SBB CFF FFS

Industrializing the Automated Condition Monitoring and Predictive Maintenance of Pantograph Collector Strips.

8th Intelligent Maintenance Conference,
EPFL, 2024.

Urs Gehrig (Head Enterprise Asset Management S/4)
Lausanne, 3rd September 2024

Agenda.

1. Swiss Federal Railways as an asset heavy company.
2. A process-oriented and failure-data driven approach towards Intelligent Asset and Maintenance Management.
3. A journey to continuously implement relevant use-cases.
4. Key take-aways.
5. Questions and answers.

As an integrated railway, we get Switzerland moving – every single day.

11’300

Passenger Services Production
7’889 trains/day

3’970

Passenger Services Markets
1.32 million passengers/day

1’110

Real Estate
3’500 buildings

10’100

Infrastructure
3’266 km of network

3’380

Freight Services
175’000 t of freight/day

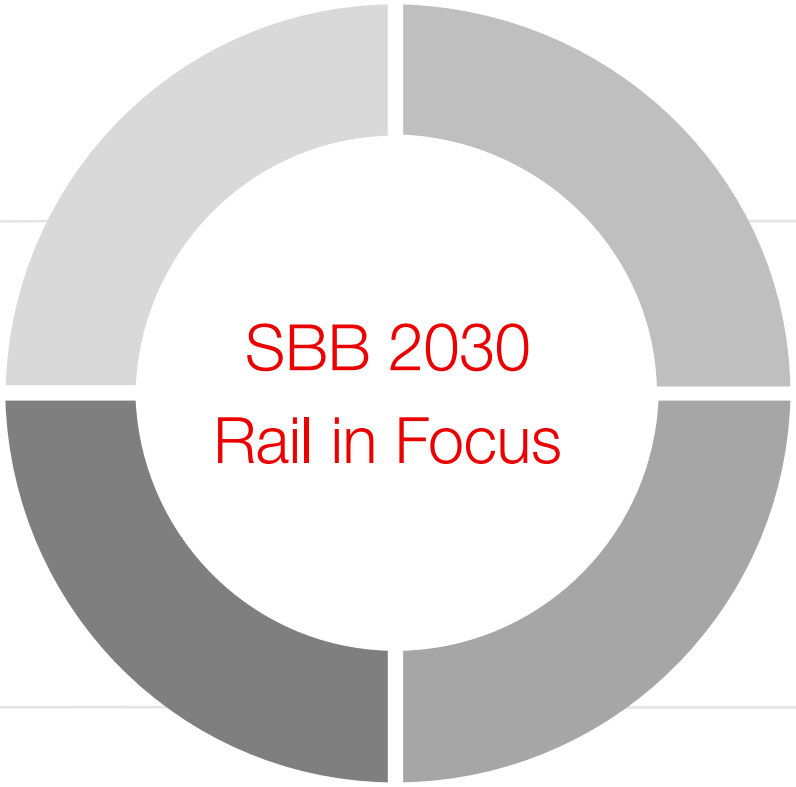
Group-Level Units: Subsidiaries (2’216 FTE), Information Technology (1’464 FTE), Human Resources (768 FTE), other group-level units (682 FTE)

5’130

SBB Strategy 2030 applies to the entire company.

More customer-focused and flexible. Integrate different forms of mobility.

Smart growth in our core business. Increase modal split.



Sustainable, by people, for people. For customers, employees and society.

More efficient and economical. Added value for public services.

Success factor: Asset Management – We manage our assets holistically and in relation to each other to ensure they provide the greatest possible customer benefit.

S/4 SBB as an enabler to bring Asset and Maintenance Management to the next level.

