



# Technology for Re-thinking Railways

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bandedanmark



# 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

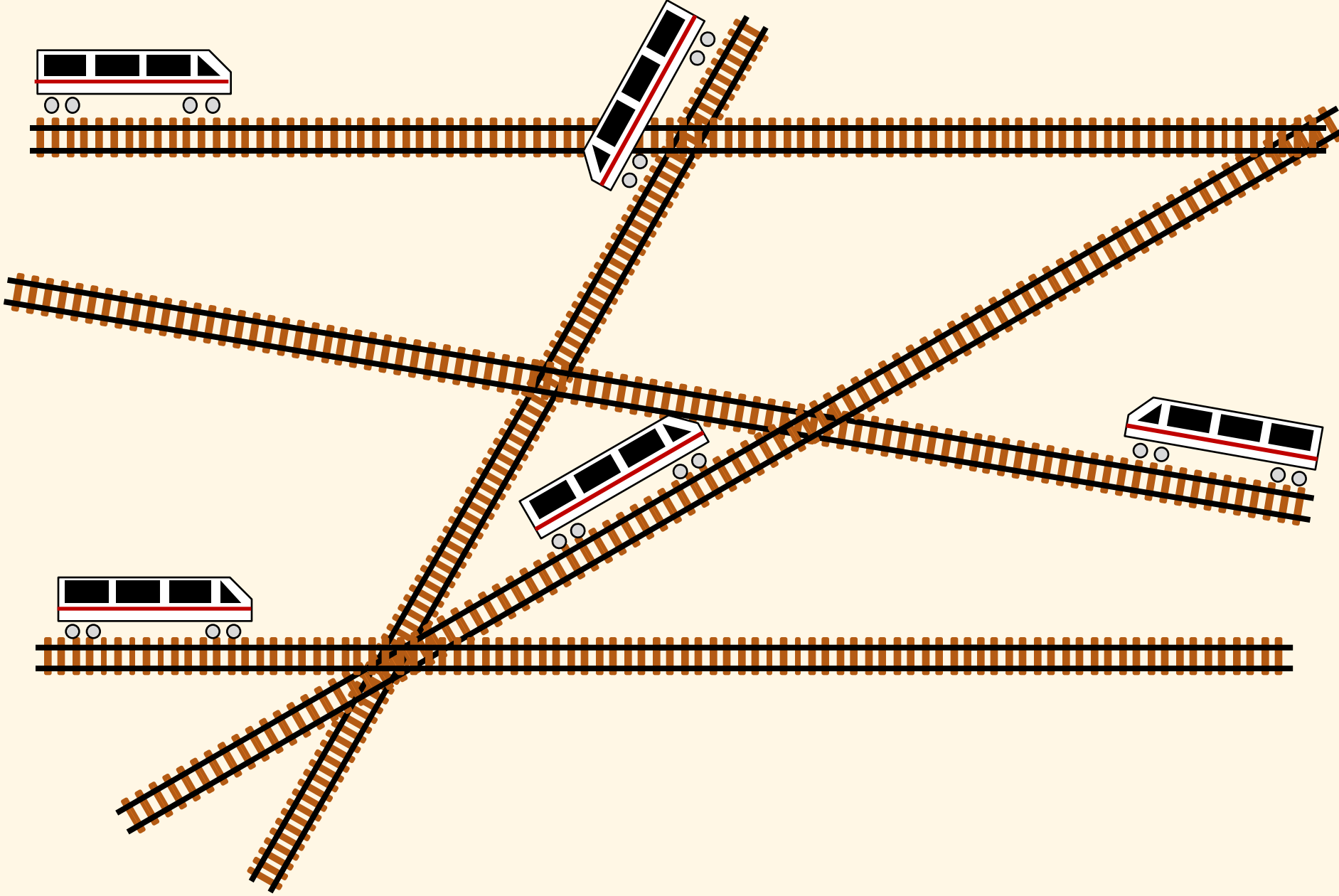
# Railways

**A classic  
19<sup>th</sup> Century  
institution**

with  
*management practices*  
based on

**19<sup>th</sup> Century  
understanding &  
technology**







***Moving trains around the network punctually.***



# Results

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

**Lipstick on a pig.**  
Modern rolling stock applied to old operating concepts.

**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 19<sup>th</sup> Century.
- Today we have:
  - **More data**
  - **Better analysis tools**
  - **Faster communications**

