Report on National Differences influencing the Determination of Capacity Bottlenecks

Chapters 1 - 3

Rail Freight Corridor Rhine – Alpine

Working Group Infrastructure and Terminals

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1. Purpose and Methodology of the Analysis

According to Reg (EU) 913/2010 Art. 11(c), the Rail Freight Corridors are obliged to prepare a "plan for the management of the capacity of freight trains which may run on the freight corridor", including the removal of the identified bottlenecks. RFC Rhine-Alpine decided in 2012 to create a Capacity Bottleneck Analysis which should determine the bottlenecks along the corridor based on one common valuation method. Unfortunately, as national calculation methods for capacity, definitions for bottlenecks and approaches to traffic forecasts differ widely, the report could not be compiled as it was aimed for. Since the publication of the last report, the working group Infrastructure and Terminals (WG I&T) of RFC Rhine-Alpine has tested different approaches to bring the national data together into one file and presented the new report to the Management Board of the RFC Rhine-Alpine in November 2019. As it was agreed that the report based on the common valuation method did not lead to added value, the Management Board decided to have the WG I&T compile a summary of the individual bottleneck analyses of the involved IMs (ProRail, Infrabel, DB Netz, SBB-I, BLS Netz, RFI) instead of applying a common evaluation method.

Building on the described situation, this analysis examines the different national approaches towards capacity calculation and traffic forecast which lead to the determination of capacity bottlenecks on the respective networks. The aim is to show the big differences in the national approaches which make a common corridor valuation method useless and impossible. This analysis shall be shared with the Executive Board, to explain the change of CBA approach and to increase the understanding of challenges for European infrastructure planning in the light of national processes. Chapter 1-3 shall also be shared with the EU Commission, RAG and TAG.

For this status quo compilation, experts in the fields of capacity and infrastructure development at the IMs provided their knowledge in the frame of a questionnaire with pre-defined open questions. This method ensured the comparability of the collected data and gave the experts the freedom to share their experiences. In some cases, also phone interviews were conducted.

2. Executive Summary

The comparison of national differences in determining capacity bottlenecks shows, that approaches towards capacity calculation and forecasts at the examined IMs differ widely. Therefore, analysing capacity bottlenecks by using a common valuation method is not feasible.

When looking at the various calculation bases for the definition of (potential) bottlenecks, one sees at first glance that **ProRail's and DB Netz's** approaches are very different from those of **Infrabel, SBB-I/BLS Netz and RFI**. At that, **ProRail** takes a separate look at dedicated freight nodes, shunting yards (SYs) and switches on the one hand and all lines including Havenspoorlijn and Betuweroute A15 on the other hand. Bottlenecks are determined with the use of overloaded hours (dedicated freight nodes, SYs and switches) and basic hour patterns (all lines). This method is not used by any other IM. **DB Netz** defines bottlenecks for lines where demand exceeds supply, presented as "congested railway lines" (ÜLS) and potential bottlenecks for lines documented as "future congested railway lines" (ZÜLS). The ÜLS are published as annexes to the DB Netz Network Statement. For these lines, DB Netz AG carries out capacity analyses and elaborates plans for enhancing the line capacity. When comparing the calculation bases and methods at **Infrabel, SBB-I/BLS Netz and RFI**, it seems that the approaches are rather equal. However, the calculations for "remaining capacity" (Infrabel), "theoretical capacity use" (SBB-I/BLS Netz) and "commercial capacity" (RFI), show large differences (also see section 4.3).

Moreover, the percentage value defining a (potential) capacity bottleneck is different among those IMs. At that, it is important to state that the terms "potential bottleneck" and "bottleneck" do not exist at RFI. The Italian IM defines sections with limited capacity if the percentage of use of the commercial capacity on that line is between 60% and 80%. Furthermore, RFI shows sections with saturated capacity if the percentage of use of the commercial capacity exceeds 80% on the RFI network. To facilitate the comparability of the different approaches, the terms "potential bottleneck" (including RFI sections with limited capacity) and "bottleneck" (including RFI sections with saturated capacity) are used in this report.

