A Framework for Capturing the Business Benefits of Railway Digitalization

Ein Konzept zur Realisierung der wirtschaftlichen Potentiale der Bahndigitalisierung

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18 November 2020

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What's slowing down implementation of ETCS and PTC?

Notes

ETCS = European Train Control System

PTC = Positive Train Control

Both are digital systems designed to improve the safety of railway operations.
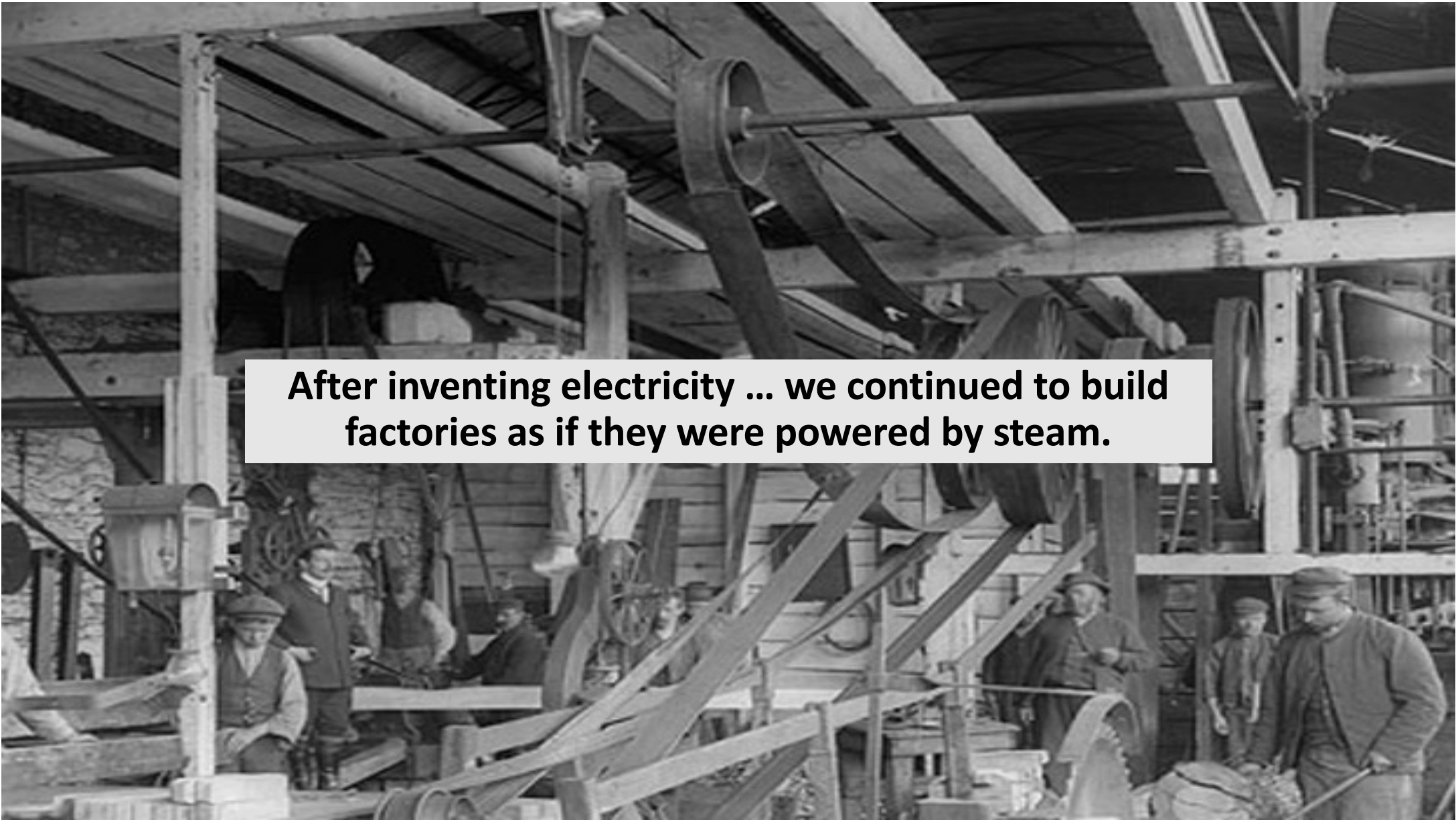
No obvious business benefit.

We've been here before.

After inventing electricity ... we continued to build factories as if they were powered by steam.

We needed to learn how to redesign our factories to take full advantage of electricity.

It's the same with digitalisation:

"You can see the computer age everywhere except in the productivity statistics."