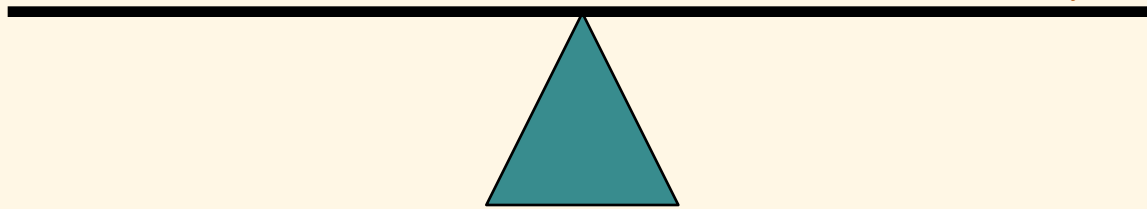


# Re-thinking railway management

- 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.

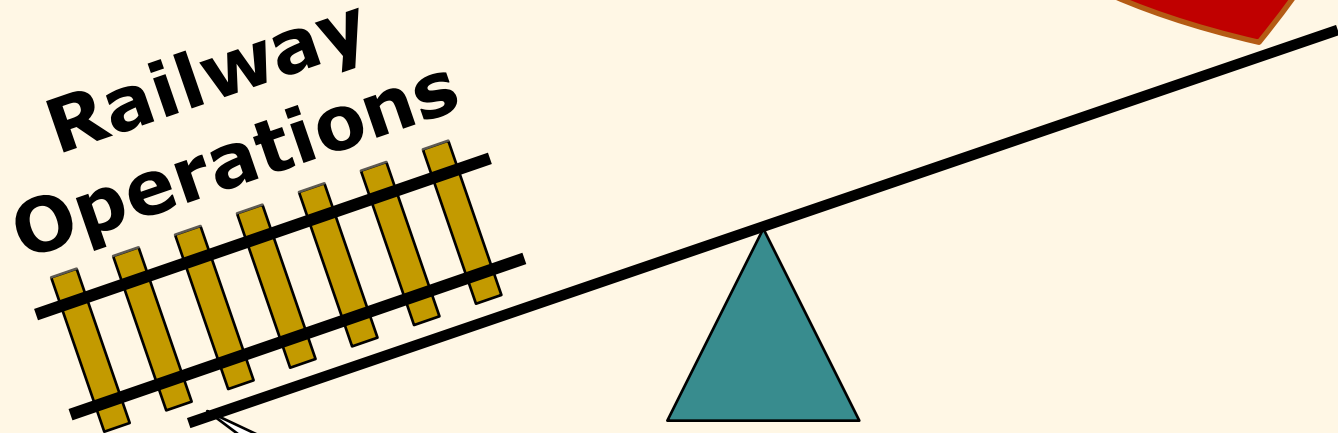
# How do you manage a railway?

**Railway  
Operations**

An icon representing railway operations, consisting of two horizontal black lines with seven vertical yellow bars between them, resembling a railway track or signal.

