Performance Analysis of Railway Infrastructure and Operations

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Content

- Impact Assessment of EC 2013 on efficiency of separated/integrated RU
- Key Performance Indicators
- Database
- Selected medium size railway networks
- Main findings
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Recent EC Impact Assessment study

Empirical evidence shows that there is a correlation between the level of separation and the intensity of infrastructure use (p. 46).
Key performance indicators (KPI)

Network characteristics
- Network length (km)
- High-speed network length (km)
- Track length (km)
- Number of (high-speed) stations
- Number of switches
- Number of (block) signals
- Number of interlockings
- Number of traffic control centres

A. Transport and traffic/a
- Number of passenger trips/inhab.
- Number of passenger-km/inhab.
- Mean travel distance
- Amount of freight [tonne, TEU]
- Gross train weight [tonne]
- Number of passenger train-km
- Number of freight train-km
- Number of gross tonne-km

⇒ in public reports mostly not available
Key performance indicators (KPI)

B. Productivity
- Passengers/station
- Passengers/train
- Passenger-km/employee (IM+TOC)
- Passenger train-km/route-km
- Freight load/train
- Freight train-km/route-km
- Total passenger + freight train-km/route-km
- Total passenger + freight train-km/employee (IM+TOC)

C. Efficiency
Infrastructure management (IM)
- Total costs IM/route-km
- Maintenance costs IM/track-km
- Maintenance costs IM/train-km
- Operations (traffic control) costs IM/train-km
- Track charge revenues/train-km
- Operating ratio IM

Train operation
- Operating (and maintenance) costs TOC/train-km
- Operating ratio TOC
Performance analysis of medium-size European railway networks

Selection criteria
- size 2,000 to 20,000 route km
- different organisation models (integrated, holding, separated IM+TOC)

⇒ Limitation: only 2009 data of incumbent train operators; data of private regional and freight train operators not available

Selected countries/ networks
- Austria (ÖBB) Belgium (SNCB, Infrabel)
- Czech Republik
- Denmark (Banedanmark, DSB)
- Italy (RFF, RFI)
- Netherlands (ProRail, NS)
- Norway (JBV, NSB)
- Poland (PKP)
- Slovac Republic
- Sweden (Trafikverket, SJ)
- Switzerland (SBB)
Network characteristics of selected medium size European railway networks

**Network Length (km) per 1000 inhabitants [2009]**

- Austria: 0.63
- Belgium: 0.33
- Czech Republic: 0.91
- Denmark: 0.39
- Italy: 0.28
- Norway: 0.18
- Poland: 0.86
- Slovak Republic: 0.67
- Sweden: 1.07
- Switzerland: 0.41

**Passengers transported per inhabitant per year [2009]**

- Austria: 24.6
- Belgium: 15.6
- Czech Republic: 35.2
- Denmark: 19.5
- Italy: 10.5
- Norway: 5.5
- Poland: 8.4
- Slovak Republic: 3.9
- Sweden: 41.7
- Switzerland: 51.0
Transport volume per station and train of selected medium size networks

**Passengers per station (1000) [2009]**

- NL: 870
- BE: 400
- SBB: 429
- SE: N/A
- DK: 515
- JR East: 3571

**Passengers per train (Pkm/Train-km Pax) [2009]**

- Austria - OeBB: 102.9
- Belgium - NMBS: 136.2
- Czech Republic - CD: 51.6
- Denmark - DSB: 103.5
- Italy - FS: 163.8
- Netherlands - NS: 144.8
- Norway - NSB: 95.3
- Poland - PKP: 135.6
- Slovak Republic - SJ: 70.9
- Sweden - SJ: 139.1
- Switzerland - SBB: 120.8
Density of passenger transport and train traffic on selected European networks