- Robert Solow, 1987
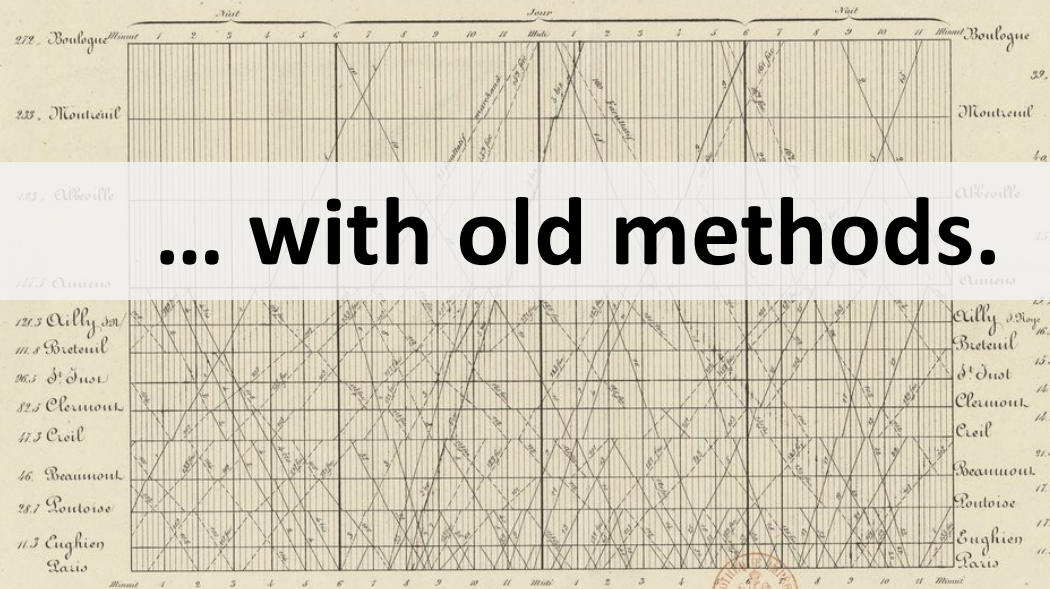
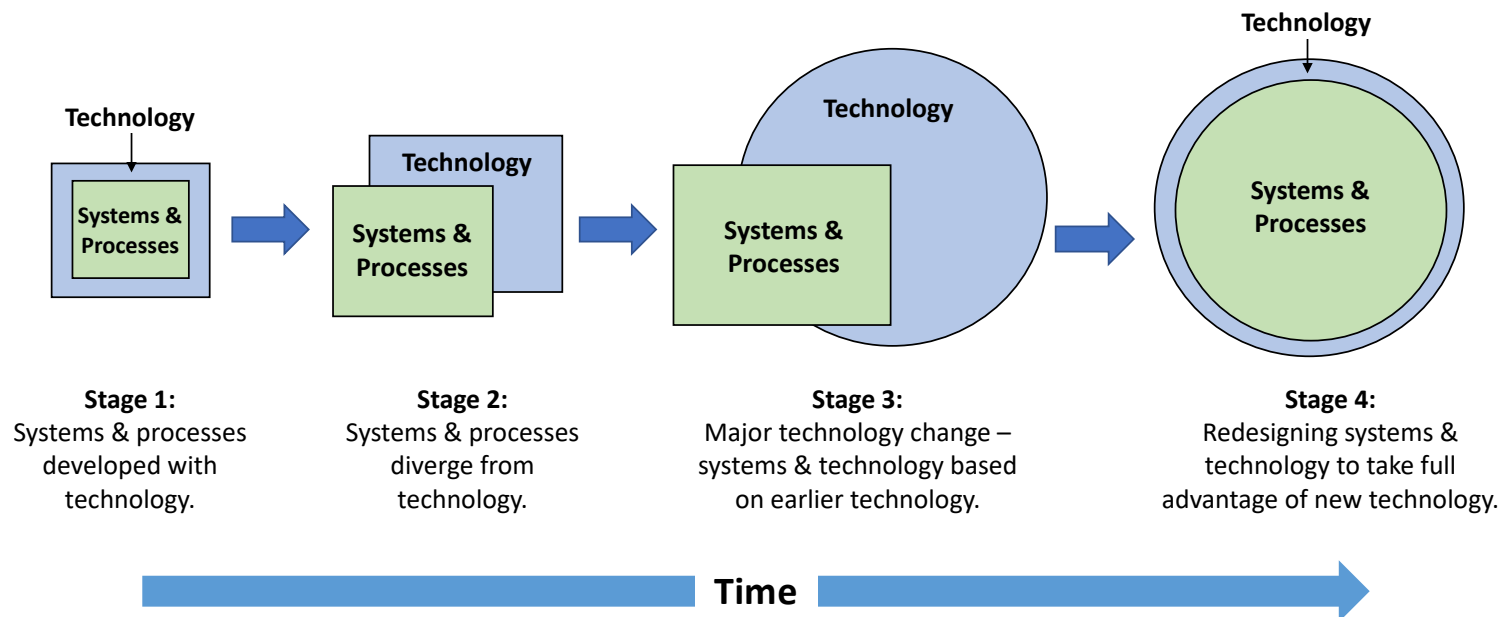Railways are using new technology ...