# Problem 1

**Railway  
Operations**



**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

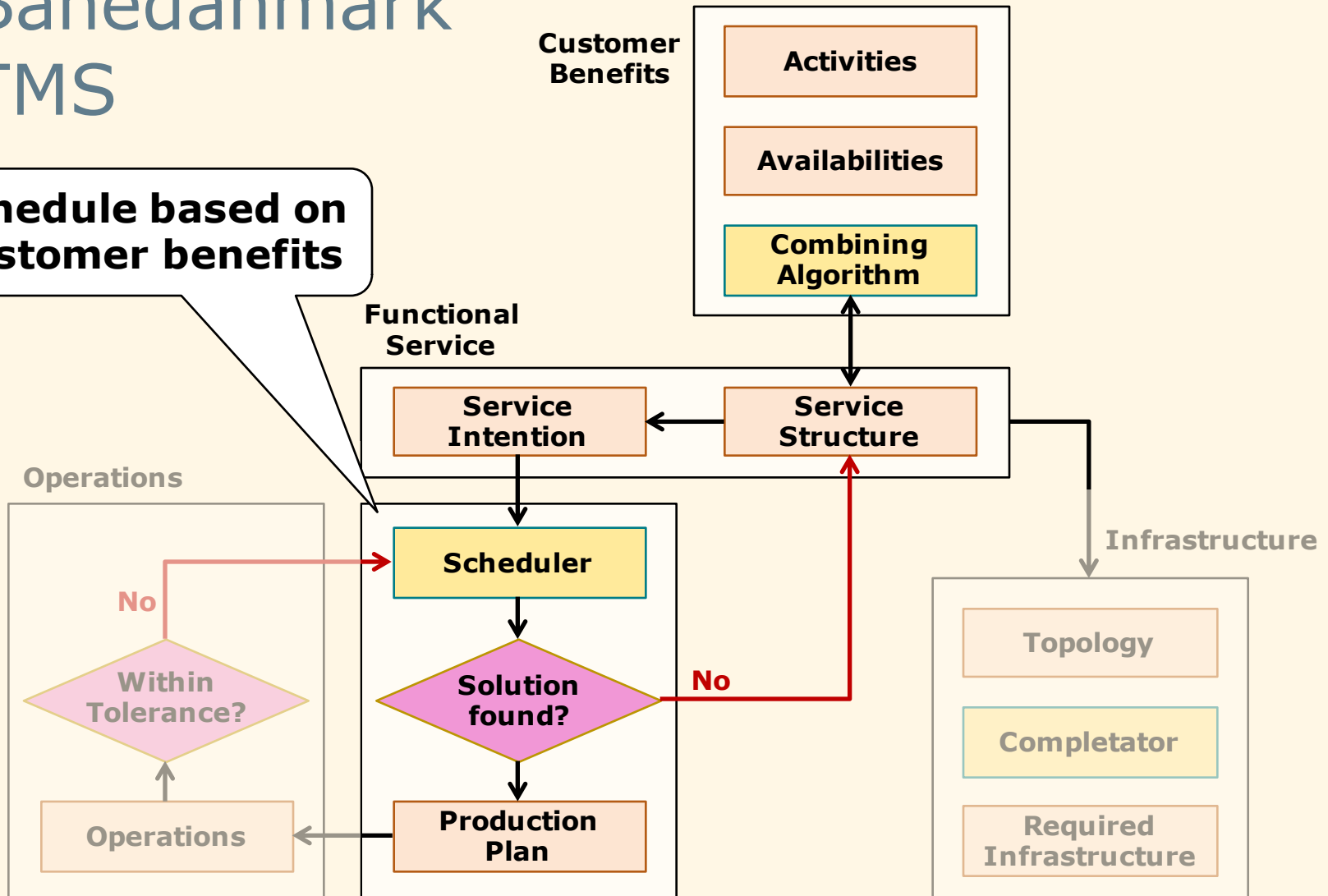
- Customers care about **activities** not precise arrival and departure times (timetables).
  - **What activities should we serve?**
    - Explicitly consider the activity so you can determine:
  - **How do we provide service to the activity?**
    - Design services that give customers the **perception**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

# Scheduling with customer needs

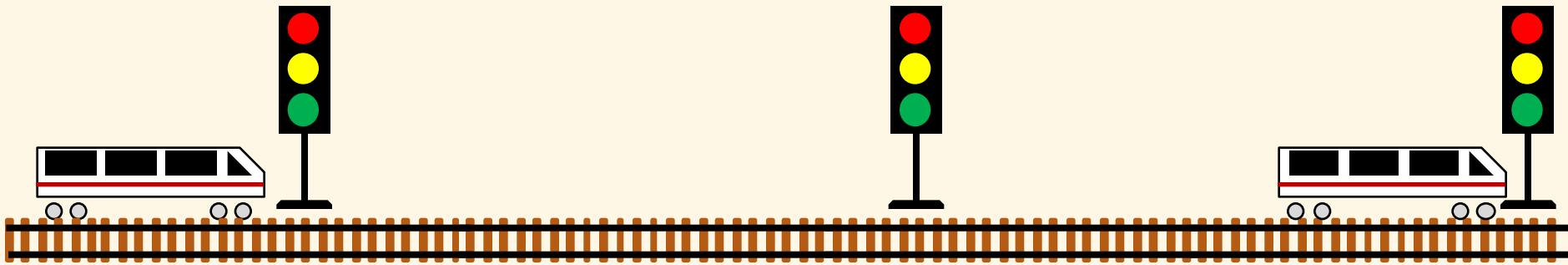
- Defining functional service:
  - **Service structure → user's cognitive map**
    - Repeating service patterns
    - Similar activities served similarly
    - E.g., Taktfahrplan, frequent bus networks
  - **Service intentions → scheduler**
    - Describe customer needs (e.g., availabilities) in railway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

