Can information technology help rail play a greater role in preventing climate change?

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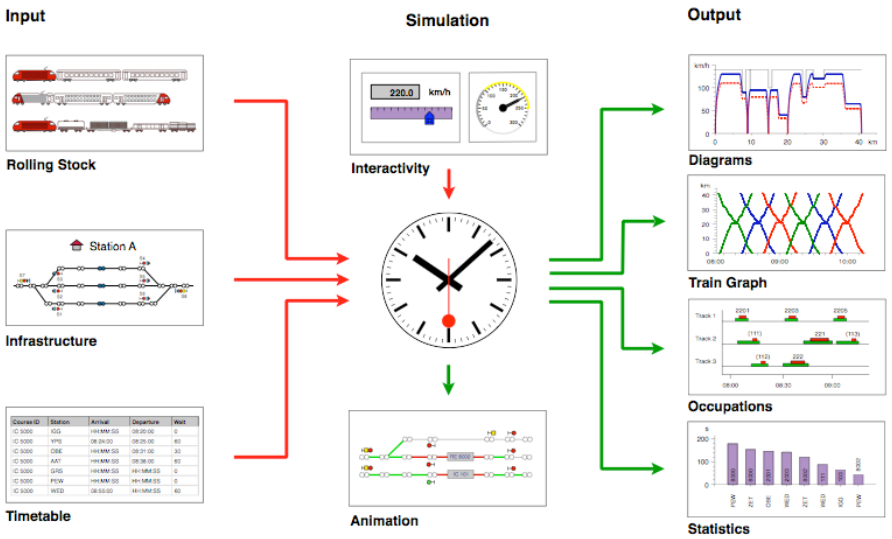
Agenda

1. Introduction: IT and Railway Potential
2. The Problem
3. Information Technology in the Railway Industry
4. Three key types of IT Applications
   - Scheduling and timetable planning;
   - Operations management and dispatching;
   - Simulation (infrastructure planning);
5. Upcoming Conferences
6. Conclusions and Recommendations

Introduction

- **Research Goal:**

  Identify opportunities for using information technology to improve railway operations and service.



- **Research based on results presented at IT08.rail conference supplemented by literature review.**
- **Presentation Goal: Highlight upcoming conferences and encourage participation from interested railway professionals:**
  - **Rail Zurich 2009 - IAROR Conference - February 11 - 13, 2009**
  - **IT10.rail conference - Zurich - January 21 - 23, 2010**

Rail's Potential for Helping Address Climate Change

- "*The railway will be the 21st Century's preferred mode of transport – if it can survive the 20th Century.*"
- Railways could help reduce energy consumption, improve the environment and reduce climate change.
- But, potential customers value the independence and high quality service provided by automobiles, trucks and airplanes.
- Railways have a window of opportunity – but they must use new technologies including IT to create:
  - New production processes,
  - New products and
  - New services