... with old methods.

Productivity gains come from …

redesigning business systems and processes
to take full advantage of new technology

… rather than simply applying
new technology to existing processes.

Business Lifecycle:
Systems & Processes vs. Technology

Stage 1:
Systems & processes developed with technology.

Stage 2:
Systems & processes diverge from technology.

Stage 3:
Major technology change – systems & technology based on earlier technology.

Stage 4:
Redesigning systems & technology to take full advantage of new technology.

Time

New Technology

Data Collection: Smart Sensors

Data Communications

Data Processing + Storage

Artificial Intelligence

Machine Learning

Deep Learning
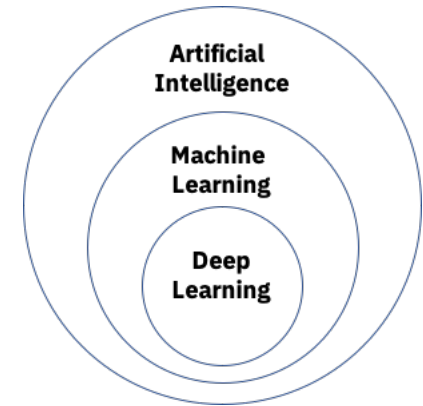
Data Driven Analysis + Decision-making

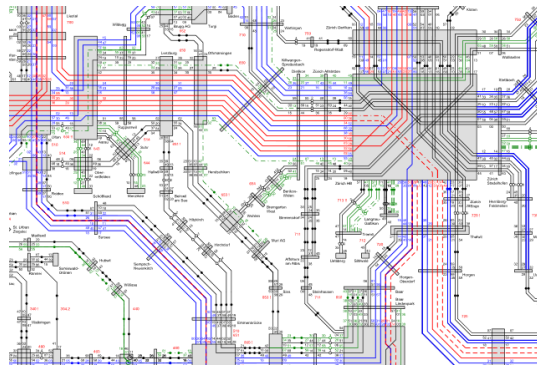**… allows railways to …**

create timetables in real time

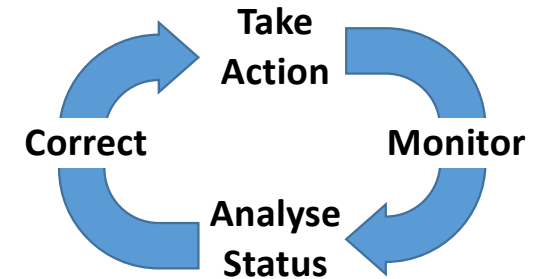**… but, the real business benefits come from combining new technology with …**

New Business Systems & Processes

**Precise
Production Planning**

**Customer-focused
Objectives**

**Closed Loop
Processes**

1 - Precise Production Planning

Timetable

Depart	Destination	Arrive
10:38..........	Høje Taastrup	10:55
10:42..........	Valby	11:15
10:45.........	Aarhus	14:30
10:45..........	Fredericia	12:45
10:50..........	Hedensted	11:42
10:51..........	Hinnerup ...	

Production Plan

Time	Task	Owner
10:38:30….	"Doors Closing"...	TrIS
10:39:00….	Blow whistle…......	Guard
10:39:20….	Lock Doors….......	Driver
10:39:25….	Visual Check…......	Driver
10:39:30….	Movement Auth..	Signaller
10:39:40….	Train Moving …...	Driver
10:39:20….	Set points A…......	System
10:39:25….	Visual Check…......	Driver
10:39:30….	Movement Auth..	Sign
10:39:40….	Train Moving	

Departure/Arrival Times

Precise Tasks

Precise Production Planning

Staff know exactly what to do.

Specific tasks can be monitored.

Opportunity to simplify processes.