Manage rolling stock

\+ Manage real estate and facilities

\+ Manage networks

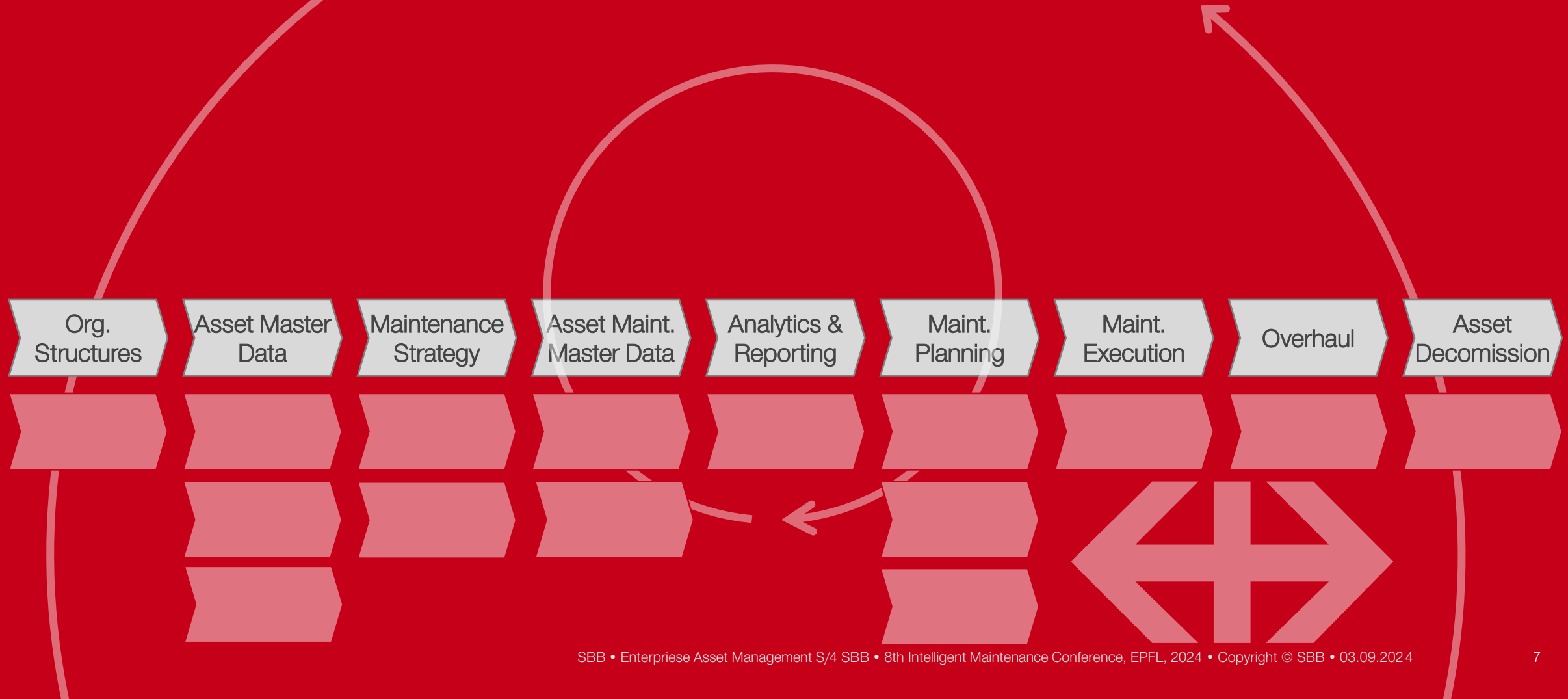
\+ Manage production means

\+ Manage supply chain

\+ Manage finance and projects

Enterprise Asset Management

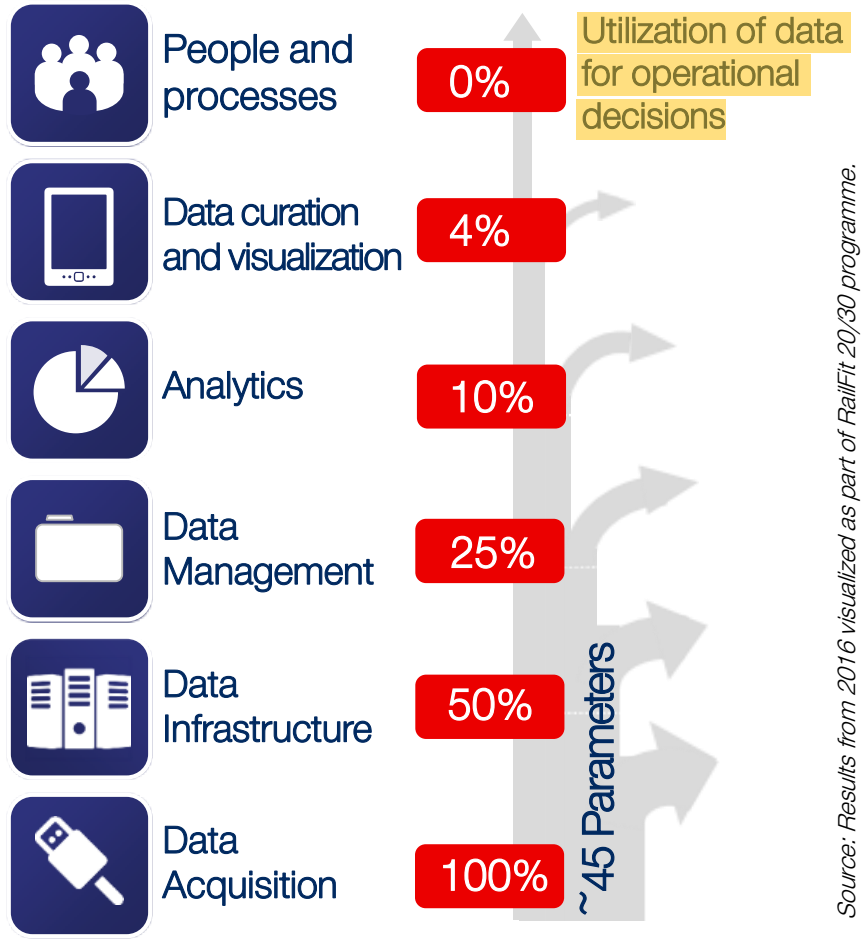
The EAM System Process «Acquire to Decommission».



Challenge

According to an SBB-wide analysis, half of the data collected has not used as a basis for decision-making.

Fact-based decision-making



Source: Results from 2016 visualized as part of RailFit 20/30 programme.

Findings from the analysis

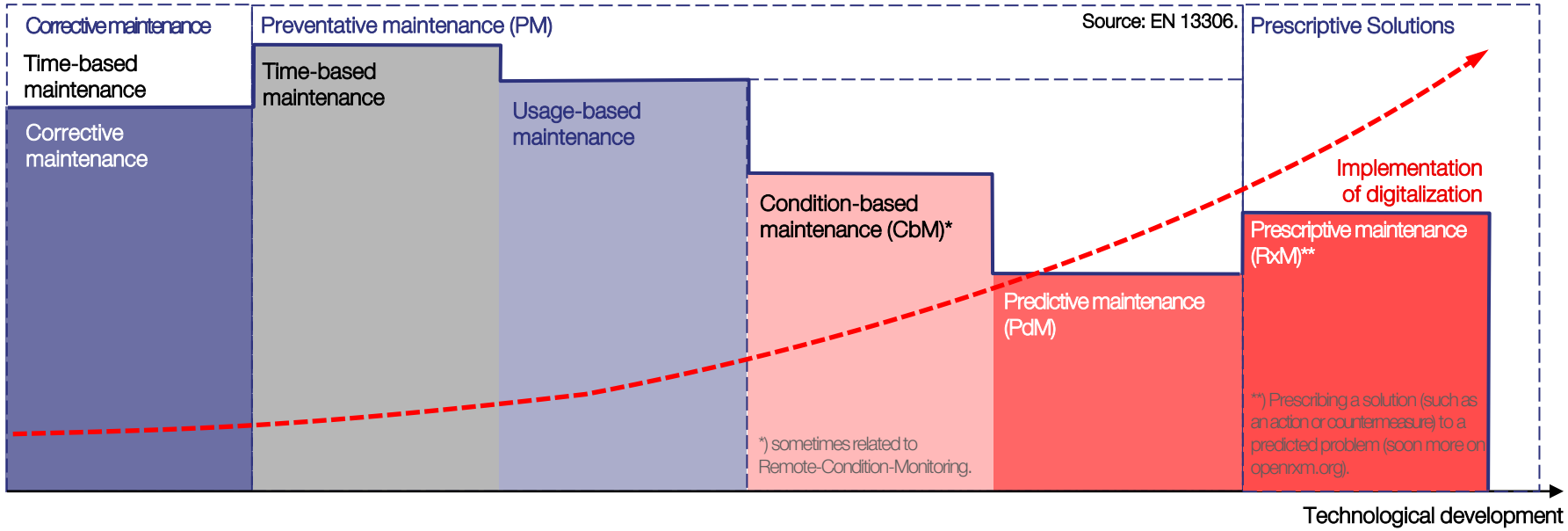
- Maintenance strategy and intervals **are experience-based** and are **not based on findings from data.**
- Real-time processing of data is not possible, **findings** are only available **after completion** of the batch or task.
- Only a few key figures are calculated and made available - with **a delay of around 1 week**.
- Accessing and utilising the measured data is very time-consuming due to the barely integrated systems.
- Only 6 months of historical data points are stored.
- 22 of the 45 measured parameters cannot be further processed.
- At least one critical parameter is not measured.

