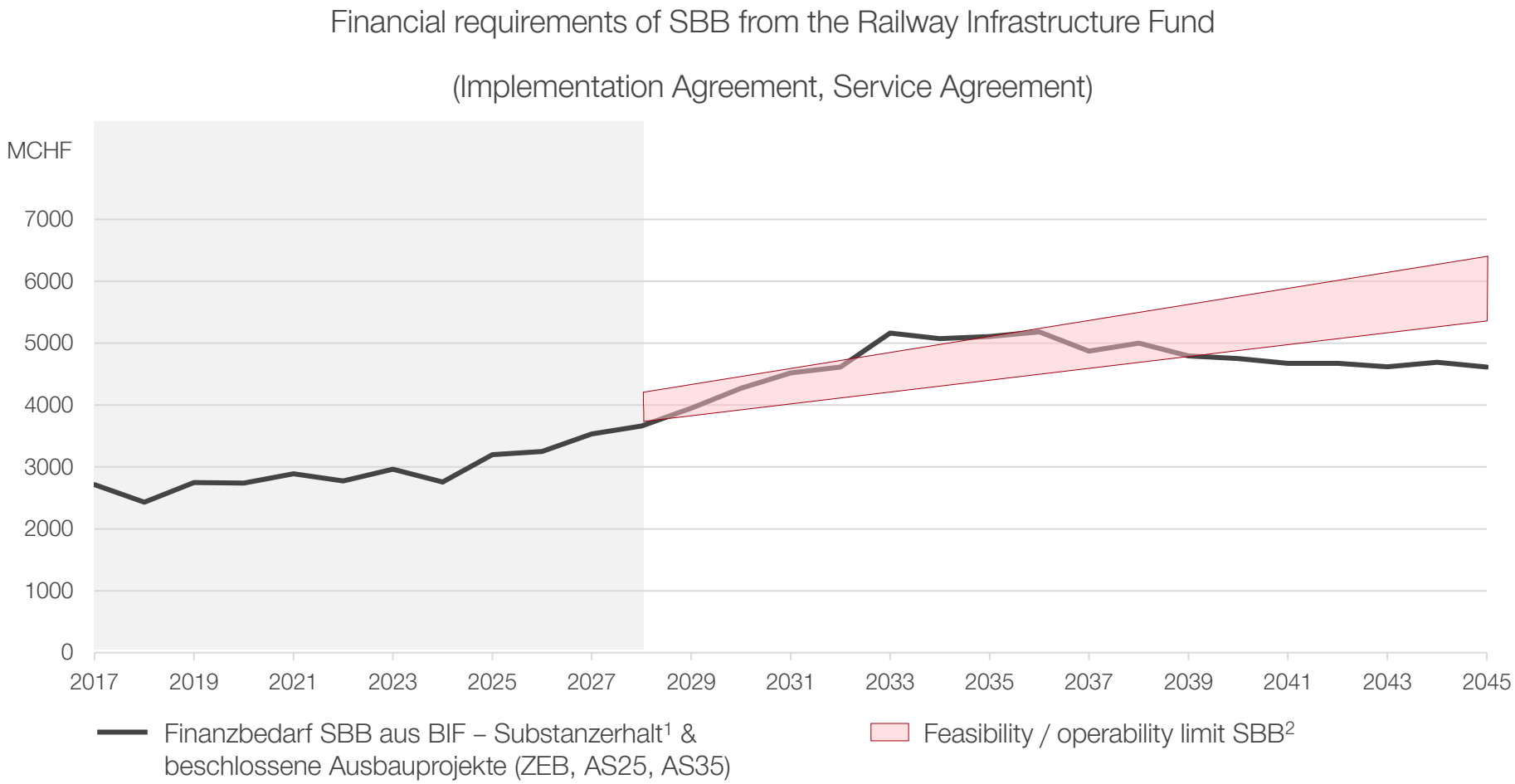
Operability

Operability refers to the ability to implement a planned service in accordance with customer needs and quality objectives. A robust, stable, and producible timetable is a prerequisite, which also takes into account capacity constraints and intervals for construction work.

Financial viability

Financial viability refers to the ability to provide the financial resources necessary for the realization of required infrastructure projects or procurements. It includes, for example, costs for personnel, materials, equipment, operations, or maintenance. Financial viability requires careful planning and management (budgeting, cost-benefit analysis, and risk assessment) and is a prerequisite for feasibility.