Production Plan

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Opportunity
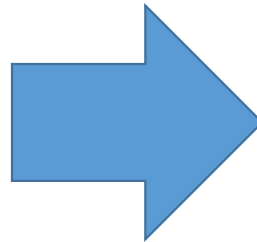
Use development of a precise production plan to
re-think *old operating and business practices.*
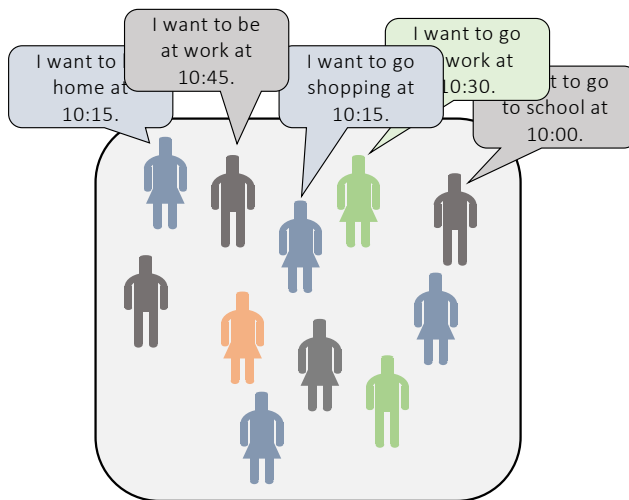
Simplifying Processes

Railway processes are like onions: a core of customer serving functions, surrounded by layers of unnecessary administrative, regulatory and institutional functions.

Simplifying processes is an opportunity to improve customer service and increase railway efficiency.

→ *Bonus: it also speeds-up the processing algorithm!*
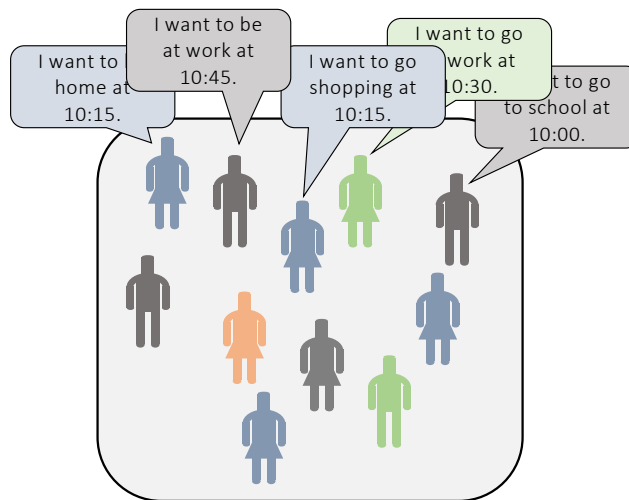
2 - Customer-focused Objectives

Customer Needs ≠ **Departure/Arrival Times**

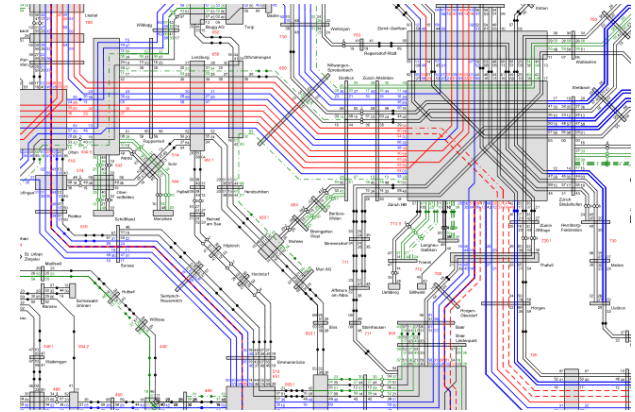# Customer-focused Objectives

Customer Needs

Trip chains → connections

Internal customers (maintenance)

Specialised services and needs

Service Intentions

Service Intentions

Describe a customer's functional transport needs.

- new parameter developed to provide a <u>quantifiable</u> measure of customer needs.

- serves as an <u>objective function</u> for production plan scheduling algorithms.

- developed by analysing the functional qualities inherent in integrated periodic timetables and generalising (based on SBB Puls90 research).

Obtaining the full benefits of new technology often requires developing new parameters made possible by new technology!