Reliability-Centered Maintenance (RCM) as **fundamental method** regarding intelligent Asset- and Maintenance Management.

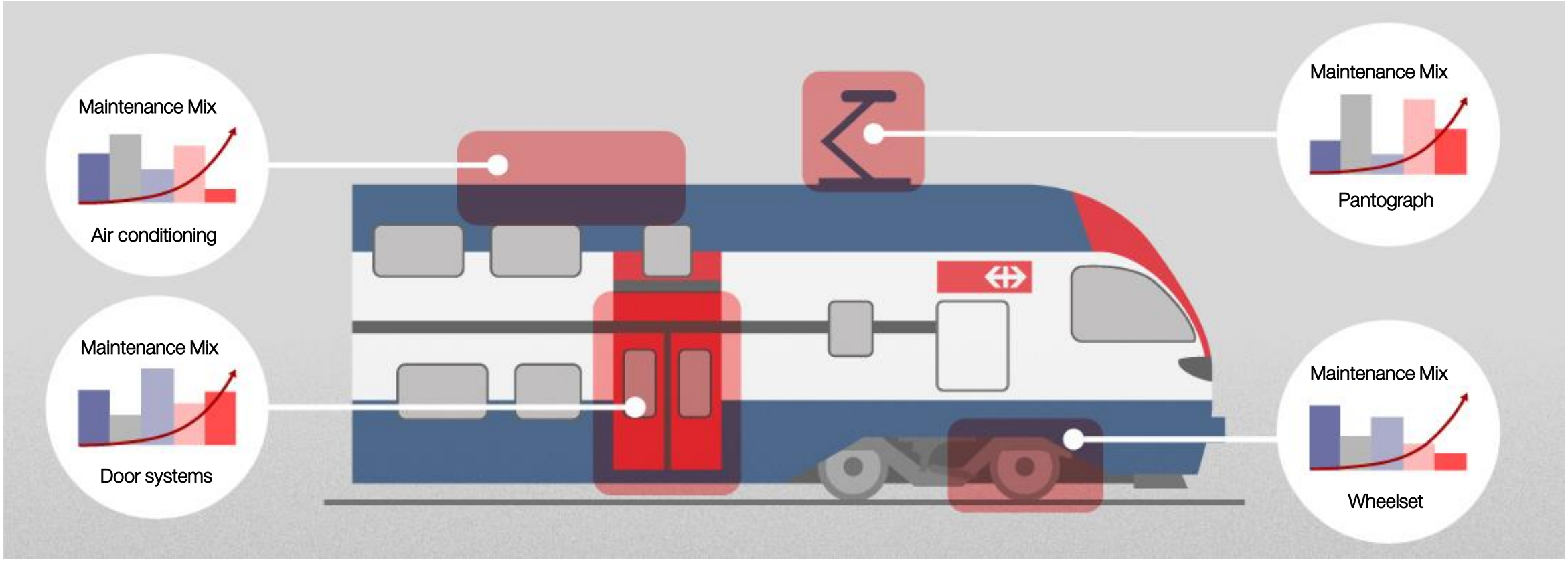
	Bundling of specialists with **technical expertise** and knowledge of the **operational context** by performing an RCM assessment.
	IT-wise documentation of RCM assessment as a justified, well-founded **maintenance file** in a **standardized and scalable way**.
	Having **preventive** and **corrective** maintenance tasks available in a **prescriptive way** to standardize activities along workshop sites.
	Knowing functions, functional failures, **failure modes** and effects, risks and countermeasures and having a **feedback-loop** for **optimization** installed.

Conclusion «Maintenance is management on 'failure-mode' level.»

Reliability Centered Maintenance gem. EN 60300-3-11:2009.