# Banedanmark TMS

**Schedule based on  
customer benefits**



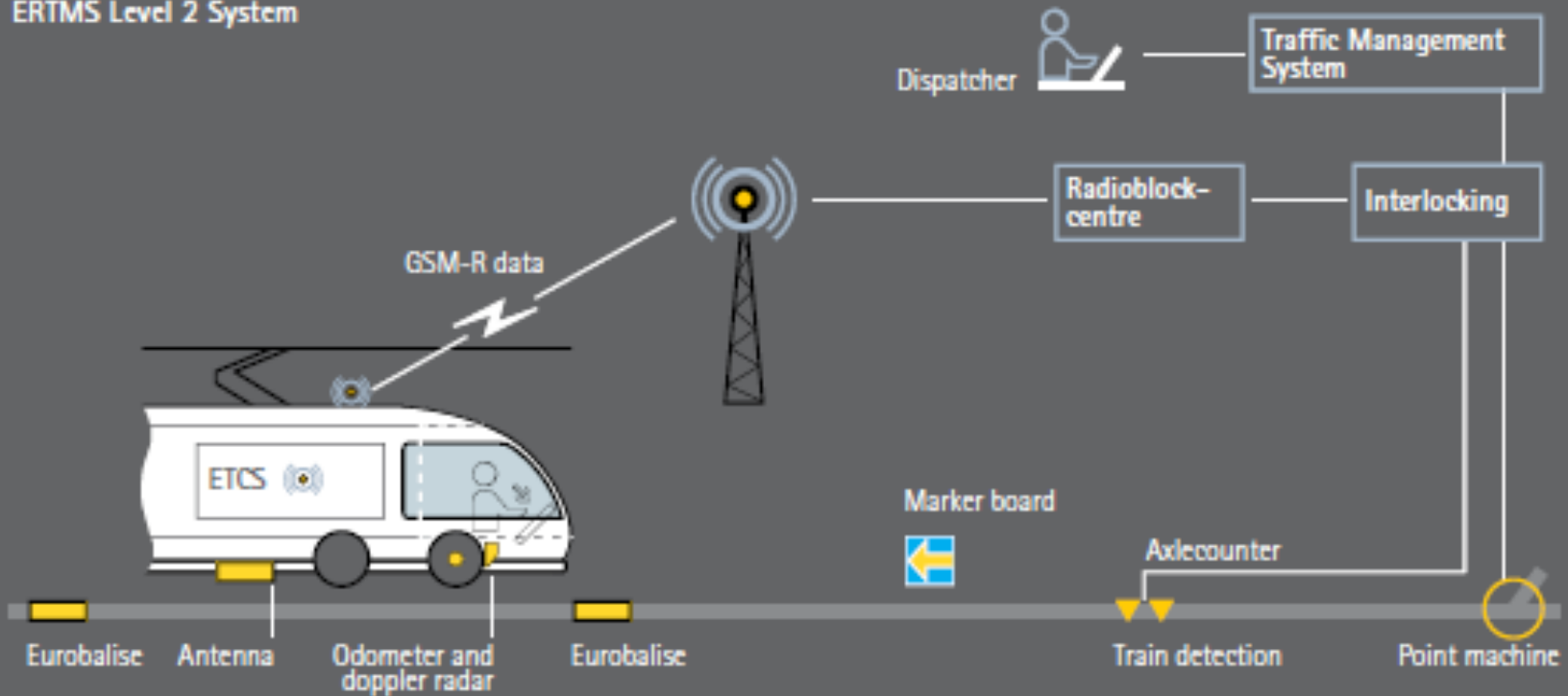
# Problem 2



**Railway capacity inefficiently used**  
because timetables are based on old  
fashioned data and control systems