Another component enhancing the differences among IMs regarding the determination of bottlenecks are disparities in calculating traffic forecasts. While traffic prognoses are derived e.g. in the **Netherlands** and **Switzerland** from socio-economic, economic and technical developments and then transferred in the expected number of train paths demanded at a certain time in the future, **RFI** e.g. uses the market demand (number of trains and their performance) of authorised applicants, complemented with specific application analysis studies as basis for the forecast. Also, some IMs conduct separate forecasts for freight and passenger traffic, while others do not. Further differences apply as not all IMs conduct a separate forecast for lines and nodes and time frames were chosen differently. **ProRail, Infrabel, DB Netz and RFI** make predictions for the year 2030 (ProRail: until 2040), while **Switzerland** has chosen its implementation plans to be realised until 2025 resp. 2035.

As already mentioned, calculation methods for capacity on lines and in nodes are the crucial factor when it comes to the comparability of defining capacity bottlenecks. In general, there is no common approach among any of the examined IMs. Also, capacity calculations in some cases include both lines and nodes and do (not) separately assess capacity for freight and passenger traffic.

For dedicated freight nodes, SYs and switches, **ProRail** investigates the number of cargo trains that can be handled in 48min (one hour with buffer) and looks at the infrastructure layout. The time consumption by cargo trains is calculated using realization data increased with the forecast value and further factors. For all lines, the demanded number of train paths/h (per train type) based on the forecast is constructed resulting in a basic hour pattern per line. If the feasibility check with a simulation model fails and possible adaption proposals are not acceptable, a bottleneck applies.

The available capacity at **Infrabel** is based on the rate of occupancy of the sections / nodes on the network.

The basis for the decision on a capacity bottleneck at **DB Netz** for existing lines is the document on "congested railway lines" (ÜLS), representing lines where demand exceeds supply. If a line is declared congested, the IM is obliged to develop a plan to increase the railway capacity including project plan and time period for the construction. Potential capacity bottlenecks are stated in the "future congested railway lines", identified with the use of railway management studies aiming to improve quality of lines with poor operational quality.

The decision on bottlenecks at **SBB Infrastruktur and BLS Netz** is based on the theoretical capacity use which is calculated by dividing the available number of tracks for freight trains and the number of forecasted freight trains per day. If demand exceeds the available tracks, infrastructure projects are planned.

For calculating bottlenecks on the Italian network, **RFI** determines the commercial capacity for each line, being the maximum number of paths that can be assigned with a transport plan consistent with the heterogeneity of demand in terms of commercial speed and with minimum distance (between subsequent trains).

As already described above, capacity calculation for nodes at **Infrabel and SBB-I/BLS Netz** is equally included in the evaluation of lines. **RFI** also calculates nodes and lines using the same method, however exceptions apply e.g. in cases of overlapping traffic on limited tracks in service facilities. In complex cases, forecast timetables are hypothesized and dynamic simulations are carried out to verify the capacity of the service facility. Further theoretical analyses are adapted individually in case of critical situations. **ProRail** calculates the available capacity for dedicated freight nodes, shunting yards and switches separately from lines, using overloaded hours for the assessment. **DB Netz** also determines capacity in nodes separately. Therefore, the German Federal Transport Infrastructure Plan (BVWP) investigates the available and future capacity and identifies bottlenecks in nodes on the basis of microscopic node examinations.

In the case of specific parameters in the networks such as track lengths for 740m long trains and 4m profile, approaches vary as well. IMs do commonly not calculate specific capacities for lines where the named parameters are already provided. For other lines, depending on the IM, further business cases are calculated (SBB-I/BLS Netz) or a catalogue with different availabilities per time slot calibrated on market needs and including Framework Agreements as well as forecasting studies (RFI) is prepared.

Finally, IMs decide, which projects to be realised to eliminate capacity bottlenecks based on various factors. **All IMs** state that a cost-benefit analysis resulting in a factor above 1 is the most important influencing factor. Besides that, **ProRail**, also considers international agreements, legal obligations, available budget and (local) government wishes with budget. **Infrabel** also considers the availability of funding. In **Switzerland**, the assessed projects using the mentioned economic and microeconomic analysis are proposed by the Cantons and IMs and selected by the BAV. In general, EU member states need to follow EU regulation in updating the network to reach the TEN-T standards.