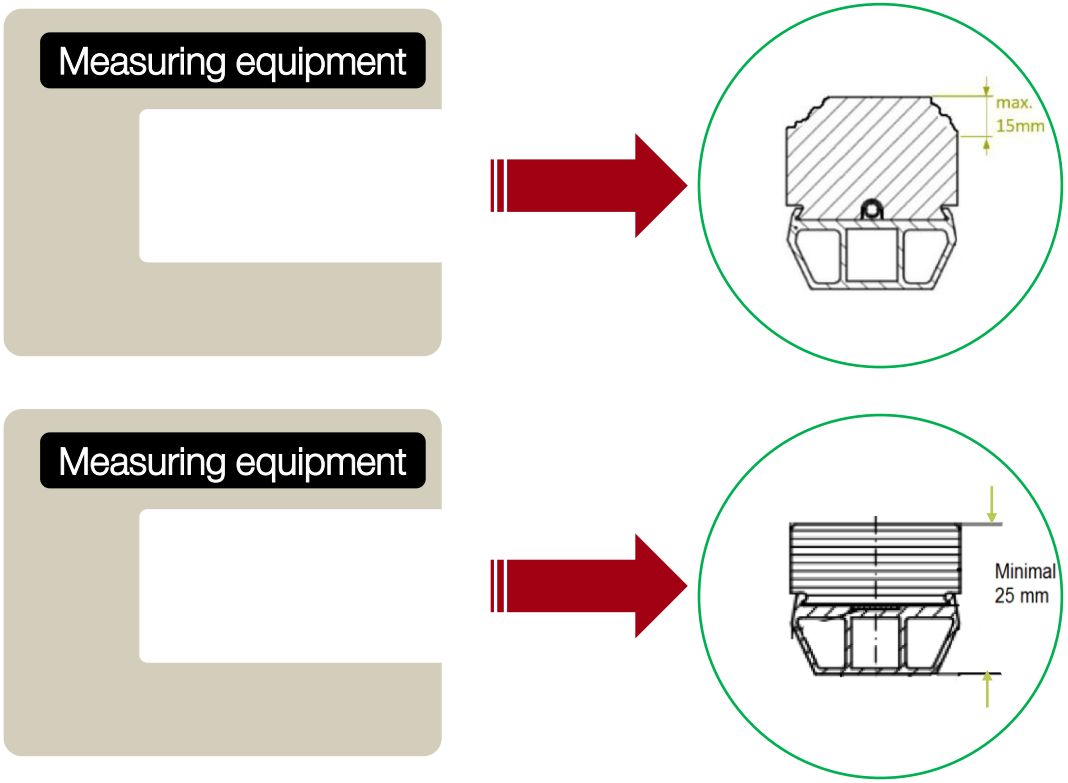


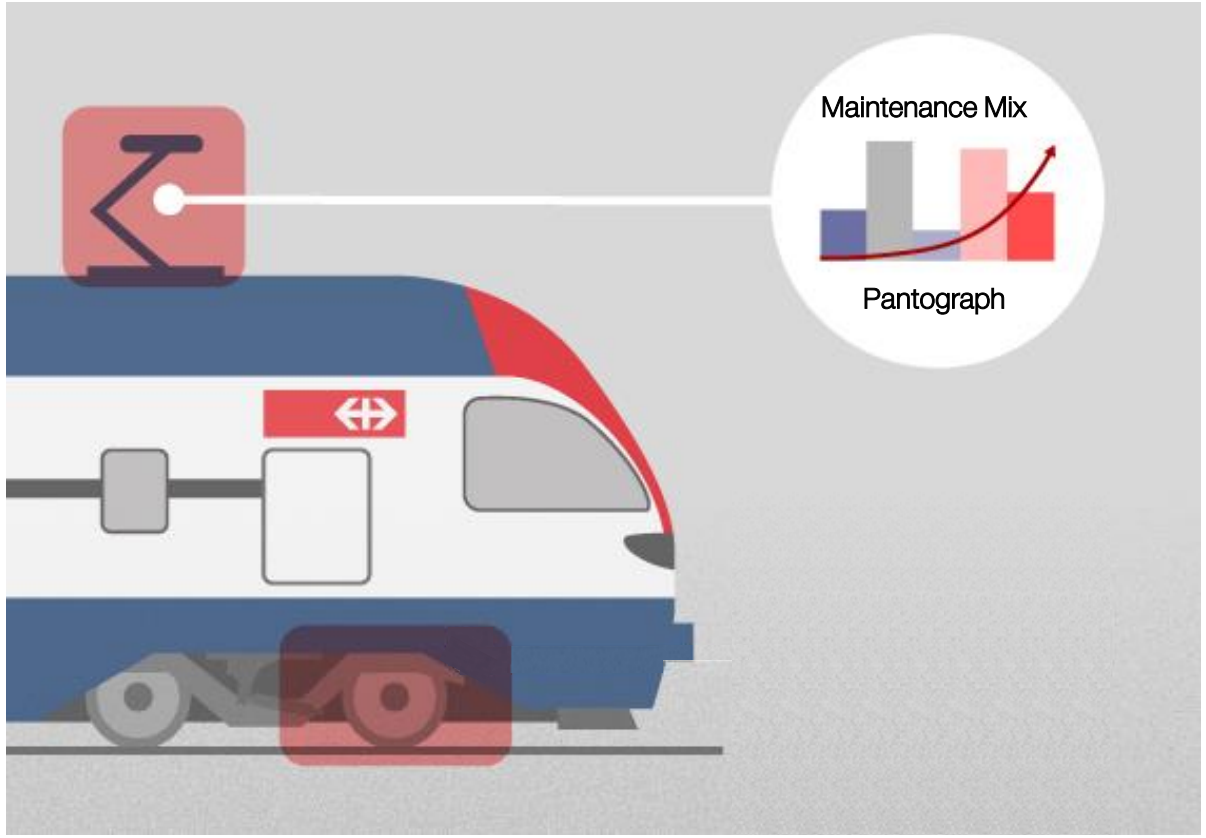
«Failure-Data Management» in a targeted and system-oriented way resulting in a specific mix of maintenance strategies.



The blend of maintenance strategies on system level is built up by identifying the appropriate maintenance approach per failure-mode. For critical systems such as bogies, entry systems, front couplers, etc. the application of a «man-made» RCM assessment is currently the best way to go. **But – such a process takes some time.**

A set of typical failure-modes of the «Sliding strip» as a component of the Pantograph and how they are checked.





Single-line or multi-line cracks due to material stresses, burnt sections after a shirt circuit or large cracks with missing sections after a hit through the cable infrastructure are all types of faults to be dealt with and candidates for a visual inspection.

S/4 SBB introduces relevant solution components for a future-oriented, next-generation and integral «Asset Management».