# New technology for data and control

Fjernbanen  
ERTMS Level 2 System

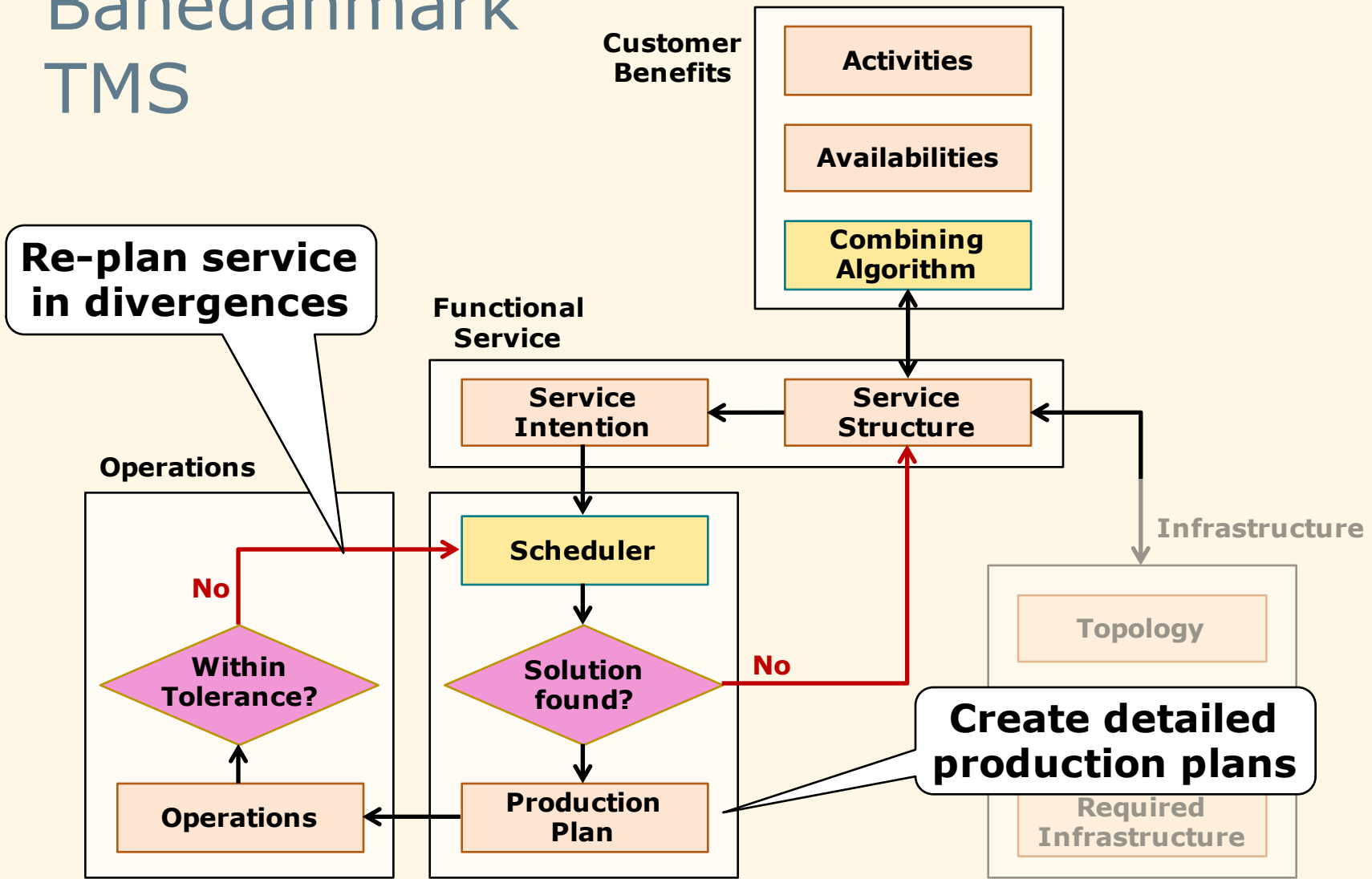




# Operating based on precise control

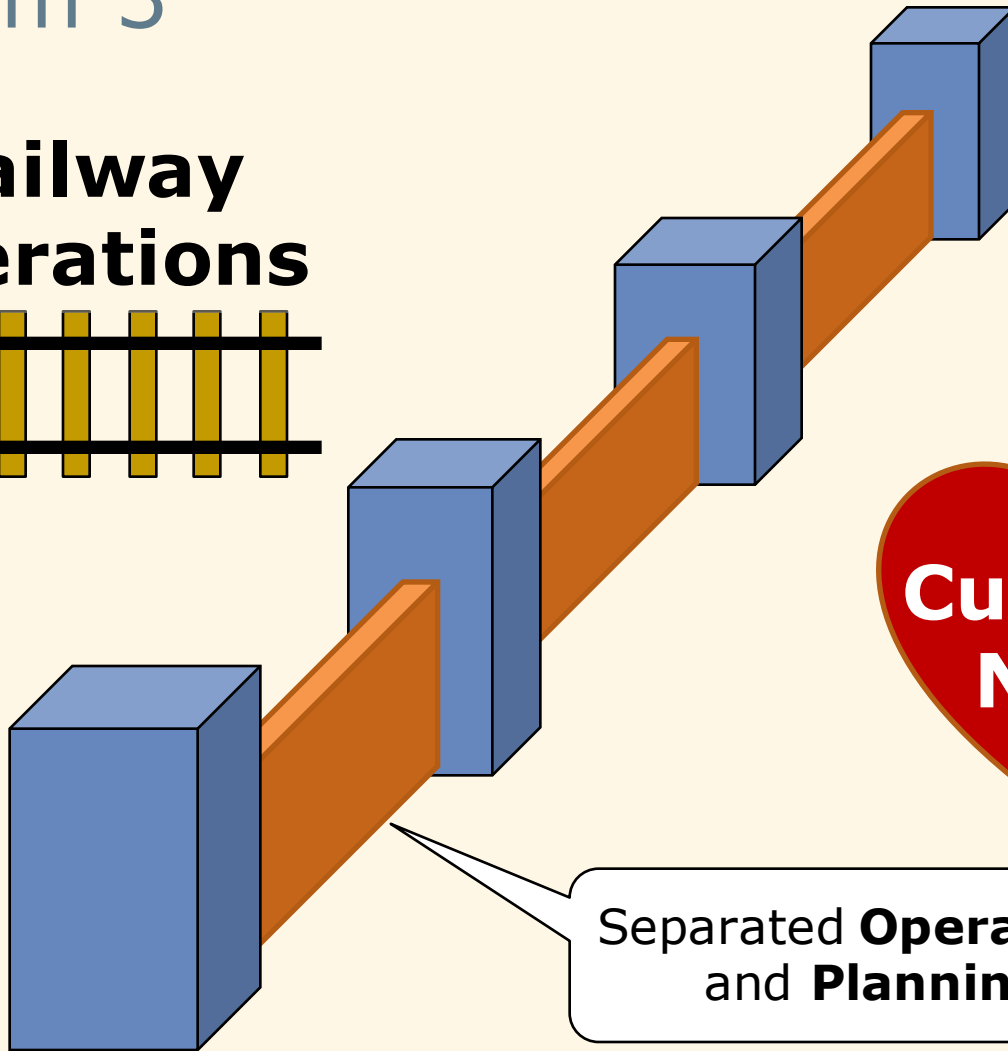
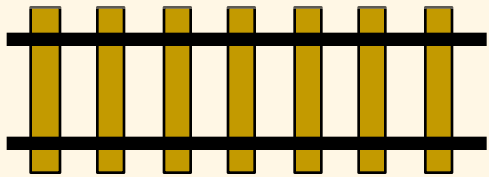
- **Production plans** describe how the railway provides quality service to its customers.
  - **Tasks**
    - Precisely describe all activities
    - Are assigned to specific staff and resources
    - Have tolerance bands for performance
    - Are monitored in real time

