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A survey of railway market organization and regulation

In the last few decades, many railway markets (especially in Europe) have been restructured to allow competition between different operators. This survey studies how competition has been introduced and regulated in a number of different countries around the world. In particular, we focus on a central part of market regulation specific to railway markets, namely the capacity allocation process. Conflicting capacity requests from different train operators need to be regulated and resolved, and the efficiency and transparency of this process is crucial. Related to this issue are how access charges are constructed and applied. Several European countries have vertically separated their railway markets, separating infrastructure management from train services provisions, thus allowing several train operators to compete with different passengers and freight services. However, few countries have so far managed to create efficient and transparent processes for allocating capacity between competing train operators.

Keywords: railway markets; vertical separation; competition; capacity allocation; access charges

Introduction

Railway markets in many countries have undergone major changes and reforms in recent years. In particular, several European countries have reorganized their railway markets to allow competition between service provider, a development further stimulated by the railway directives from the European Commission (EC) (EC 2017). This has introduced new challenges for capacity allocation processes and systems for access charges. The purpose of this paper is to survey the current status of railway market regulation and organization in a number of countries, to allow for comparison and (to the extent possible) critical assessment. Our intention is to provide a basis for further discussions of the opportunities and challenges that these new market structures bring. There are few surveys attempting to review railway market (re-)organization worldwide, and even these quickly become outdated give the rapid changes and

reforms. A particular focus of our survey is the capacity allocation process, including access charges. This is a crucial mechanism for any competitive railway market, in particular when several operators compete for capacity on the same tracks, so-called open access railway markets.

- For each country, the survey is structured as follows:
- The background of the current structure – a brief history and how the new structure was introduced
- The type of operators allowed to use the railway system; e.g. public operators, monopolistic commercial operators, competing commercial operators etc.
- Resolution of conflicting capacity requests from different train operators
- Principles for calculating access charges

The survey focuses more on national railway markets than on local systems. Detailed methods for train timetable construction are out of our scope. Since most market reorganizations are very recent, or even ongoing, it is probably too early to assess and compare the performances of different allocation strategies or market regulation strategies. Ultimately, however, we hope that the survey will serve as input for such assessments; at this stage, we limit ourselves to qualitative comments about our perception of the transparency and efficiency of the capacity allocation processes.

Section 2 introduces some background information and terminology on railway systems and markets. Section 3 describes the market structure of a number of countries, using the structure explained above. The countries have been selected to give a reasonably broad and varied overview of different ways to organize railway markets. A summarizing discussion is given in Section 4, and Section 5 concludes. Appendices contain a glossary of terms and common abbreviations.

Background and Terminology

This section presents terminology used throughout the review. A railway system is as a complex supply chain consisting of several interconnected components. For our purposes, it is convenient to distinguish between railway services and infrastructure management. How these two roles are organised and how they interact is the core of any railway system (Yeung 2008). Railway services relate to the tasks of running trains according to specific operational constraints. The inflexibility of the railway infrastructure means for instance that the timetables need to specify the exact times and routes that each train takes. The quality of these services depends on many infrastructure management tasks such as capacity allocation, timetabling, platforming and monitoring the network. The infrastructure management comprises various components such as planning, construction and maintenance of infrastructure components such as signalling systems, electrification systems, switches, tunnels or bridges, train stations and terminals. Other systems such as safety and communication systems can also be included. These elements determine the performance and quality of any railway system (Makovsek, Benezech, and Perkins 2015).

Railway services

Railway services consist essentially of the operations related to running passenger or freight trains on a national or multinational railway network. These may also include operations such as ticketing and traffic information. The way these operations are assigned and performed plays an important role in shaping the structure and the efficiency of the railway market.

There are different categorizations, see Figure 1. The main distinction is between freight and passenger train services. Freight services consist of all the operations of shipping and transporting cargo and is generally between a production site

(e.g. mine, factory) and a warehouse or an intermodal terminal (e.g. port). These are of various types of haul such as bulk, intermodal containers and other special cargo. Passenger services can be categorized in different subservices that differ from one country to another depending on the speed of the trains, the distance travelled, the frequency or the subsidization of the service. There are different passenger services such as commuter, intercity, long distance and high-speed train services.

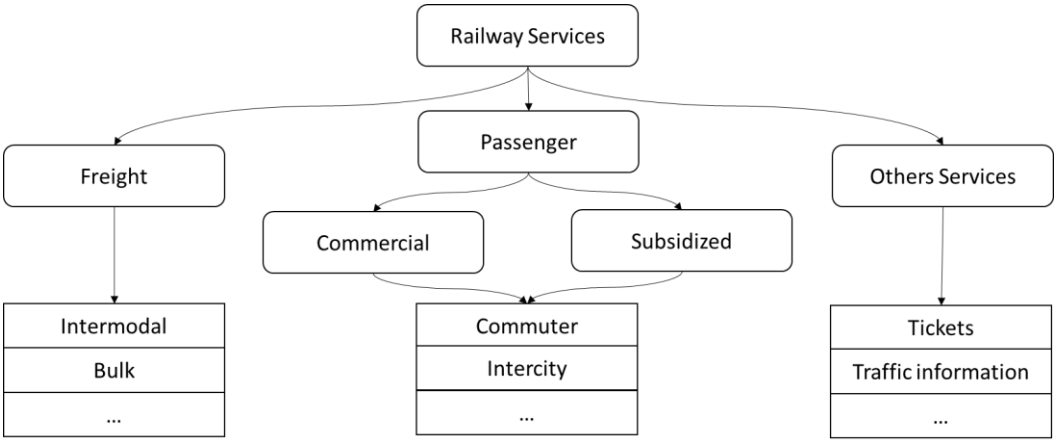

Figure 1 – Overview of the various types and examples of railway services.