3. Comparison of National Differences

		ProRail	Infrabel	DB Netz	SBB-I / BLS Netz	RFI
Definition of (potential) bottlenecks (4.1)	Calculation basis for the definition of (potential) bottleneck	<u>For dedicated freight nodes, shunting yards and switches:</u> number of overloaded hours <u>For all lines:</u> Basic Hour Pattern (BUP)	Rate of occupancy of the lines / nodes and the subsequent remaining capacity The remaining capacity results from the comparison of the theoretically available capacity and the expected used capacity.	Determination of capacity bottlenecks via the “overloaded railway”, which means that demand exceeds supply. Determination of potential capacity bottlenecks via the “future congested railway line”	Theoretical capacity use The theoretical capacity use is calculated by dividing the available number of tracks for freight trains and the number of forecasted freight trains per day.	Commercial capacity
	Evaluation criteria for the definition of (potential) bottleneck	<u>For dedicated freight nodes, SYs and switches:</u> number of overloaded hours • Potential bottleneck: 10-25 overloaded hours • Bottleneck: > 25 overloaded hours <u>For all lines:</u> BUP If no basic hour pattern with the desired number of trains is possible and no useful adaptions are feasible, a bottleneck applies.	<u>For lines</u> • Potential bottleneck: < 40% of remaining capacity • Bottleneck: < 25% of remaining capacity <u>For nodes</u> • Potential bottleneck: < 50% of remaining capacity • Bottleneck: < 40% of remaining capacity		• Potential bottleneck: >85% capacity use • Bottleneck: >95% capacity use	<u>Assessment on an hourly basis:</u> • Potential bottleneck[1]: >75% capacity use • Bottleneck[2]: >85% capacity use <u>Assessment on a daily basis:</u> • Potential bottleneck[3]: >60% capacity use • Bottleneck[4]: >80% capacity use

[1] Section with limited capacity
[2] Section with saturated capacity
[3] Section with limited capacity
[4] Section with saturated capacity

		ProRail	Infrabel	DB Netz	SBB-I / BLS Netz	RFI
Calculation of Traffic Forecast (4.2)	Principles of traffic forecasts	The initial Netherlands-wide forecast on the development in all sectors including transport is provided by the Central Planning Bureau and the Netherlands Environmental Assessment Agency. The development for cargo trains is presented in a matrix covering the various scenarios. With the NEMO model, the number of trains needed for the transport of the forecasted cargo is calculated. Several scenarios are available for the number of trains on the different routes for several years, e.g. assessment of % of 740 m trains, different routing to the border etc.	The development is forecasted based on the expected increase/decrease of freight and passenger traffic. The calculation is based on the current rate of occupancy which is increased/decreased according to the expected traffic development.	The forecasted traffic mix (freight and passenger traffic) is determined per line. DB Netz receives the forecast from the ministry (BMVI). The ministry (BMVI) uses a three-stage forecast process to generate Germany-wide source-destination matrices for freight and passenger traffic for the base year 2010 and the forecast horizon 2030. Also, traffic and travel performance of the individual modes of transport on lines are determined. Influencing factors for the modelling of freight transport demand on rail are a.o. transport distances, transport costs, transport times and reliability / unscheduled waiting times, wagon formation, train formation and capacity-dependent allocation.	An external consultant prepares the initial traffic forecast for freight demand (in tonnes) on an aggregated level (BIET and commodity groups). The forecast includes socioeconomic, economic and technological developments. Growth factors of the calculated forecast are used to extrapolate the number of waggons in Switzerland up to the relevant forecast year. The traffic model does not include capacities. The model is used to analyse bottlenecks and to define new infrastructure projects.	The forecast in the medium term (up to 10 years) is built on the market needs and the subsequent signature of Framework Agreements for capacity booking. The market demand (number of trains and their performance) of authorised applicants are complemented with specific application analysis studies conducted. The network capacity required to meet forecast demand is calculated basing on a TT scheme. The process is defined as follows: 1. Market demand 2. Transport plan 3. TT scheme 4. Required network capacity 5. Need for infrastructure interventions 6. Cost-benefit analysis

