Case study ProRail: understanding the drivers of Railway (in)efficiency

Jan Swier, ProRail
Who is Jan Swier?

- Jan Swier, 63 years
- Married and five children
- Civil Engineer
- Expert in asset management
- Career:
  - bridge engineering
  - maintenance contractor
  - staff manager
  - advisor
Theme of the presentation

- Separation Transport-Track
- Costs & Earnings Transport
- Cost drivers Infra
- (In)efficiency drivers
Railways in the Netherlands

Together with Switzerland we have the most densely used network in Europe

- Line: 3063 km
- Track: 7033 km
- Stations: 404
- Punctuality: 94% (<5’)
- Passengers: 1,1 mio/day
- Freight: (net ton): 0,1 mio/day

Value rail infra: €32,000 mio
M&R costs infra: €1,200 mio/yr
Earnings Transport: €2,500 mio/yr
Rail Transport Costs & Revenues increased fast because of changing conditions and circumstances.
The institutional triangle was born as a consequence of increasing government involvement.
Full vertical separation created a clear division of roles, money flows and responsibilities.

A subsidy is “Commercial Poison”

“Who pays decides”

One infra Manager
Means of production
Subsidy
Costs
Infra Performance & LCC
(Very) Long Term focus

Multiple TOC’s (>15)
Product
Revenues
Profit
Transport profitability
Short/Medium Term focus

Euro’s (€) in millions

€1000
€130
€270
€2500
Quality & Utilization improved after separation

Increase utilization

Increase punctuality (<3’)

Full vertical separation created positive optimization circumstances:
- three views)* and contributions on one common goal: improving customer satisfaction,
- an open debate about the best solution
- “Who pays decides”

* TOC’s: transport costs, revenues and profit
  Asset Manager: infra life cycle costs & performance
  Government: national transport policy & public interest
Separation had a “purifying” effect on rail asset financing and reporting; full transparency to the taxpayer

Depreciation …*based on construction value* ……*based on renewal value*

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Railway Business in Europe is complex because of multiple users and costs are higher as revenues and

Railway Business Model:
- Realization of 95 lines
- TOC-costs are modelled, based on known quantities and yearly costs
- Total infra-costs = Infra + Users Charge. Both are based on realization.
Social benefits are a part of the rail transport business

Social benefits:
- travel time savings by reducing traffic jams;
- less accidents;
- (possible) less air pollution;
- (possible) less landscape damage;
- (possible) lower production costs;
- (possible) economic stimulus.

Rail Transport in the Netherlands is abundantly profitable because of high utilization/earnings and considerable social benefits.
Business (in)efficiency can be measured as the ratio \[ \frac{\text{Earnings} (= \text{Performance})}{\text{Costs}} \]

Efficient = effective = business like = competent = economical

**Railways**

**Train Operation**
\[
\frac{\text{Earnings} + \text{PSO Subsidy}}{\text{Costs}}^* + \text{Access Charge} = 1,08
\]

Efficiency Train Operation

Euro’s (€) in millions

\[
\frac{\text{€2400 + €200}}{\text{€2100 + €300}} = 1,08
\]

**Rail Infrastructure**
\[
\frac{\text{Subsidy} + \text{Access Charge}}{\text{Costs}}^{**} + \text{Back log}^{***} = 0,98
\]

Efficiency Rail Infrastructure

Euro’s (€) in millions

\[
\frac{\text{€1000 + €300}}{\text{€1300 + €50}} = 0,98
\]

* Only Train Operation not real estate and stations

PSO = Public Service Obligation

** Traffic Control, M&R & Capacity Mngt

*** Back log = % main track with speed restriction * M&R-costs Infra

**Example**

**Train Operators**

\[
\frac{(\text{€2400} + \text{€300})}{(\text{€3400} + \text{€300})} = 0,72
\]

Efficiency Railways

**Government**

\[
\frac{\text{€1200}}{\text{€52}} = 0,32
\]

Public Service Value

= 1,04
Drivers behind (in)efficiency are understood by analyzing differences & analogous between companies.