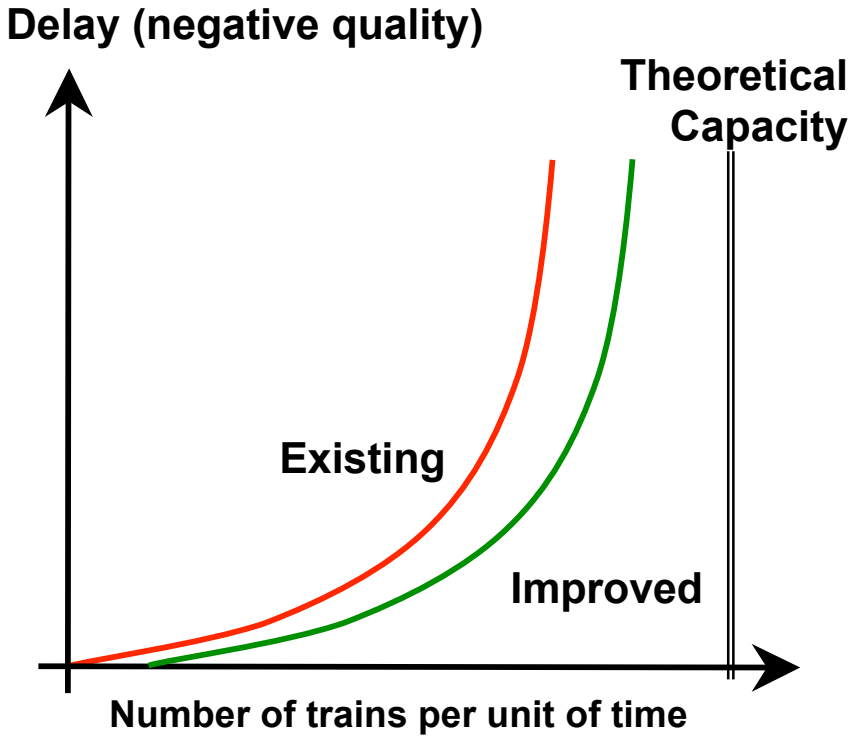
  … tailored for 21st Century customers.

The Problem

- Rail is an attractive and efficient means of transport in many market segments, including:
  - Bulk freight (e.g. coal)
  - High density passenger routes (e.g. HSR)
- But: while volumes have been growing, mode share is generally falling. Why?
  - Capacity constraints
  - Demand for higher quality service by passengers & freight
- In some markets, e.g. European freight corridors, California Capitol Corridor, where institutional barriers have been reduced, real partnerships have been created and new products introduced, rail has been particularly successful.
- These successes highlight rail's strong potential.

Compounding the Problem: More Trains = Lower Quality

- Rail capacity is a function of:
  - infrastructure quality
  - type of operations
  - scheduling assumptions
- Railway service quality:
  - punctuality
  - reliability
  - comfort/security
  - price



- As demand increases quality decreases, first slowly, then sharply.
- Timetable and dispatching improvements can increase the number of trains operated while maintaining the same quality of service.

Solving the Problem: Improving Quality and Increasing Capacity

1. Add infrastructure
   - Expensive
   - Difficult (especially where capacity is often most needed!)
2. Revise schedules (timetables and organizing principles)
3. Improve operations management (e.g. dispatching)

Best: do all three! But …

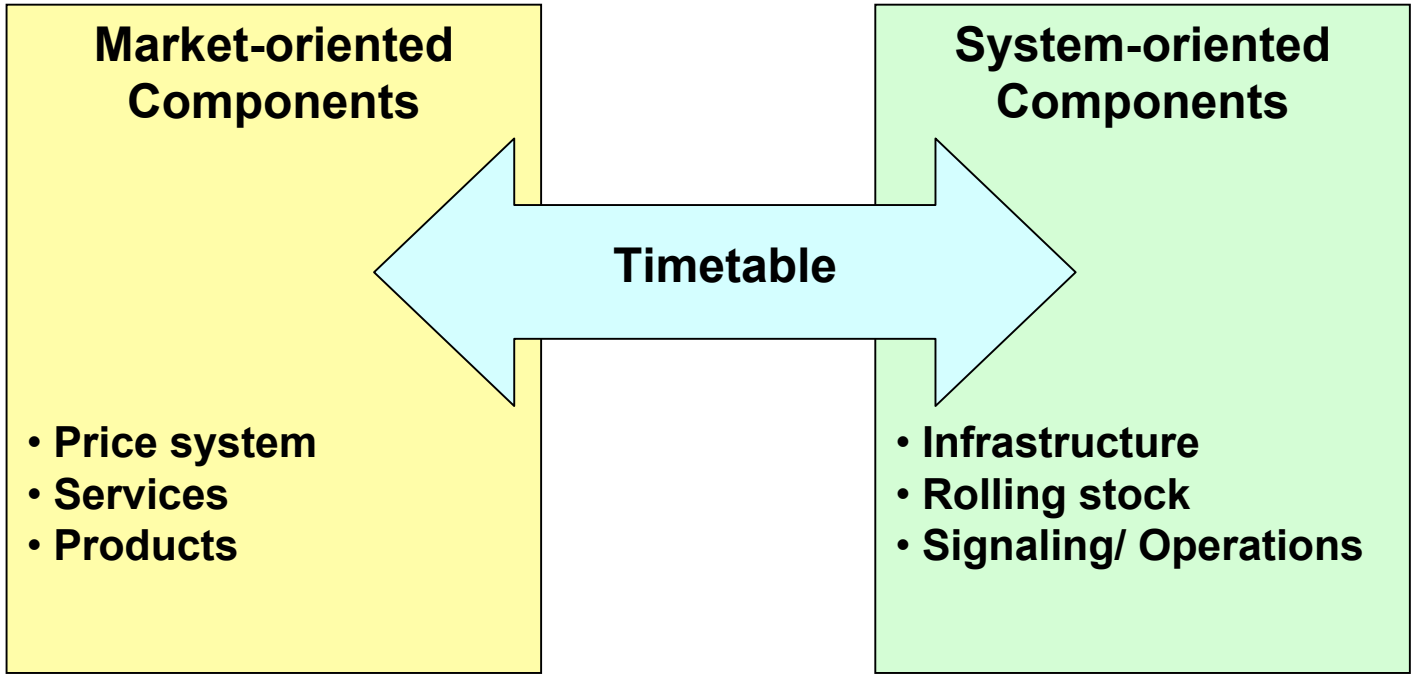
- How do you decide what to do?
- How do you set priorities?
- How do you operate in the meantime?