Opportunity →

Virtual Reality · **Gig-economy** · Ich A.G. · Automation · **Globalisation** · *Virtual Collaboration* · On-line Shopping · **Home Work** · Streaming
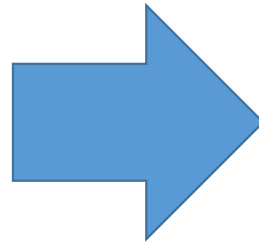
Use digital data from ETCS to
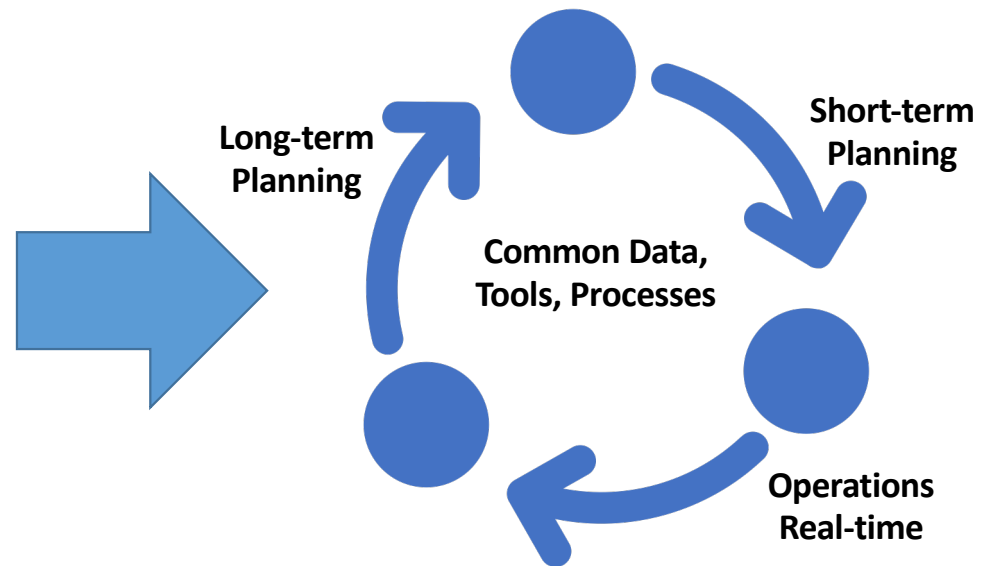*re-focus* railways on the needs of today's customers.