Conclusion on the assessment of feasibility / operability / financial viability.



1: Includes renewal & maintenance. Growth rate from 2029 7% p.a.
2: Rough estimate of feasibility / usability; following the results of “Botschaft 26“ this needs to be examined in greater detail..

Consequences of neglected preservation of substance.

Example Germany.

Unpunctuality resulting from neglected infrastructure.

DB in chaos: The condition of the rails and signal boxes has never been so bad.

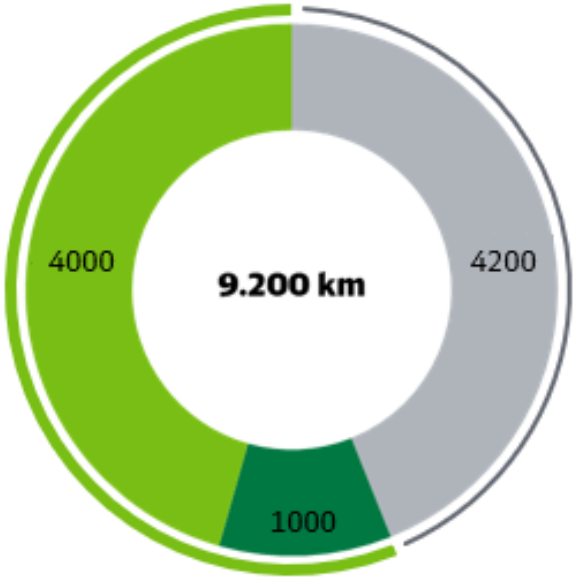
How reliable are train timetables when Deutsche Bahn struggles with thousands of changes every day?
An inside report reveals dramatic conditions.

What happens when infrastructure is neglected? Ex. Germany.

General refurbishment of over 4,000 km planned to create the new high-performance network by 2030.

High-performance network in 2030

[in distance km]



- General renovation
- Track in good to very good condition
- Maintenance

Failure-resistant systems ensure a more reliable infrastructure and thus increase punctuality for our customers

Optimal equipment and layout standards ensure more train volumes and thus increase the performance of the infrastructure

We improve the customer experience through attractive, clean and barrier-free stations

We are reducing future traffic restrictions to a minimum and thus creating more predictability for our customers

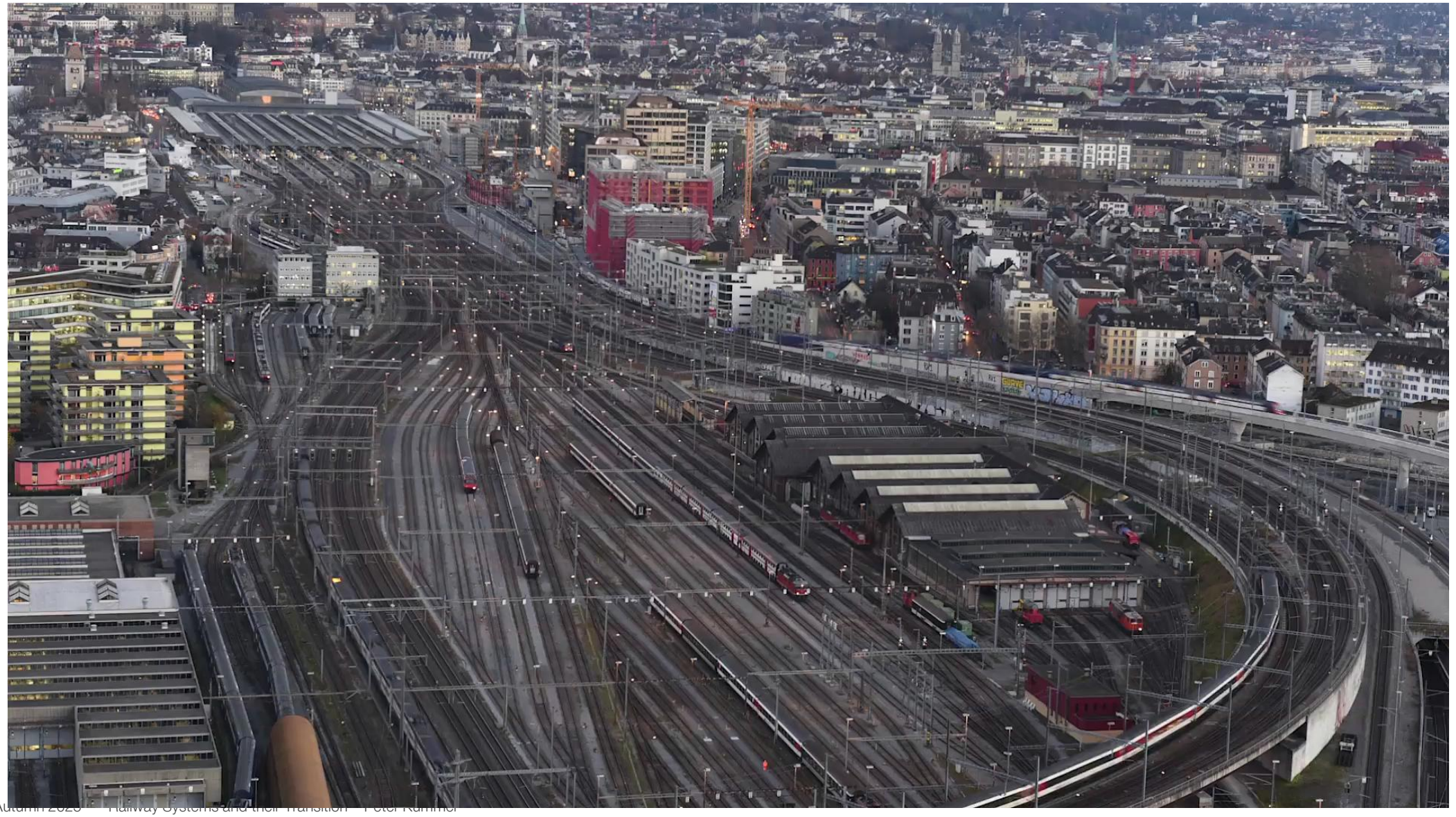
Conclusion.

