Technology for Re-thinking Railways

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Outline

- Railway management today
- Re-thinking railway management to take advantage of new technologies
- Scheduling based on customer needs
- Operating based on precise control
- Real time data and control
- Integrated planning and operations
Railways

A classic 19th Century institution

with management practices based on

19th Century understanding & technology
Moving trains around the network punctually.
Lipstick on a pig. Modern rolling stock applied to old operating concepts.

Customer need mismatch! Customers care about their activities - not railway punctuality.

Inefficient management. New technology could improve control of operations.
Railway management today

- Railways are managed using *timetables*
  - **Too precise for customers**
    - Customers care about travelling to participate in an activity, not precise arrival and departure times;
  - **Not precise enough for operators**
    - Arrival and departure times do not provide sufficient information for efficient operations.
Why?

- Timetables were the *best possible technology* available in the 19th Century.

- Today we have:
  - More data
  - Better analysis tools
  - Faster communications
Re-thinking railway management

- How do we best take advantage of these new information technologies?

  - **New technology + existing practices**
    - Incremental improvement: doing what we do now faster, better and more efficiently;

  - **New technology + new practices**
    - Disruption: re-thinking basic business practices to take full advantage of new technologies.
How do you manage a railway?
Problem 1

Railway Operations > Customer Needs

Railway operations > customer needs because there is no language for describing the customer’s functional needs or process for using them in railway scheduling.
A language describing customer needs

- Customers care about **activities** not precise arrival and departure times (timetables).
  
  • **What activities should we serve?**
    - Explicitly consider the activity so you can determine:
  
  • **How do we provide service to the activity?**
    - Design services that give customers the **perception** they can use the transport without thinking.
    - **Availabilities** ➔ frequency, travel time, transfers
Scheduling with customer needs

- Defining functional service:
  - **Service structure → user’s cognitive map**
    - Repeating service patterns
    - Similar activities served similarly
    - E.g., Taktfahrplan, frequent bus networks
  - **Service intentions → scheduler**
    - Describe customer needs (e.g., availabilities) in railway functional terms.
    - Used as an objective function for the scheduling algorithm.
Banedanmark TMS

Schedule based on customer benefits

- Activities
- Availabilities
- Combining Algorithm

Service Intention

- Functional Service

Scheduler

- Solution found?
- Within Tolerance?

Production Plan

- Operations

Infrastructure

- Topology
- Completator
- Required Infrastructure
Problem 2

Railway capacity inefficiently used because timetables are based on old fashioned data and control systems
New technology for data and control
Operating based on precise control

- **Production plans** describe how the railway provides quality service to its customers.

  - **Tasks**
    - Precisely describe all activities
    - Are assigned to specific staff and resources
    - Have tolerance bands for performance
    - Are monitored in real time
Banedanmark TMS

Re-plan service in divergences

Operations

Within Tolerance?

No

Scheduler

Solution found?

No

Production Plan

Create detailed production plans

Customer Benefits

Activities

Availabilities

Combining Algorithm

Service Intention

Service Structure

Functional Service

Operations

Infrastructure

Topology

Required Infrastructure

Re-plan service in divergences

Create detailed production plans

Banedanmark TMS
Problem 3

Railway Operations

Separated Operations and Planning

Customer Needs
Integrated planning and operations

- **Production plans** can be prepared easily enabling them to be used more frequently.
  
  - **Service planning**
    - Precisely evaluate future service plans
  
  - **Infrastructure planning**
    - Precisely evaluate future investment plans
    - How will planned infrastructure work?
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Evaluate future service options ...

... using detailed production plans.

Evaluate how infrastructure will work ...

Operations

No

Customer Benefits

Activities

Availabilities

Combining Algorithm

Functional Service

Service Intention

Service Structure

Scheduler

Solution found?

No

Operations

Infrastructure

Topology

Completerator

Required Infrastructure

Production Plan
What is Banedanmark’s TMS?

An advanced traffic management system to precisely plan and provide railway service for customers.
Banedanmark’s TMS

Increases Railway Capacity

Precisely manages railway operations.

Customer Needs

systematically considers customer needs.
Questions?