		ProRail	Infrabel	DB Netz	SBB-I / BLS Netz	RFI
Calculation of Traffic Forecast (4.2)	Separate forecasts for passenger and freight traffic available	Yes	Yes	No	Yes	Yes
	Separate forecasts for capacity on lines and in nodes available	No	No	Yes, the BVWP investigates the available or future capacity and identifies bottlenecks in nodes on the basis of microscopic node examinations.	No	No
	Current time frame for traffic forecasts	2030-2040	2030	2030 The next traffic forecast is currently planned from the ministry (BMVI) until 2035.	2025 and 2035	2030

		ProRail	Infrabel	DB Netz	SBB-I / BLS Netz	RFI
Calculation of Available Capacity (4.3)	Calculation method for determining the available capacity	Calculation of overloaded hour for dedicated freight nodes, SYs and switches: • Demand: Realization data for ± ½-1 year are increased with the forecasts + further factors • Available capacity: infra-layout, headway time calculation; Assessment if number of trains can be processed in 48 min at the railway yard → outcome: number of overloaded hours = cargo trains that can be handled in 48 min (80%) + infra-layout Calculation of basic hour pattern (BUP) for all lines (including Havenspoorlijn and Betuweroute A15): • Determination of demanded number of train paths/h (per train type) based on forecast • Construction of BUP	The Infrabel calculation method takes into account all trains (freight and passenger) on the different sections of the network, it makes a mix of all possible variations, determines for each variant the rate of occupancy and calculates the average rate of occupancy. A section is considered to be a bottleneck when the remaining capacity is < 25%.	Capacity bottlenecks: Determination via “overloaded railway”, representing lines where demand exceeds supply. A line is declared congested by the EBA and the Federal Network Agency. As a consequence, the IM is obliged to draw up a plan to increase the railway capacity. That plan includes how and by when the congestion of the line is eliminated. Potential capacity bottlenecks: Determination via the “future congested railway lines”. The “future congested railway lines” is identified with the use of railway management studies aiming to improve quality of lines with poor operational quality.	• Preparation of investment plans based on forecasts for passenger and freight traffic by the Swiss FOT • Determination of number of train paths required by passenger and freight (separately) • If demand > available tracks: planning of infrastructure projects to solve the bottlenecks. • Number of passenger and freight tracks per day on the Swiss rail network are planned yearly by the FOT The theoretical capacity use is calculated by dividing the available number of tracks for freight trains and the number of forecasted freight trains per day.	The commercial capacity (CC) is the maximum number of paths that can be assigned with a transport plan consistent with the heterogeneity of demand in terms of commercial speed and with minimum distance (between subsequent trains) equal to that prescribed in the technical specifications of the line. Thus, CC is dependent on the timetable. CC=theoretical capacity/coefficient K Theoretical capacity (TC) is the maximum number of paths that can be assigned in a certain time and at minimum acceptable distance between subsequent trains (TC= T/D).

		ProRail	Infrabel	DB Netz	SBB-I / BLS Netz	RFI
Calculation of Available Capacity (4.3)		• Check of feasibility with simulation model "Open Track" • ProRail adaption proposals if BUP is not feasible • Bottleneck applies, if adaption proposal is not acceptable → outcome: number of train paths in BUP	In the future, capacity bottlenecks are identified comparing forecasted capacity vs forecasted demand, taking into account the existing bottlenecks on the network.	A bottleneck analysis is created as part of the BVWP, from which plan cases and ultimately projects are derived.		The K coefficient summarizes the percentage of heterotachic and technical voids
	Separate calculation for passenger and freight traffic available	Yes	Yes	No	Yes	No
	Separate calculation for capacity on lines and in nodes available	Yes • All Lines = BUP • Nodes, shunting yards, or switches for freight trains = Overloaded hours	No, nodes are equally included in the assessment of the network.	Yes, the BVWP investigates the available or future capacity and identifies bottlenecks in nodes on the basis of microscopic node examinations.	No, nodes are equally included in the assessment of the network.	No, exception may apply. In cases of overlapping traffic on limited tracks in service facilities, an analysis similar to the one of the lines is conducted. In complex cases, forecast timetables are hypothesized and dynamic simulations carried out to verify the capacity of the service facility. Further theoretical analyses are adapted individually in case of critical situations.