Information technology plays an important and growing role in answering these questions.

Information Technology in the Rail Industry

- Key benefit of rail IT applications is their ability to test many different alternatives quickly and accurately, enabling planners and operators to make better decisions.
- The main types of rail planning IT applications parallel the three main types of capacity/quality improvements above:
  1. Scheduling and timetable planning;
  2. Operations management and dispatching;
  3. Simulation (infrastructure planning);
- An important element of current rail IT research is linking applications and adding more automated analysis functions.
- These planning applications are also being more closely linked with ‘administrative’ rail IT applications (e.g. staff scheduling).

1. Timetable Planning



- The timetable is a railway's central organizing element;
- Therefore … it forms an important basis for many rail information technology applications.

Timetable Planning Strategies

- Rail timetables need to be both:
  - Stable: able to recover quickly from service disturbances and delays, and
  - Robust: able to function despite service disturbances and failures.

- IT applications developed for planning timetables use conceptual scheduling principles including:
  - Stable and simple service concepts (e.g. Taktfahrplan);
  - Optimization of train connection relationships;
  - Achievable (realistic) conflict-free train paths;
  - Resource planning (e.g. staffing); and
  - Real time slot access and pricing.

Example Timetable Planning Strategy: Slot Pricing

- Slot pricing is a fundamental element in creating a more effective and efficient rail system.
- Slot pricing is complex and prone to charges of favoritism and discrimination.
- IT timetable planning systems can be used to e.g.:
  - Identify opportunities for adding trains to heavily used networks;
  - Create a systematic approach for setting slot prices and priorities;
  - Explore opportunities for real-time slot pricing strategies (e.g. auctions in the case of delays);
- Focus is on linking different applications and creating more transparency in the system.