Railway Assets – Conclusion.

- There are **numerous railway assets** and **their lifecycle differ** in between some 5 years and up to 100+ years.
- Especially with the heavy (infrastructure) assets there is a lot of «brownfield» and this leads to a lot of work and effort for substance conservation.
- We need to i**ncrease the usage of digital twins** and transparency capabilities to streamline these efforts.
- We need to **balance substance preservation a**nd expansion and allocate the tight resources efficiently.

Balancing substance conservation and expansion.

Priority on substance conservation.



Case Study Railway Assets.

Case Study question for next week.

Case Study «Asset Management: Resource allocation».

How would you prioritise and why?

- **Pure Substance Preservation**: Investing in traditional maintenance to maintain current capabilities (e.g., road renewal, non-accessible platforms, or signal replacements without upgrades).
- **Technological Upgrade for Substance Preservation**: Investing in technology to enhance existing capabilities (e.g. upgrading platforms for level boarding or migrating signalling technology).
- **Customer-Focused Upgrade for Substance Preservation:** Investing in improvements that enhance the customer experience (e.g. longer platforms or loading gauge for double deck trains).
- **Network Expansion**: Capacity increase to allow for more trains and new service offerings.

How would you allocate resources among these four investment strategies? What limits might you encounter in making these allocations? Additionally, which strategy do you believe has the most influential (political) advocacy for each strategy, and how might this affect decision-making?

Case Study «Asset Management: Resource allocation».

Who you are and what to do?

- You are responsible for the planning of asset management regarding the **financial negotiations with the political entities**.

- Your role is a **close to (top) management** and you have to analyze the different internal & external key contributions and derive a **briefing as well as a decision proposal** for the strategic resource allocation.

- You have to **balance the conflict of interests** internally from your organisation as well as public expectations.

- Derive a strategic approach and a **present a stringent communication** for your strategy.