		ProRail	Infrabel	DB Netz	SBB-I / BLS Netz	RFI
Capacity calculation and forecast for specific parameters (4.4)	Capacity Calculation and forecast for specific parameters	<u>740m trains:</u> For every train type ProRail has determined a feasible maximum train length. The number of tracks on shunting yards are calculated for every type of trains based on forecasts of each train type + scenarios with the growth of 740 m trains	<u>4m gauge:</u> The 4m profile is already available on all core sections in Belgium. <u>740m trains:</u> Those trains are allowed on the Infrabel part of RFC Rhine Alpine outside of peak hours (6:00 to 9:00 and 16:00 to 19:00). The capacity for these trains depends on the capacity planning for "average" freight trains, which again is calculated by taking also passenger trains into account.	The parameters 740 m - trains and profiles form the basis for the planning of transport projects in the Federal Transport Infrastructure Plan. In addition, there is a 740 m network project that includes around 75 projects nationwide.	<u>4m gauge / 740m trains:</u> 740m long trains and 4m-profile are standard parameter on the transit tracks via the Gotthard axis with beginning of the new timetable in December 2020. Via the Lötschberg axis all transit tracks are available with 740m and 4m-profile. On other sections where e.g. 740m and/or 4m are not standard parameters, the timetable department analyses the available capacity per day based on forecasted timetables. To analyse the number of tracks with specific parameter, forecasts will be prepared (calculation of business cases).	<u>4m gauge:</u> Once the infrastructure is adequate, all freight paths can be operated at 4m gauge. No separate capacity needs to be calculated. <u>740m trains:</u> Given the difficulty in adapting all stations of an entire line with 740 m tracks, a catalogue for freight with different availability per time slot is available, which will have to be calibrated on market needs, including Framework Agreements, and will take into account the demand forecasting studies. To realize a common forecast (defined value of goods on a specific border/specific scenario), IMs would jointly identify technological and infrastructural interventions to create a compatible level of capacity.

		ProRail	Infrabel	DB Netz	SBB-I / BLS Netz	RFI
Influencing factors on infrastructure projects to eliminate bottlenecks (4.5)	Influencing factors on infrastructure projects to eliminate bottlenecks	• Social cost-benefit analysis > 1 (most important factor) • International agreements • Legal obligations • Available budget • (Local) government wishes with budget	• Cost benefit analysis • Availability of funding • Priorisation according to TEN-T status of line: • Stretch on RFC Network and TEN-T core network: obligations for infrastructure development by 2030 (high priority) • Stretch on TEN-T comprehensive network: obligations by 2050 (lower priority) • Stretch does not lie on TEN-T network: reduced priority (lowest priority)	The economic perspective is most important for the decision on a project. The benefit / cost factor must be higher than 1.0.	Investment Plan: • Cantons and IMs prepare “wishes” for infrastructure projects • First selection; “remaining wishes” serve as raw data for the investment plan • Realisation of economic and microeconomic assessments for all potential measurements • Measurements with the best resulting cost-benefit-ratio are included in the investment plan. Leistungsvereinbarung: This contract is agreed on by the FOT and IMs for the next 4 years. It contains a smaller budget for smaller measurements. Those projects are assessed by an economic and a microeconomic assessment.	For any intervention of a certain importance, such as the removal of a bottleneck[5], an analysis of the alternatives is carried out. Quantitative methods shall find the best solution, also considering future transport demand scenarios. Organizational solutions, such as reorganisation of the offer to remove the bottleneck must be evaluated as a priority. The infrastructure parameter double track / single track is relevant for finding the best intervention solution. After the determination of project, the Ministry of Transport must be addressed to insert the intervention in the Investment Planning Contract.

[5] Section with saturated capacity