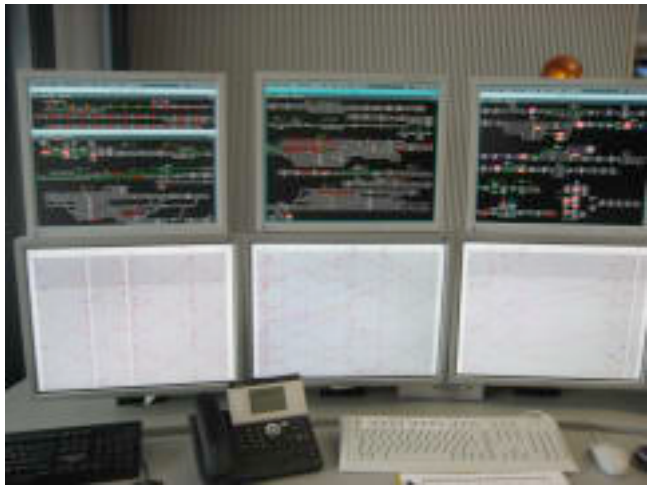
2. IT and Rail Operations Optimization

Three ideas for using IT to optimize rail operations:

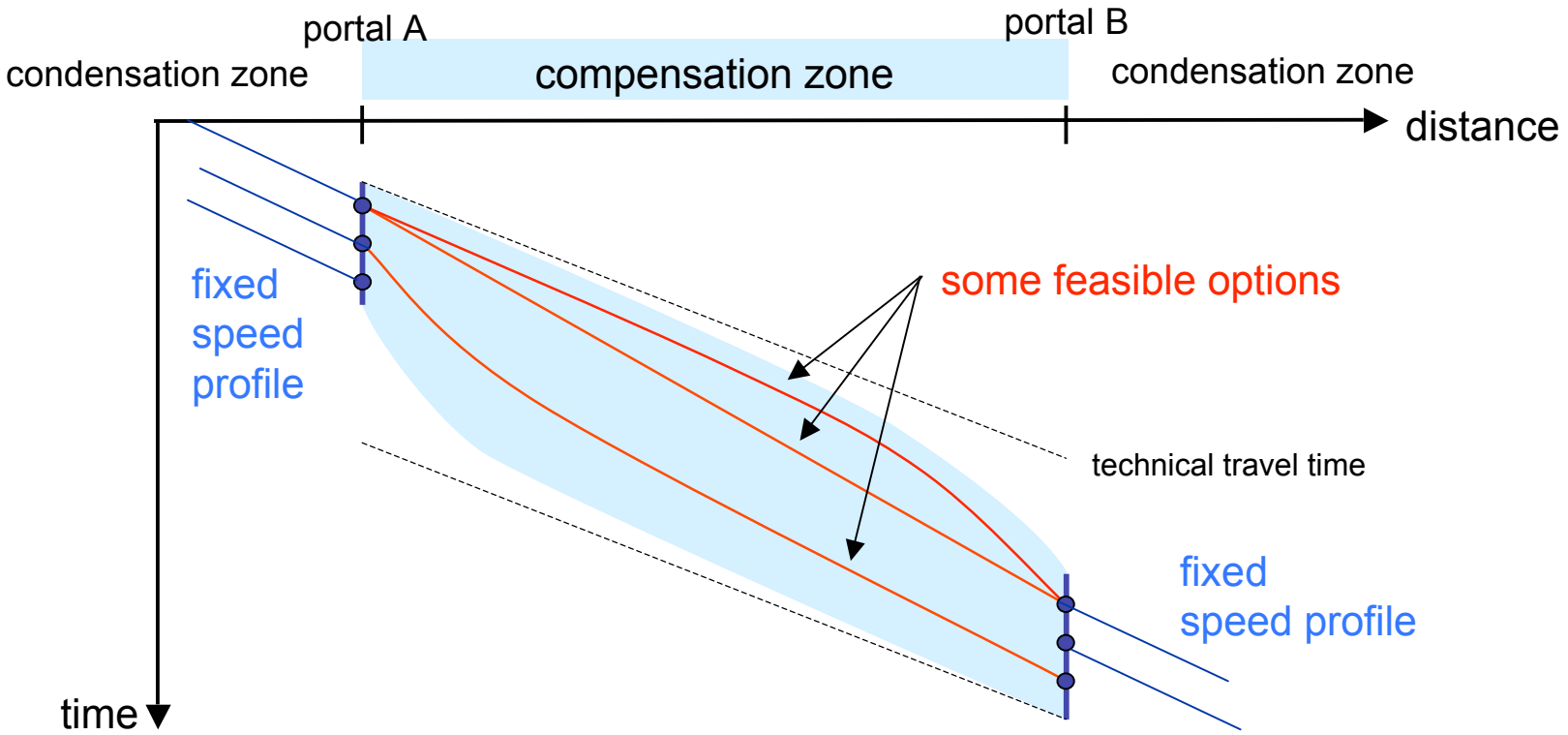
1. Improved dispatching systems (next slides);
2. Improved train control systems:
   - Combine real time dispatching information with driver-machine interfaces to more precisely implement timetables;
3. Improved travel information systems:
   - Customers expect high quality real time information (automobile GPS, freight delivery);
   - Use ability to re-direct passengers (and trains) to provide more customer-friendly delay/incident recovery plans.