# Banedanmark TMS



# Problem 3

## Railway Operations

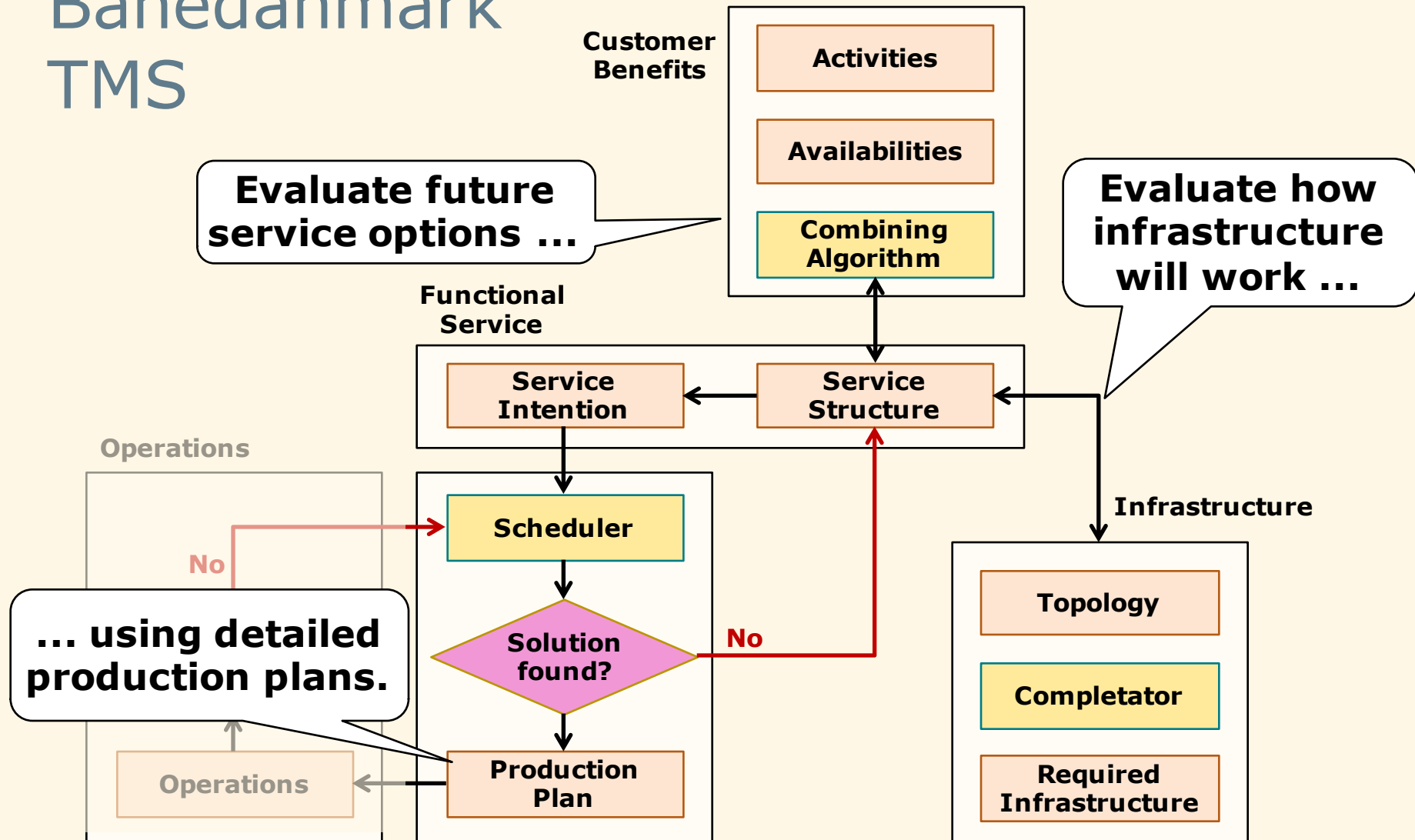


**Customer Needs**

# 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?

# Banedanmark TMS

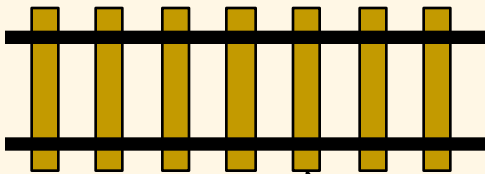


# What is Banedanmark's TMS?

*An advanced  
traffic management system  
to **precisely**  
**plan and provide** railway  
service **for customers.***

# Banedanmark's TMS

**Increases  
Railway Capacity**



***Precisely  
manages railway  
operations.***

***systematically  
considers  
customer needs.***

# Questions?