3 – Closed Loop Processes

Planning and Operating Silos

Long-term Planning

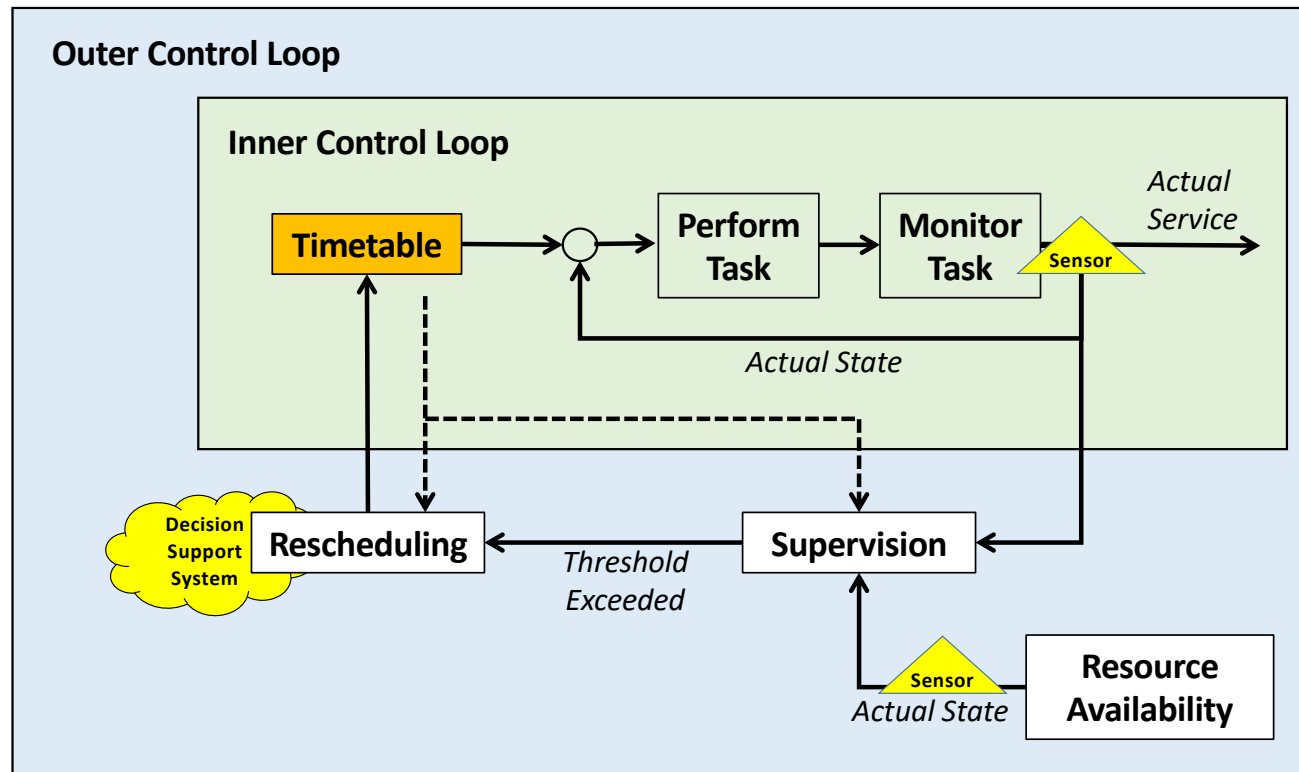**Short-term Planning**

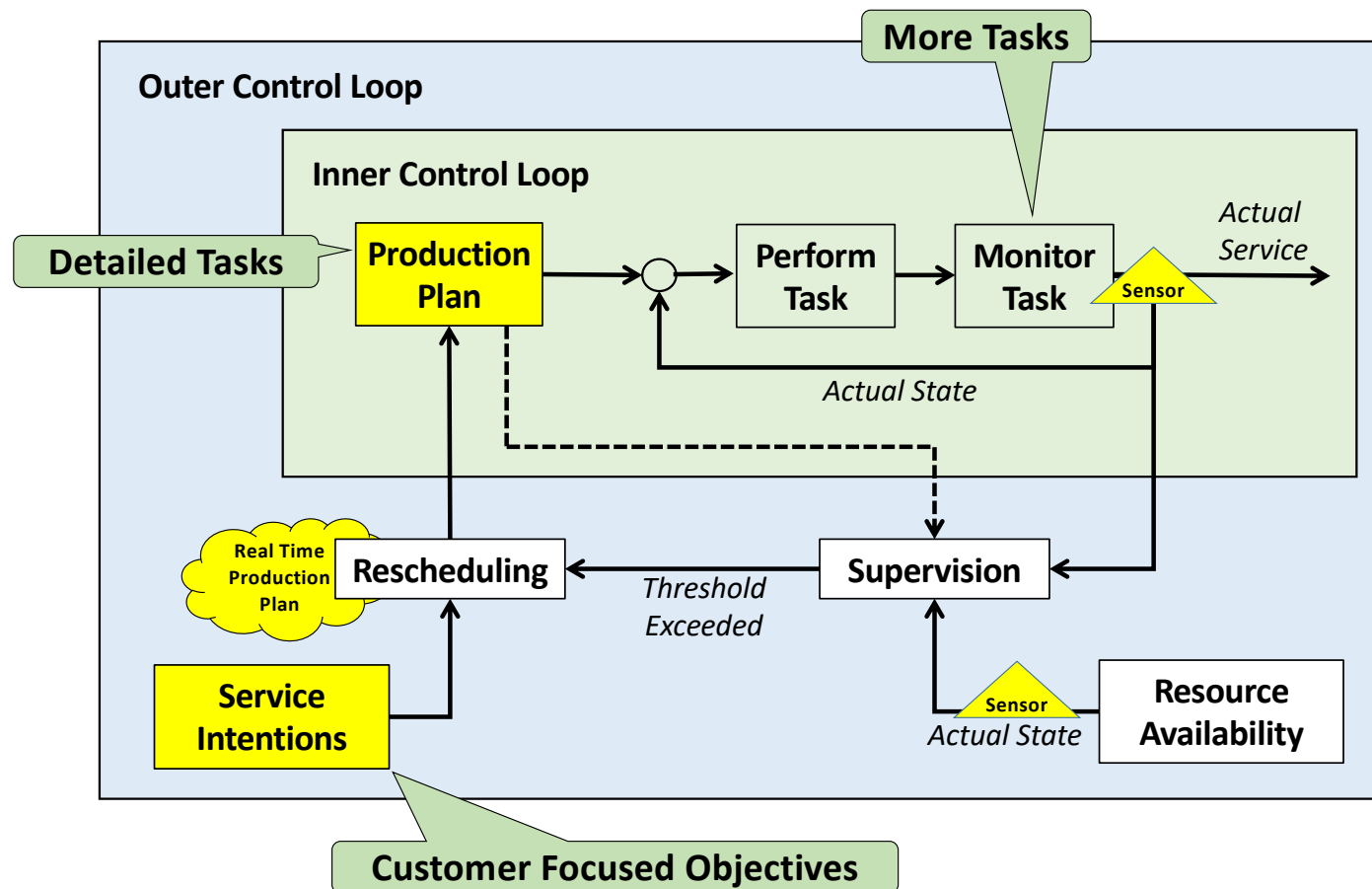**Common Data, Tools, Processes**

Operations Real-time
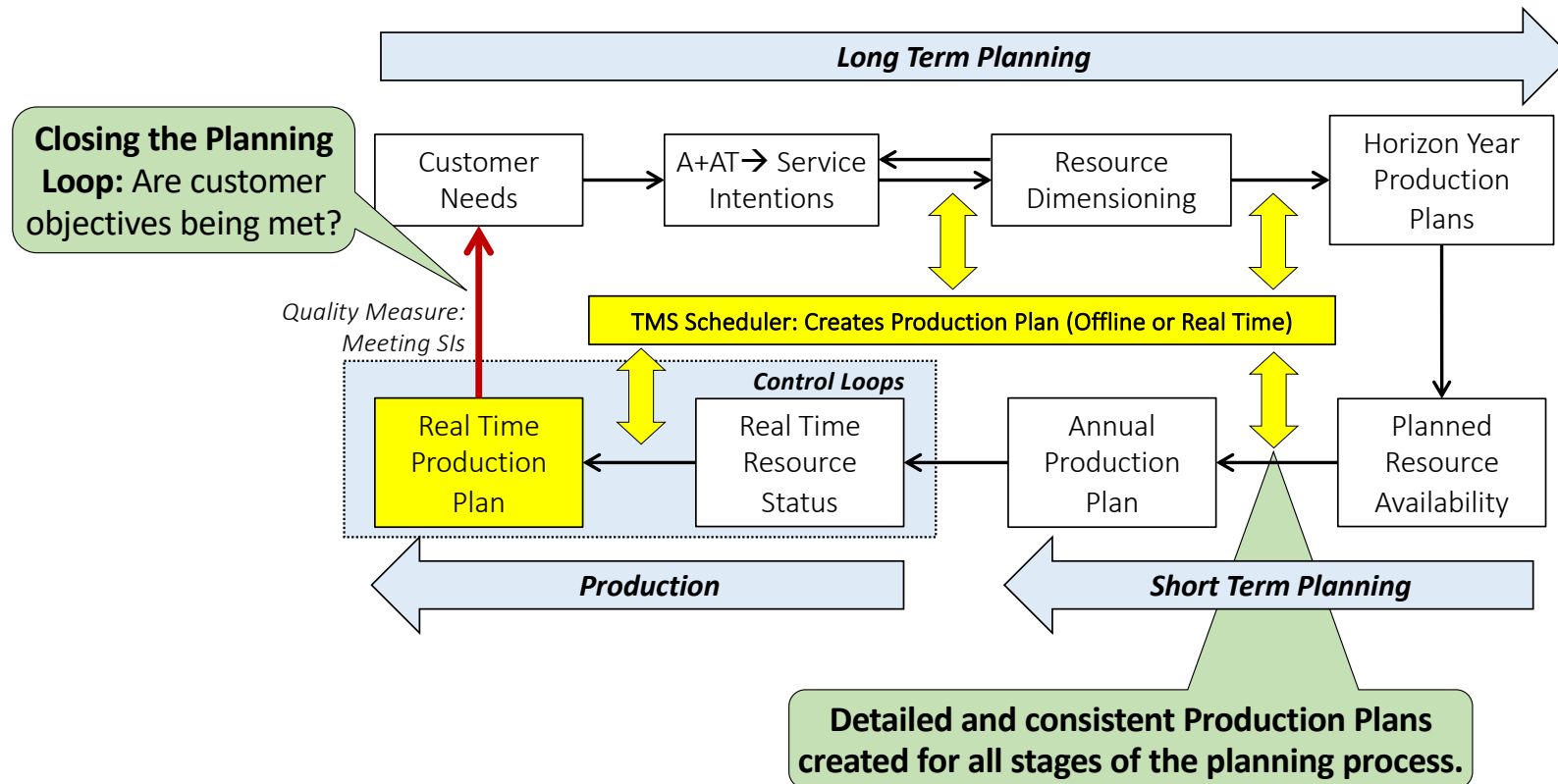
Fully Integrated Planning and Operations

Control Loops *Closed*: New Tech + *Old Processes*

Control Loops *Closed*: New Tech + *New Processes*

New Closed Loop: *Planning and Operations*

Closing the Planning Loop: Are customer objectives being met?

Quality Measure: Meeting SIs

Long Term Planning

Customer Needs

A+AT→ Service Intentions

Resource Dimensioning

Horizon Year Production Plans

TMS Scheduler: Creates Production Plan (Offline or Real Time)

Control Loops

Real Time Production Plan

Real Time Resource Status

Annual Production Plan

Planned Resource Availability

Production

Short Term Planning

Detailed and consistent Production Plans created for all stages of the planning process.