Example Rail Operations : Improved Dispatching Systems

- Dispatching IT:
  - Today = monitoring and conflict detection;
  - Tomorrow = provide solutions and consider more variables (e.g. energy use).
- Key issues:
  - Problem complexity;
  - Can machines ‘anticipate’ problems (like an experienced dispatcher) or simply ‘react’?
  - Data acquisition (data is out there, but where?);
  - How do you measure success?
  - Human factors (will dispatchers accept the help? Generational issue: T-Rex vs. PacMan vs. iPod?).



Improved Dispatching: SBB Puls90 Program



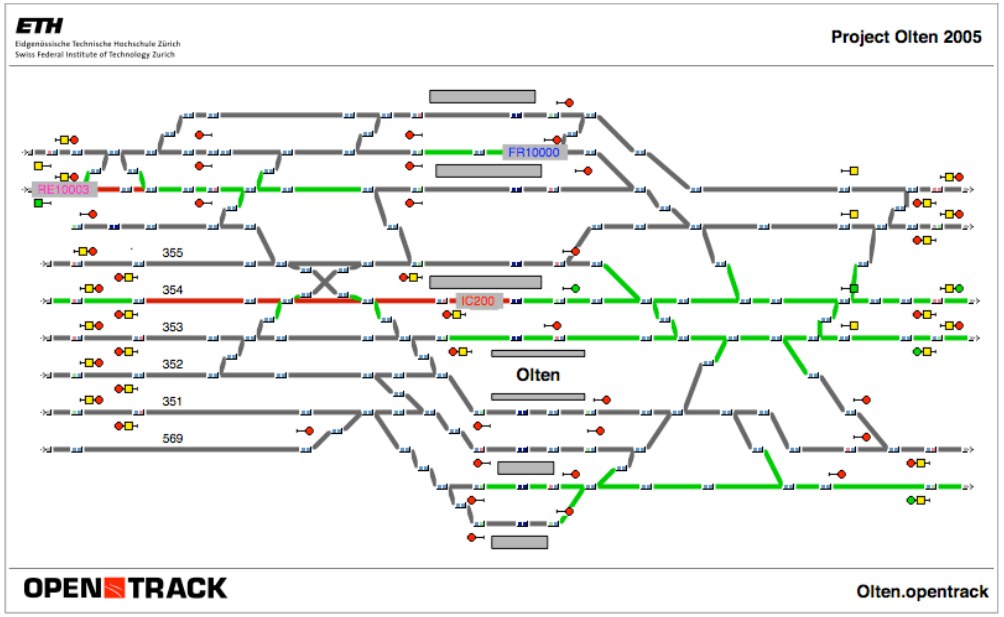
Puls90 - addresses complexity by dividing network into zones with excess capacity (compensation zones) and zones operating at capacity (condensation zones).

Two main principles of Puls90 are:

- Automated real-time rescheduling in case of delays or disturbances
- Driver-Machine-Interface with real-time data to adjust driving behavior

3. Railway Simulation and Infrastructure Planning

- ‘Classical’ application of information technology to railway planning and operations.
- Planners can develop and test many different combinations of:
  - Infrastructure
  - Rolling stock
  - Schedules/operating strategies
- Especially effective at identifying the most cost effective solutions;
- Future: more interfaces with other rail IT applications and more automated problem analysis.