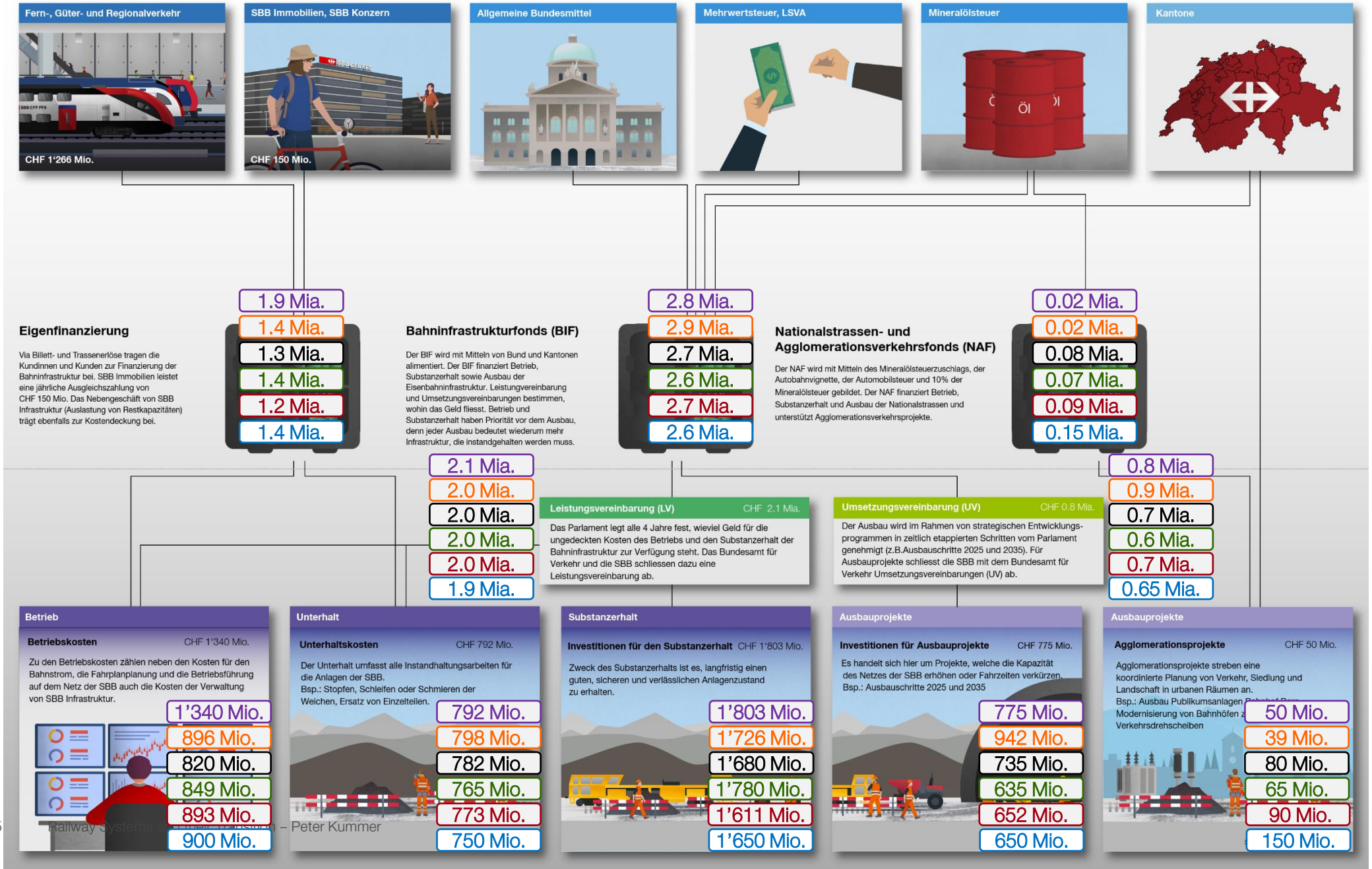
Case Study «Asset Management: Resource allocation».

Helpful information and tips.

- Your work should be about **50:50** in between
  - **analyzing** the situation and the contributing factors and
  - formulate a **strategic communication** for stakeholders
- Apart from todays lecture you can use the introduction part of the network condition rapport *(on Moodle)* as your primary source. We encourage you to search for news articles to fetch examples from different European railway companies.
- On the following slide you'll get an overview about the sums involved in the last years within SBB Infrastructure.
- With this task **there might be no «everyone is happy» solution**, so your approach should consider how to communicate with «Loser» where you have to decide in between conflict of interests.

Finanzierung der SBB Bahninfrastruktur

2024 | 2023 | 2022 | 2021 | 2020 | 2019



Further reading.

Further reading.

Network Condition Report *2022*
(English Translation not every year)

Mgmt Summary and
Chapter 4 (page 26ff)

You can find it on
moodle

Netzzustandsbericht 2024
(German)

Mgmt Summary and
Chapter 4 (page 28ff)