Capabilities

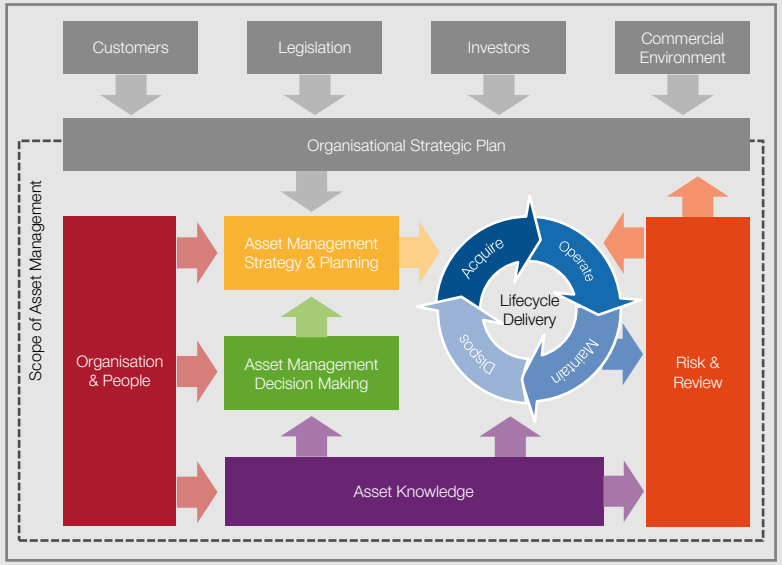


Image 1: International Standard as a reference-model such as ISO 55000.

Solutions

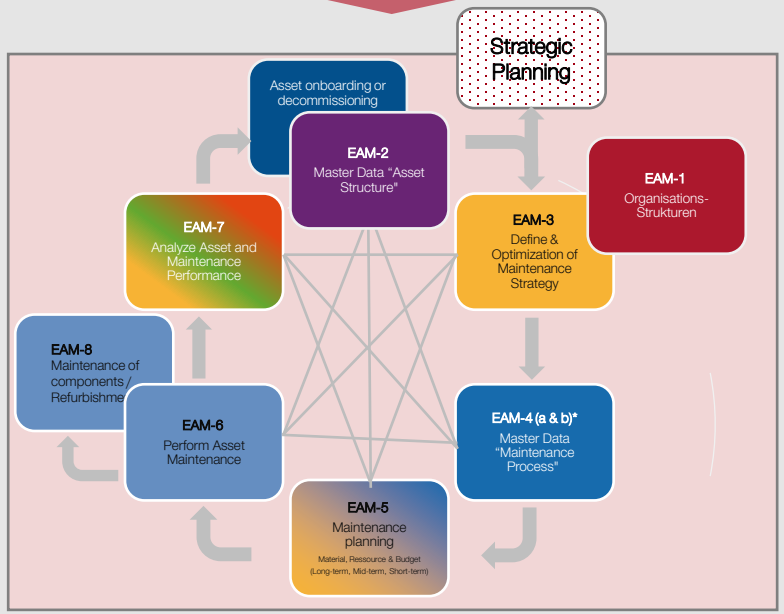


Image 2: Comprehensive view of asset and maintenance management.

Processes

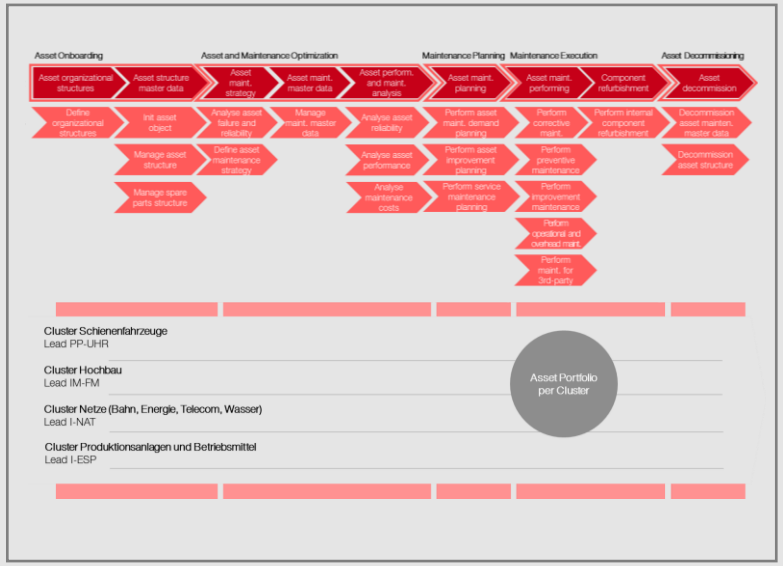
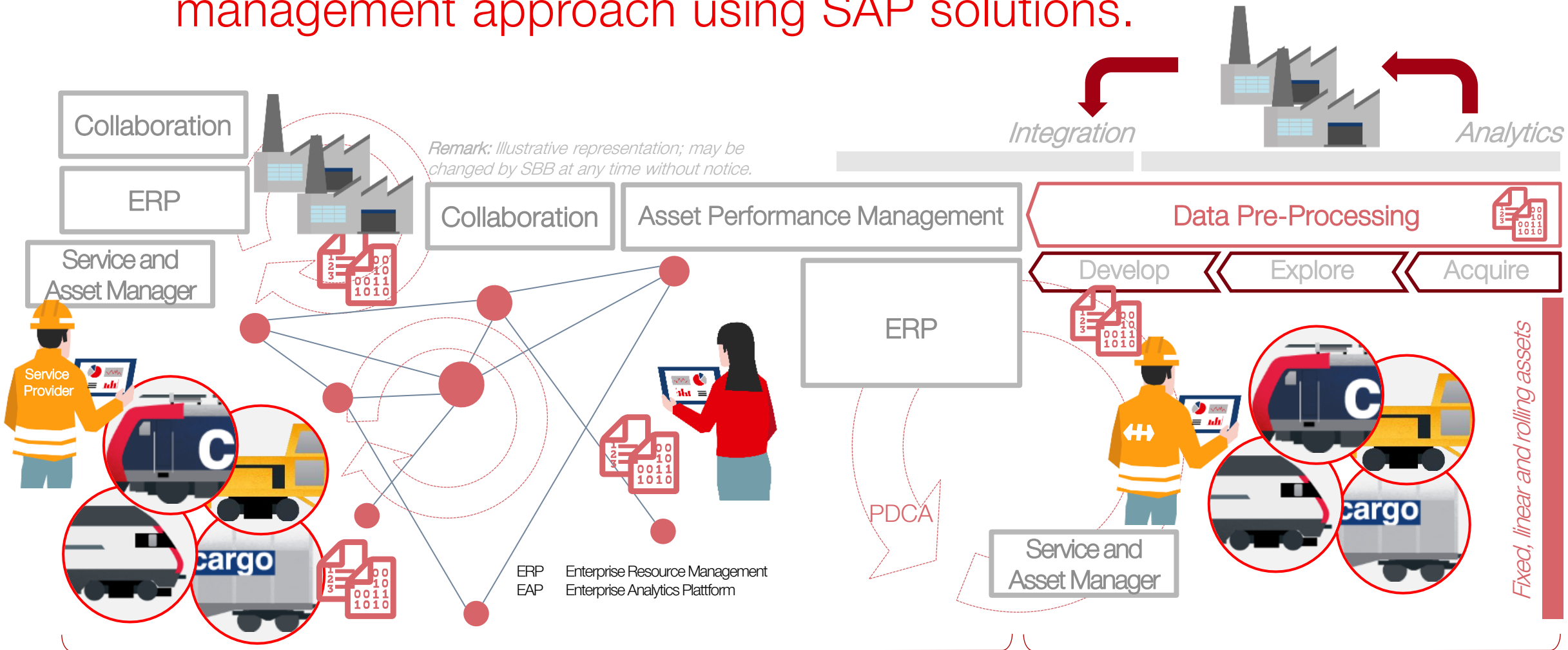


