Internet of Trains

Nederlandse Spoorwegen (Dutch Railways)

How TIBCO products help to fulfil our strategy

Wim Liet and Hans Tönissen
June 7, 2017, Berlin
Topics and Presenters

1. Dutch Railways: Facts and Figures
2. Goals 2019
3. Customer Experience
4. What we want

5. Use Cases
6. Architecture
7. TIBCO
8. Focus, Vision, Fun
Dutch Railways: Facts & Figures

1.2 million travelers a day,
5200 rides each day

17 billion km / year
410.000 x around the earth

9 million customers travel with NS each year

Amsterdam Central: 165.000 travelers a day

6.830 km tracks ‘from Utrecht to Tibet’,
3000 carriages,
800 trainsets

3.430 train drivers
2.950 conductors,
1500 service employees at train stations

Benefits (yearly):
4.97 billion euro
Profits (yearly):
118 million euro

Busiest Railtracks in EU
1. Netherlands,
2. Austria,
3. Italy
“IT on Trains” and the Strategic Goals of Dutch Railways

Contribution Projects IT on Trains

- Social Value
  - Goals NS 2019
    - Passenger-growth CPB + 1,5%
  - Financial benefits RoE 5,5%
- Organisation

Other Projects in Relation with IT on Trains

General Customer Satisfaction

- Control
  - # Train seats 19%
  - Punctuality 9%
  - Travel information 4%
- Appreciation
  - Hospitality 9%
  - Contacts 9%
  - Cleanness 4%
- Freedom
  - Stations 18%
  - Activities 13%
  - Easy Travel 10%

Customer Satisfaction (80%)

Passenger-growth CPB + 1,5%

Financial benefits RoE 5,5%

Customer Satisfaction = Contribution Projects IT on Trains

# Train seats 19%
Hospitality 9%
Stations 18%

9% Contacts
13% Activities
4% Cleanness
18% Stations

2017 - BERLIN
Customer Journey Optimization

Three Opportunities to Maximize Customer Satisfaction

- Home
- Trainstation
- Train
- Trainstation
- Destination
Business Stakeholders – Early OBIS Adopters 2015

IT OPS
IT on Trains Office

Real-time Travel information

Wifi and Infotainment
An increasing number of business stakeholders with requirements
Multiple and increasing amount of trains and train types
We want a standardized Train IT infrastructure => OBIS on all our trains!
An Increase of More Than 100% in the Next Six Years

<table>
<thead>
<tr>
<th>Year</th>
<th>ICMm</th>
<th>VIRM</th>
<th>DDZ</th>
<th>FLIRT</th>
<th>SNG</th>
<th>ICNG</th>
<th>SLT</th>
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<td>363</td>
<td></td>
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<tr>
<td>2017</td>
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<tr>
<td>2018</td>
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<tr>
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<td>2020</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>79</td>
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</table>

Trains ‘Powered By’
Wayfinding Signs on the Intelligent Platform Bar
Example: Wayfinding Signs on the Intelligent Platform Bar
Example: Travel Information and Other Vontent on Screens
Example: Trainradar: All Trains in the Netherlands in Travel Planner
And 50 more ideas to support train staff and passengers using smart technology!!

Be prepared: only a one second view
Working Together

Train Builders

API supplier, App builder

Nomad Digital

Backend Systems

Third Parties

NS Techniek

robis 2.0
Use Cases

Architecture

TIBCO
UC “Position Information”: Use of Multiple Sensors

On Train

GPS10
CEP = 10 m

DGPS
CEP = 1 m

DGPS
Real Time Kinematic
CEP = 2 cm

On Track

Position from Mobile phone of Passengers

Enriched GPS: GPS (perpendicularly) on Track

Balise

ODO meter
UC “Position Information”: Calculate Position

Preference
- GPS10
- DGPS
- Enriched GPS
- ODO
- Balise Track

Premium Position Service

TIBCO NOW 2017 - BERLIN
### UC “Trip Phase”: Phase in Trip Related to Platforms on Stations

**Trip**
- Number 5011
- June 7, 2017
- 11.20

<table>
<thead>
<tr>
<th>Trip Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>3</td>
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<tr>
<td>4</td>
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<tr>
<td>5</td>
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<tr>
<td>6</td>
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<tr>
<td>11</td>
</tr>
</tbody>
</table>