<table>
<thead>
<tr>
<th>Country</th>
<th>Passenger-km per Network-km (million) [2009]</th>
<th>Train-km per Network-km (thousands) [2009]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria - ÖBB</td>
<td>1.19</td>
<td>16.67</td>
</tr>
<tr>
<td>Belgium - NMBS</td>
<td>2.92</td>
<td>18.54</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>0.71</td>
<td>N/A</td>
</tr>
<tr>
<td>Denmark</td>
<td>2.87</td>
<td>16.75</td>
</tr>
<tr>
<td>Italy - FS</td>
<td>2.77</td>
<td>39.05</td>
</tr>
<tr>
<td>Netherlands - NS</td>
<td>0.80</td>
<td>N/A</td>
</tr>
<tr>
<td>Norway - NSB</td>
<td>0.61</td>
<td>6.83</td>
</tr>
<tr>
<td>Poland - PKP</td>
<td>0.71</td>
<td>N/A</td>
</tr>
<tr>
<td>Slovak Republic</td>
<td>0.63</td>
<td>N/A</td>
</tr>
<tr>
<td>Sweden - SJ</td>
<td>5.20</td>
<td>42.67</td>
</tr>
<tr>
<td>Switzerland - SBB</td>
<td>0.00</td>
<td>9.69</td>
</tr>
</tbody>
</table>

Note: N/A indicates data not available.
Operating expenditure incumbent passenger train operator of selected European networks

<table>
<thead>
<tr>
<th>Country</th>
<th>Operating Expenditure TOC P per Network-km (million Euro) [2009]</th>
<th>Operating Expenditure TOC P per Train-km P (Euro) [2009]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria - OeBB</td>
<td>0.39</td>
<td>21.2</td>
</tr>
<tr>
<td>Belgium - NMBS</td>
<td>0.71</td>
<td>33.0</td>
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<tr>
<td>Czech Republic</td>
<td>0.17</td>
<td>13.0</td>
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<tr>
<td>Denmark - DSB</td>
<td>0.64</td>
<td>23.9</td>
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<tr>
<td>Italy - FS</td>
<td>0.56</td>
<td>34.6</td>
</tr>
<tr>
<td>Netherlands - NS</td>
<td>0.91</td>
<td>17.7</td>
</tr>
<tr>
<td>Norway - NSB</td>
<td>N/A</td>
<td>9.9</td>
</tr>
<tr>
<td>Poland - PKP</td>
<td>0.09</td>
<td>15.2</td>
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<tr>
<td>Slovak Republic</td>
<td>0.08</td>
<td>18.8</td>
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<tr>
<td>Sweden - SJ</td>
<td>0.00</td>
<td>0.0</td>
</tr>
<tr>
<td>Switzerland - SBB</td>
<td>0.80</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Regression analysis of passenger transport and traffic density

\[ y = 1.4905x \]
\[ R^2 = 0.2711 \]

\[ y = 0.1363x \]
\[ R^2 = 0.8604 \]

\[ y = 0.0274x \]
\[ R^2 = 0.8368 \]

- Correlation insignificant!
- Strong correlation!
Operating expenditure of incumbent train operator and infrastructure manager

Operating expenditure incumbent operator per passenger-km TOC (Euro) [2009]

Operating Expenditure IM per Track kilometer (Million Euro) [2009]
Ticket sale revenues of incumbent passenger train operator of selected networks

Ticket Sale Revenues (€) per Passenger-km Passenger Train Company [2009]

Ticket Sale Revenues (€) per Train-km Passenger Train Company [2009]
Mean track charge revenues and operating ratio of incumbent passenger train operators in selected networks.
Transport and traffic density of integrated vs. separated railway undertakings

Railway passenger transport density

Train traffic density

⇒No correlation with organisational model!
Conclusions

- Analysis limited to data of incumbent train operators and infrastructure managers in 2009; data from non-incumbent private passenger and freight train operators often missing
- Dutch railway network generated 2009 highest passenger volume and passenger-km resp. per station and per route-km in Europe
- SBB operated 2009 top passenger train-km per network-km
- Estimated mean operating costs per passenger train-km of NS in 2009 were lowest and operating ratio highest in Europe
- There exists not any correlation between performance, market share and the organisational structure of the railway European countries; higher network performance is related to economies of density
- Performance analyses should cover periods of 5 to 10 years