Image 3: End-to-end best-practice process template applied to asset-portfolios.

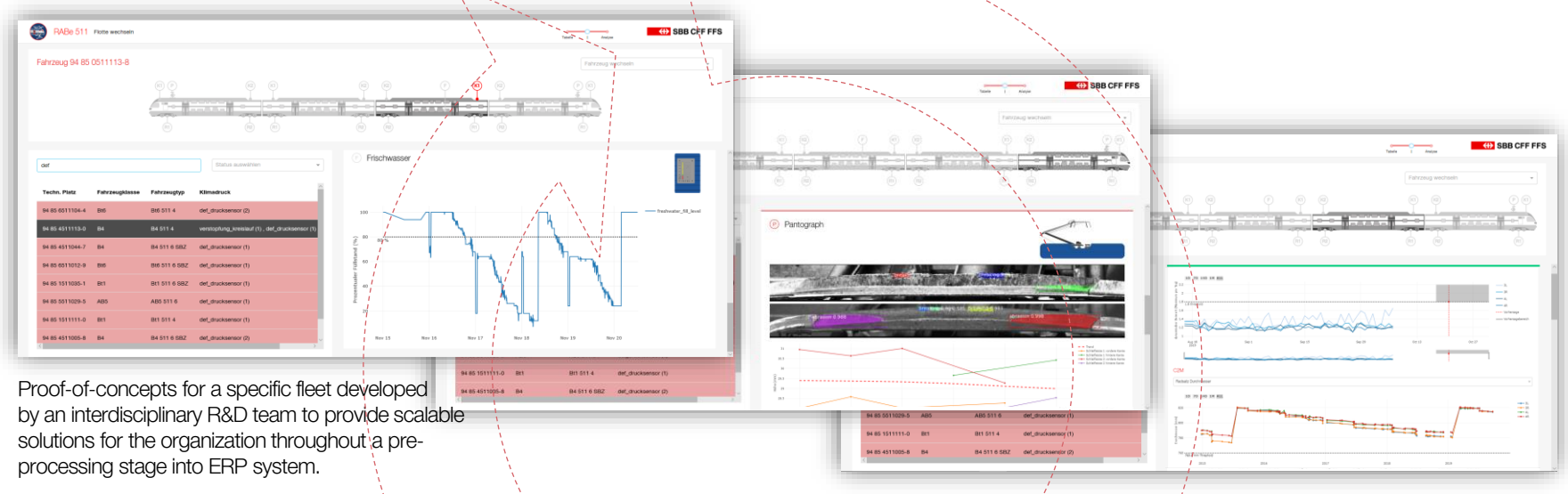
Generic architectural overview on an integrated maintenance management approach using SAP solutions.



Challenge

Pushing the operationalization of «Predictive Maintenance» by elaborating relevant «use-cases» regarding train operation.

Industrialisation



Proof-of-concepts for a specific fleet developed by an interdisciplinary R&D team to provide scalable solutions for the organization throughout a pre-processing stage into ERP system.