![Diagram of trip phases](image)
## UC “Trip Phase”: Needed for Showing Travel Information in Train

<table>
<thead>
<tr>
<th>Trip Phase</th>
<th>Show on Screens</th>
<th>Next Station(s)</th>
<th>End Station</th>
<th>Disturbances</th>
<th>Changing Platforms</th>
<th>Delays</th>
<th>Service Message</th>
<th>Content (movie)</th>
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</thead>
<tbody>
<tr>
<td>1 Train Approaching Platform (Begin Station)</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>3 Underway</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
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<tr>
<td>4 Train Approaching Platform</td>
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<td>2</td>
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<td></td>
</tr>
<tr>
<td>5 Train at Platform</td>
<td></td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>6 Train Leaving Platform</td>
<td></td>
<td>1</td>
<td>2</td>
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<tr>
<td>11 Train Leaving Platform (End Station)</td>
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<td>1</td>
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</tr>
</tbody>
</table>

### Scheduling and Prioritizing (by Content Management System)
UC “Trip Phase”: Calculate Trip Phase

Data from Sensors
- Premium Position
- Speed
- Rolling Stock Composition
- Doors Open/ Closed

Data from Back End
- Trips
- Geo Info Stations and Platforms

Trip Phase

<table>
<thead>
<tr>
<th>Trip Phase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Train Approaching Platform (Begin Station)</td>
</tr>
<tr>
<td>3</td>
<td>Underway</td>
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<tr>
<td>4</td>
<td>Train Approaching Platform</td>
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<tr>
<td>5</td>
<td>Train at Platform</td>
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<tr>
<td>6</td>
<td>Train Leaving Platform</td>
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<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>11</td>
<td>Train Leaving Platform (End Station)</td>
</tr>
</tbody>
</table>
Generic Platforms On Board and On Shore

Virtual Train = Real Time Software Model of all Trains (Fleet)
Architecture of Train/ Rolling Stock

OBIS Platform (on Board)

Train Portal

Content Management

Intelligent Train

Configuration Management

CCTV, …

Train Service Bus

Train Communication Service

Virtual Train

NOC

Train Radar

API MGT

Fleet Platform (on Shore)

Integration platform

Backend

Back End

Back End

Back End

Third Party

Business Intelligence

Sensor Bus Shore

APN

Configuration Management

Shore Communication Service

Train Communication Service

Shore

Configuration Management

CCTV, …

APN

Internet
Underlying Technology: (Complex) Event Processing

(Complex) Event Processing
TIBCO in Architecture of Train/Rolling Stock

- OBIS Platform (on Board)
  - Train Portal
  - Content Management
  - Intelligent Train
    - TIBCO ActiveSpaces
    - TIBCO BusinessEvents
    - TIBCO BusinessWorks
    - TIBCO EMS
- CCTV, ...

- Fleet Platform (on Shore)
  - Virtual Train
    - TIBCO ActiveSpaces
    - TIBCO BusinessEvents
    - TIBCO BusinessWorks
    - TIBCO EMS
    - TIBCO Enterprise Runtime for R
    - TIBCO Live Datamart
    - TIBCO LiveView
    - TIBCO Spotfire
    - TIBCO StreamBase

- Train Service Bus
- Customer Device
- NS Personal Device
- Train Devices
- Some intelligence

- API MGT
- Train Radar
- Integration platform
- Backend
- Back End
- Third Party

- Internet
- APN
- Sensor Bus Shore
Future Thoughts: Also Use of Other TIBCO products

Future

• TIBCO ActiveSpaces
• TIBCO BusinessEvents
• TIBCO BusinessWorks
• TIBCO EMS
• TIBCO Enterprise Runtime for R
• TIBCO Live Datamart
• TIBCO LiveView
• TIBCO Spotfire
• TIBCO StreamBase

Now

• TIBCO ActiveSpaces
• TIBCO BusinessEvents
• TIBCO BusinessWorks
• TIBCO EMS
• TIBCO Enterprise Runtime for R
• TIBCO Live Datamart
• TIBCO LiveView
• TIBCO Spotfire
• TIBCO StreamBase
Focus, Vision, Fun

The only Dutch Railways IT program with its own beer…