Opportunity

Long-term

Short-term

Real-time

Independent Planning Processes and Tools

Integrated Planning Processes and Tools

Use digital technology + new approach to

Integrate planning processes and tools

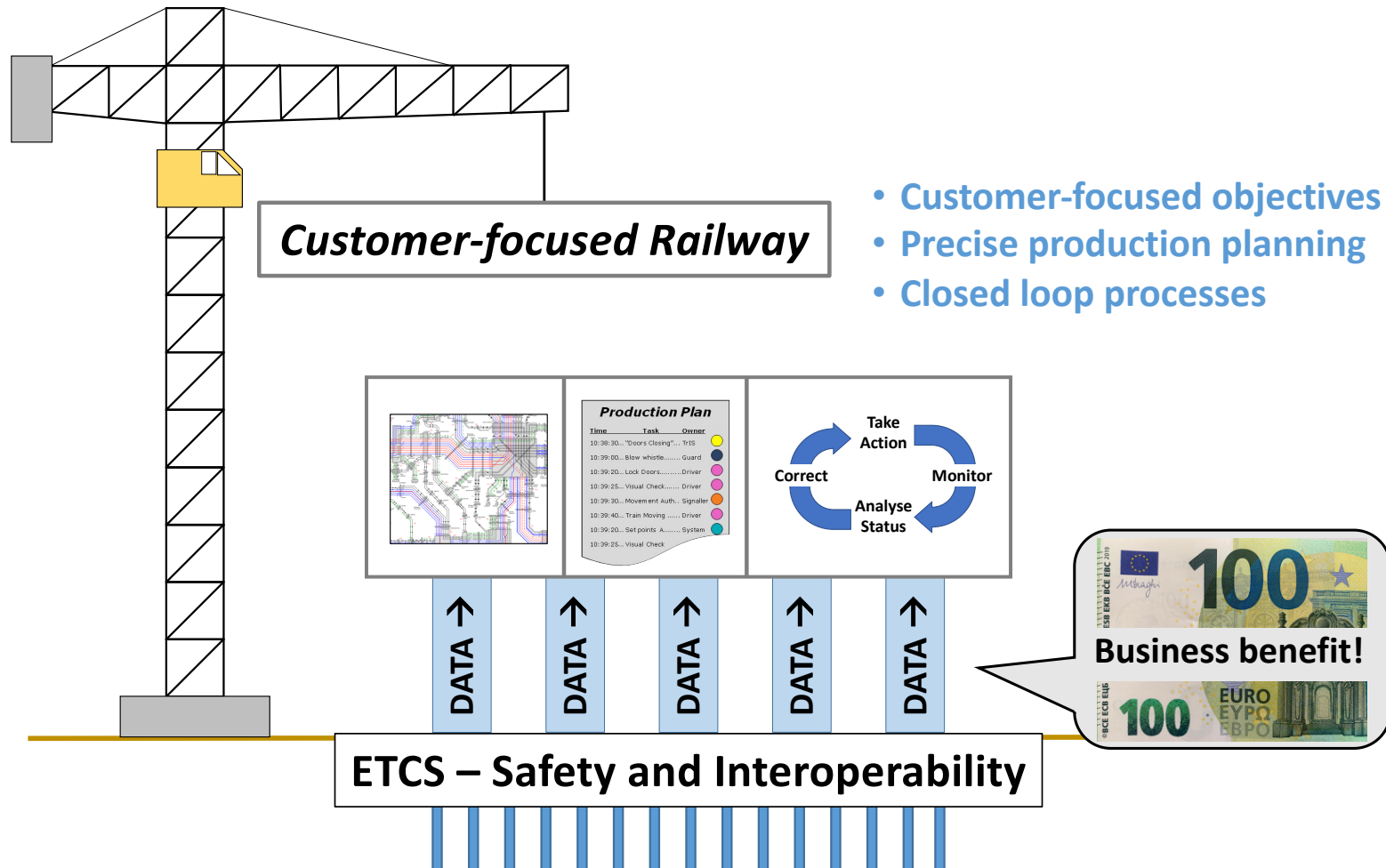… to increase service quality and operating efficiency.

Our systems and processes reflect the technology of their time.

To achieve the full benefits of digitalisation, we must revise railway systems and processes to reflect today's technology.

The Framework.

Customer-focused Railway

- Customer-focused objectives
- Precise production planning
- Closed loop processes

Business benefit!

ETCS – Safety and Interoperability

References

Photo Credits

- Murphy's Saw Mills at Ferrybank; By National Library of Ireland on The Commons - https://www.flickr.com/photos/nlireland/6294404287/, No restrictions, https://commons.wikimedia.org/w/index.php?curid=41577782

- Iran tractor factory, photo by amin khorsand on Unsplash.

- Historic graphic timetable: Bibliothèque nationale de France.

- Railway sensor: https://www.tugraz.at/institute/igms/projects/current-projects/condition-monitoring-of-railways-with-distributed-fos/

- Supercomputer: https://commons.wikimedia.org/wiki/File:Sierra_Supercomputer_(48002385338).jpg

- All other photos and diagrams: Andrew Nash

Links

About the author and publication downloads: https://andynash.com