Impact

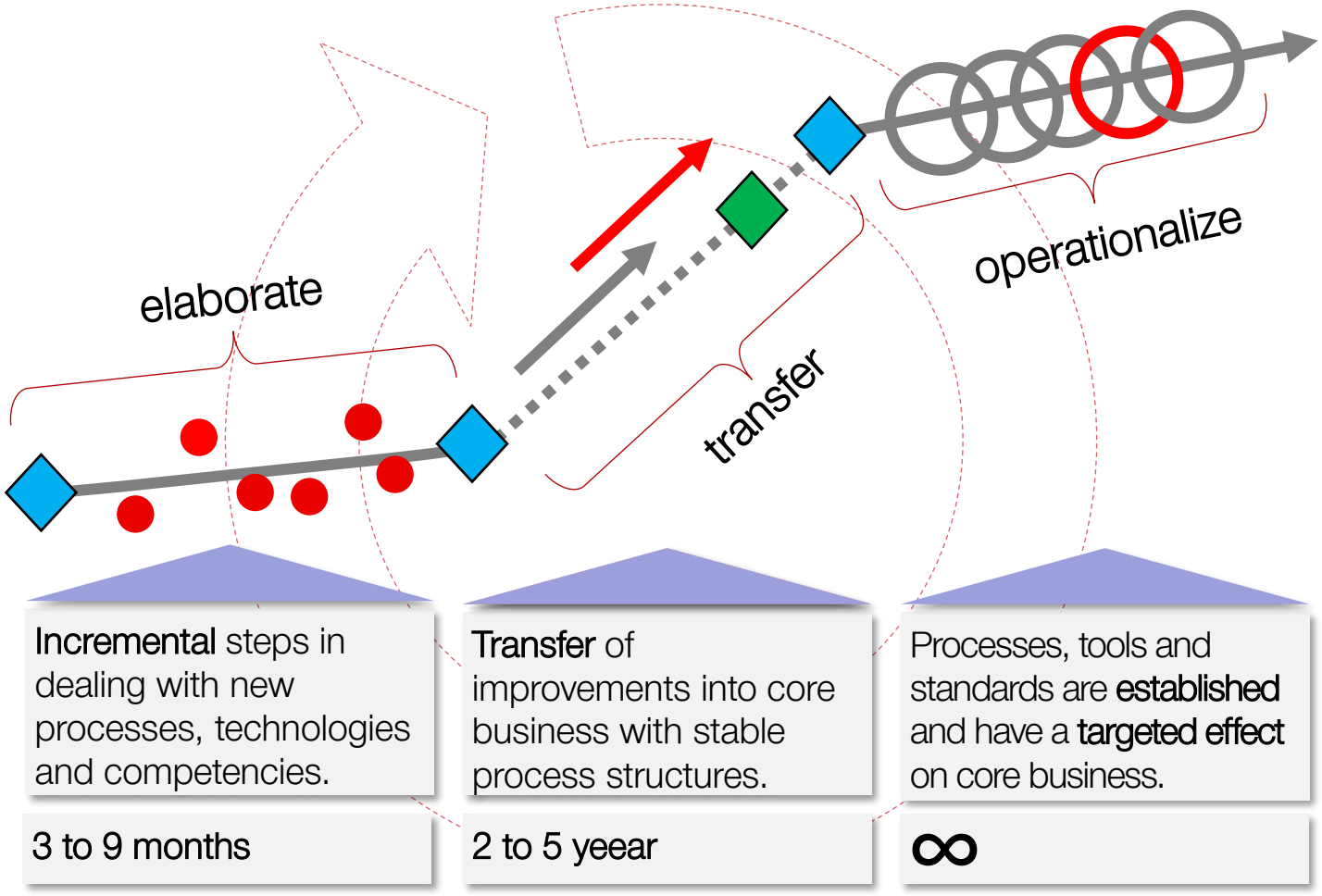
Acquire and Explore | Design and Develop | Decide and Operate

Challenge

Manage digitization topics using a method toolbox and a use case portfolio in Asset- and Maintenance Management.

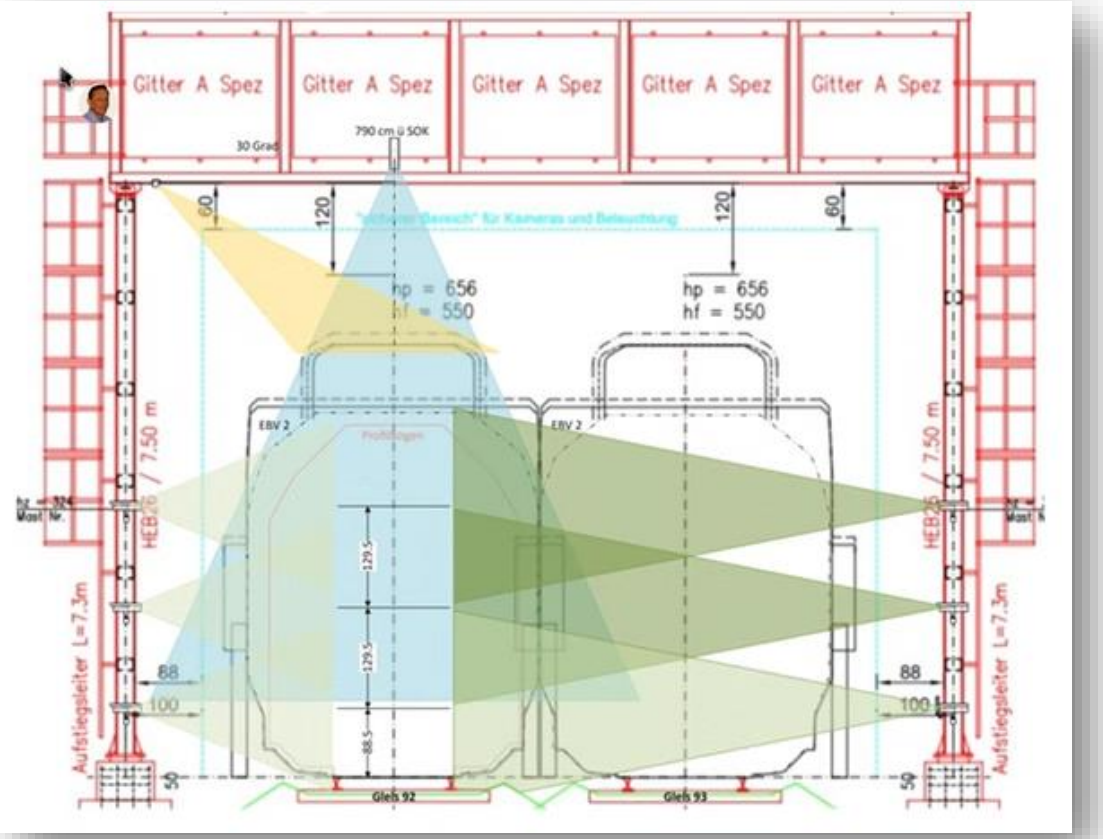
Industrialisation

1. Field of action **«Processes»**: the targeted use of data and/or new technologies alone does not necessarily add value if process integration is lacking.
2. Field of action **«Data»**: Data that exists in principle is not used in the process or cannot be used integrally
3. . Field of action **«Technology»**: new technologies are not used or are not used in a targeted manner, either because of a lack of know-how or because of false restraint.
4. Field of action **«Methods»**: established methods and standards are not used consistently enough.



Challenge

Thorough evaluation and practical testing of edge hardware as a key success factor for the end-to-end workflow.



To specifying, evaluate and field-test the appropriate camera, flash, position, triggering etc. was a long-lasting but fruitful journey.