Railway Information Technology Conferences

IT08 RAIL

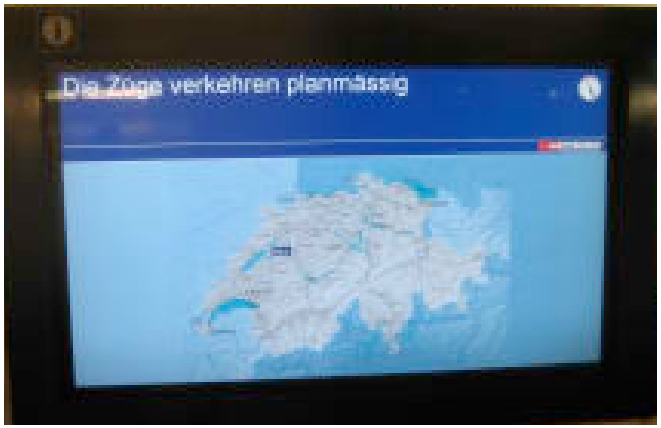
Closing the Loop - Capacity and Quality of Railway Systems
24 - 26 January 2008 in Zurich

- **RailZurich2009: IAROR Conference**
  - February 11 - 13, 2009
  - 3rd International Seminar on Railway Operations Modeling and Analysis - Engineering and Optimization Approaches
  - www.ivt.ethz.ch/news/railzurich2009

- **International Association of Railway Operations Research (IAROR)**
  - www.iaror.org

- **IT10.rail Conference:**
  - 21 - 23 January 2010
  - ETH Zurich
  - www.it10rail.ch - details forthcoming!

IT08.rail Conference - Overview



- Day 1: User Workshops
  - Viriato timetable development and analysis application
  - OpenTrack rail simulation application
- Atelier - Automatic Train Traffic Control Systems of the Future - group workshops discussing ideas and problems;
- Day 2: Technical Symposium (next slide);
- Day 3: Excursion - Lötschberg Basis Tunnel and BLS tunnel control center.

IT08.rail - Technical Symposium

(www.sma-partner.ch/it08rail/symposium/index_en)

Stability and Reserves

- Dagmar Haase, DB Netz AG - The relationship between stability and reserves
- Prof. Leo Kroon, Erasmus University Rotterdam - Robust timetables: Determination of reserves in the planning process

New Methods in Dispatching

- Dr. Felix Laube, SBB AG - Puls 90 – A new method to deal with reserves from strategic planning up to operations
- Prof. Eckehard Schnieder, TU Braunschweig - What is the state of the art of current dispatching systems? What are the most promising approaches?

Route Management and Open Access

- Jean-Michel Dancoisne, CEO Thalys - Planning of top-quality international HS routes
- Roland Hartkopf, Railion Germany - Challenges and opportunities with Open Access for a freight operator

Incident Management and Quality Assurance

- Martin Wyss, BLS AG - The human dispatcher in the complex control technology environment
- Prof. Ingo Hansen, TU Delft - Quality assurance: Analysis of operational data as input to the planning process of future timetables
- Prof. Dr. Ulrich Weidmann, ETH Zurich - Conclusions: The reserve as an adjusting lever in the over-all process of planning, operations and quality

Conclusions

- Railways could carry a greater share of freight and passenger trips thereby helping reduce energy use and climate change;
- Rail IT applications are already helping railways increase capacity and improve service quality … but
- To succeed railways must combine these new technologies with institutional change to create new products and services tailored to meet the demands of 21st Century customers;
- Two important areas for further research are:
  - Technical innovation to help improve rail IT applications;
  - Socio-institutional research on how new technologies can be applied within an old business model to create truly innovative new products.

Thank you very much for your attention!

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