2-4 trains/day
1 track
>5000 ton/train
>2000 m/train

>200 trains/day
2 tracks+
70-1000 ton/train
40-600 m/train

**Rail infrastructure costs**

<table>
<thead>
<tr>
<th>Countries / companies</th>
<th>Cost index/km</th>
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<td>USA, company X</td>
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<td>The Netherlands</td>
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<tr>
<td>Japan, company U</td>
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<td>Hong Kong, company O</td>
<td>320</td>
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TOC-costs per line differ substantial because of differences in train length, -type and -intensity

**Regional**
- Intensity: 1 or 2 trains/hr/direction
- Trains: Short, simple
- Demand: Low / Medium
- Distance: Short / Medium
- Personnel: Train driver
- Speed: 100 km/hr

**Intercity**
- Intensity: Depending need
- Trains: Long, simple
- Demand: Medium / High
- Distance: Medium / Long
- Personnel: Train driver + conductor(s)
- Speed: 140 km/hr

**Freight**
- Intensity: Depending need
- Trains: Long, simple
- Demand: High load per train
- Distance: Long
- Personnel: Train driver
- Speed: 100 km/hr
Infra costs per line differ substantial because of differences in utilization and complexity

Regional line
- Single track
- Simple layout
- Simple signaling
- No catenary
- 100 km/hr
- 17-20 ton axle load

Intercity main line
- Double (or more) track
- More complex layout
- Double/single track signaling
- Catenary
- 140-200 km/hr
- 22.5 ton axle load

Yards
- Complex layout: many switches
- Complex signaling
- Complex catenary
- Complex traffic control
- Complex surrounding
- Low(er) speed

+- € 200,000 /km line
+- € 500,000 /km line
> € 1,000,000 /km line
Modelling maintenance cost drivers revealed the impact of the conditions

Maintenance cost model:
- Prediction of M-costs for projects, tenders, etc.
- Applicable for networks, lines, contract area's
- High reliability ($R^2=0.9$)
- Also applicable to understand cost differences between countries/continents
The big infra-cost gap between US-Netherlands are because of **difference in usage & complexity**

- No catenary
- 60% less switches
- 80% less signals
- 90% more day work
- 7/5 more effective working hours
- Higher utilization in the US
- Scale advantages (estimated)
- Cargo related specs (estimated)
- Operational excellence (estimated)

**LCC rail infrastructure NL**
- Complex marshalling yards
- More diesel refuel installations
- No catenary
- 60% less switches
- 80% less signals
- 90% more day work
- 7/5 more effective working hours
- Higher utilization in the US
- Scale advantages (estimated)
- Cargo related specs (estimated)
- Operational excellence (estimated)

**LCC rail infrastructure US**
- More (complex) marshalling yards
- More diesel refuel installations
- More day work (90% versus 65%)
- More effective working time (7/5)
- Higher utilization in the US
- Scale advantages (estimated)
- Cargo related specs (estimated)
- Operational excellence (estimated)
Maximizing asset efficiency depends on the skills and quality of the organization to manage all risks.

"The mechanism behind Asset Management"
Performance improved after separation because of focus on clients, continuous improvement and co-operation

Example: Performance Analysis Bureau: (at ProRail Traffic Control):
- independent knowledge center for the whole branch
- provides all kind of train process info
- feedback loop plan-realization train process
- practical train process knowledge
- development and improvement info systems

Kind of improvements in the branch:
1. minute/seconds in timetable per train series
2. track use per station
3. optimized maintenance schedules
4. decrease of red signal approaches
5. de-complex infrastructure, less switches/signals, less failures, increased speed
6. maintenance change: less train failures
7. Improved stop-&-go linking per station
8. Improve start-punctuality per station
9. Improved depart procedure trains
10. ......................

TC = traffic Control
The cost-performance ratio improves when the whole system is de-complicated.

Performance* increases and costs go down when the system is de-complicated.

* Capacity, Functionality and RAMSHE-quality
Conclusions

1. Railways in Europe can’t exist without government financing.
2. Full vertical separation created beneficial circumstances as a result of well separated roles, money flows and responsibilities
3. Full separation created positive optimization circumstances:
   - TOC’s: transport costs, revenues and profit
   - Asset Manager: infra life cycle costs & performance)*
   - Government: national transport policy & public interest
4. Role fulfillment of the government and co-operation are decisive
5. Earning/cost-ratios are high level indicators for efficiency
6. Usage and complexity are the main rail infrastructure cost drivers
7. Risk management is key to optimize infra costs & performance)*
8. Skills, conditions, circumstances and price determine (in)efficiency.

*) Infra performance = Capacity, Functionality and RAMSHE-quality
Our ambition:
the best infra manager in Europe
and leading in the World