Perform measurement processes on rolling stock automatically.

The «use case» Pantograph Scanner:

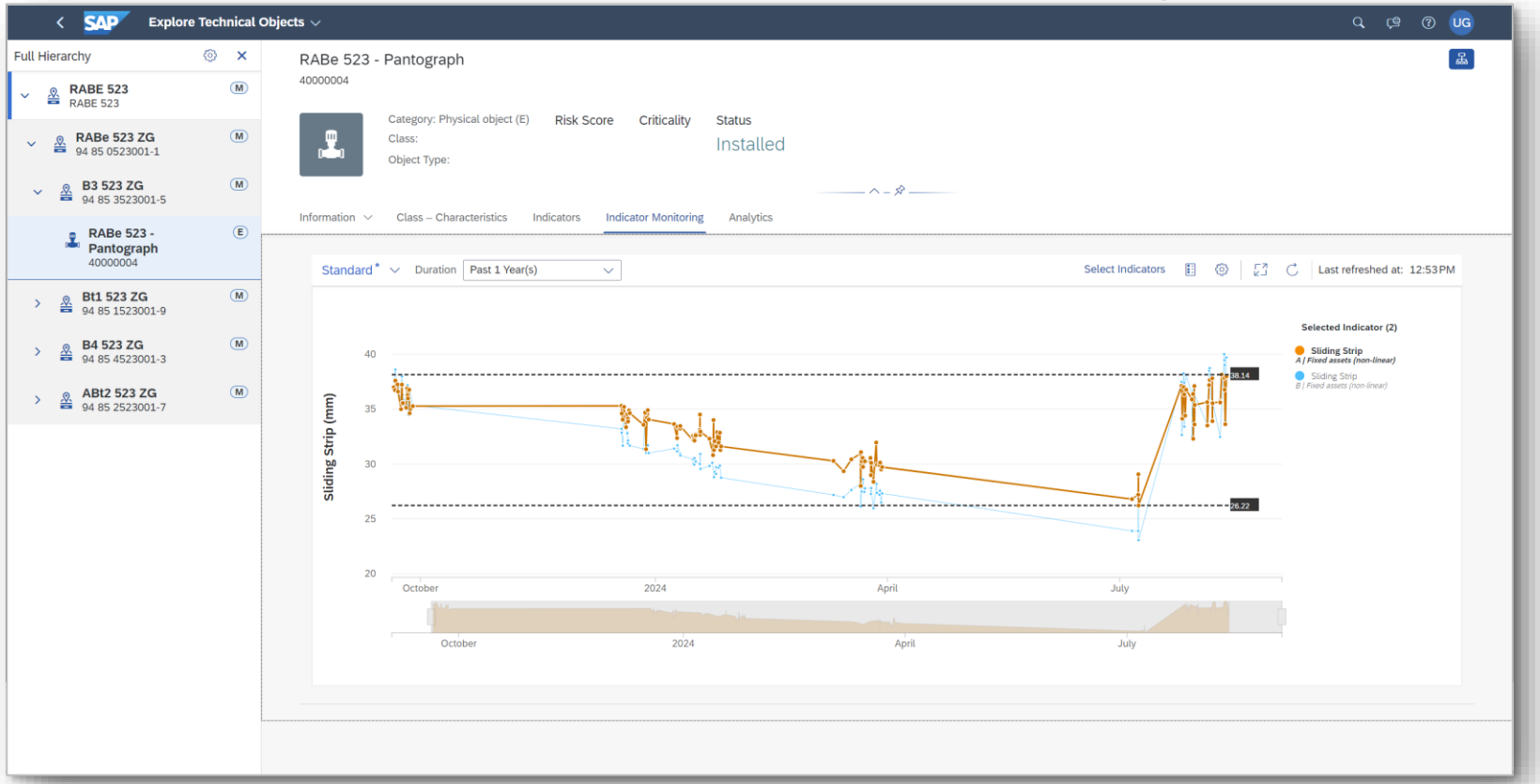
- The aim is to capture an image of a train passing by a measuring device - and
- to use image processing algorithms to obtain increasingly accurate measurement results of the contact strip thickness from this image by training models.

Network training:

- The starting point for measurement is a simple image taken from a train driving-by.
- The challenge of extracting the relevant features.

Establishment of networks:

- Images generated by the current collector contact strip using a measuring test rig
- Testing of the established networks; validated with manual measurements.



pat. pending.

Key take-aways and next steps.

- **Processes**: SBB invests a lot of effort into business process optimization; one of the main triggers in Asset and Maintenance Management was the S/4HANA transformation program.
- **Innovation-Management**: It is crucial to have an innovation funnel to manage a backlog of ideas that address relevant pain-points.
- **Industrialization**: There is no easy way; service architecture, capabilities, process, data, IT architecture (incl. AI technologies) are Enterprise Architecture elements that need to be looped continuously.
- **AI/ML integration**: AI/ML frameworks and models therefore need to be fully integrated into the Enterprise Architecture to enhance operational efficiency and decision-making.
- **Business effect**: A failure-data driven approach regarding Asset and Maintenance Management brings the effect, where it is required.

Questions and answers.

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Wir sehen der Zukunft mit Zuversicht entgegen.

Vortragender.

Urs Gehrig is Principal Consultant Business Development and Head of the Competence Center (CoC) Predictive Maintenance SBB. He has a degree in Electrical Engineering (HTL), a Master in Law (lic. iur.) and a degree in Secondary Education. Urs Gehrig currently leading the Integration Management of the S/4 SBB program at SBB Infrastructure Division. He is giving lectures on «Digitalized Maintenance» at Zurich University of Applied Sciences and is a member of the Advisory Board of the Locomotive bOgie Condition mAinTEnance (LOCATE) project running European Union's Horizon 2020 research and innovation program, as well as in POLIMI (UIC Project 2020/RSF/664), AIPM (UIC P700) and SENTINEL with ETHZ/EPFL. He is a Certified SAFe® 5 Agilist. Urs is Chairman of SUGRail SIG for Intelligent Asset Management since 2019. He is a passionate drummer and composer.

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