Railway services are provided by railway operators (sometimes called railway undertakings; this is the term usually used in national network statements). Operators are usually either commercial companies (privately or publicly owned) or government agencies. The contracts for running trains can have different forms, such as public service obligations, concessions, franchises or open access.

It is important to distinguish between market-based passenger services, which are commercial and profit-driven, and non-market-based, which are under public control, usually subsidized and the aim is to generate some type of social benefit. There are no general rules as to which train services should be non-market-based, however. In Europe for instance, freight, intercity, long-distance, high-speed and international train services are generally operated by commercial railway operators working in a profit-

driven manner. Commuter and regional services are often under some degree of control by local or central authorities, and often subsidized.

Infrastructure management

Infrastructure management can differ slightly from one country to another depending on the market structure and laws. However, the management of the railway infrastructure generally includes the development, operation and maintenance of infrastructure and associated real property such as land and stations (EC 2013). An *infrastructure manager* (IM) is an entity responsible for this – often a state-owned company or a governmental agency. Figure 2 summarizes the different tasks usually falling on the IM.

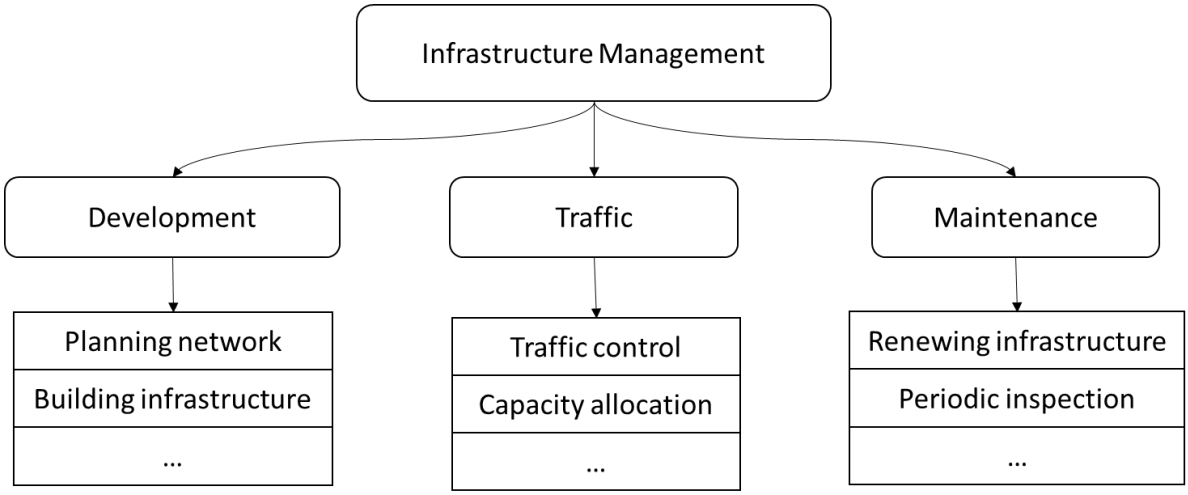

Figure 2 - Overview of the main aspects of infrastructure management with examples of different tasks.

The development of the railway infrastructure includes planning, financing and building railway infrastructures such as tracks, stations, associated buildings, network equipment and signalling systems. “Traffic” includes operations planning and control, including capacity allocation, determining and collection of access charges, and traffic management and control. Finally, the IM is also responsible for maintenance and renewal of railway infrastructure such as tracks, signalling systems, switches, etc.

Railway markets

Through the history of railways, there have been may ways of performing and combining the roles of the railway system, which have led to various organization and railway market models. It is often useful to characterize railway markets according to the extent of *vertical* and *horizontal separation*, respectively. The vertical dimension involves the relationship between infrastructure management and railway services. A typical example of a vertically separated railway market is when a government agency is responsible for railway infrastructure, while one or more companies are responsible for running the trains, including deciding about supply and pricing. However, there are many different ways to allocate tasks and responsibilities among stakeholders in a vertically separated market. The horizontal dimension concerns the relationship between different actors with similar roles or responsibilities, such as different infrastructure managers or different railway operators (Yeung 2008). In a horizontally separated market, there may for example be several railway operators providing competing or supplementary services, or several infrastructure managers with responsibilities for different parts of the network. An illustration of the different structures of railway markets is presented in Figure 3.

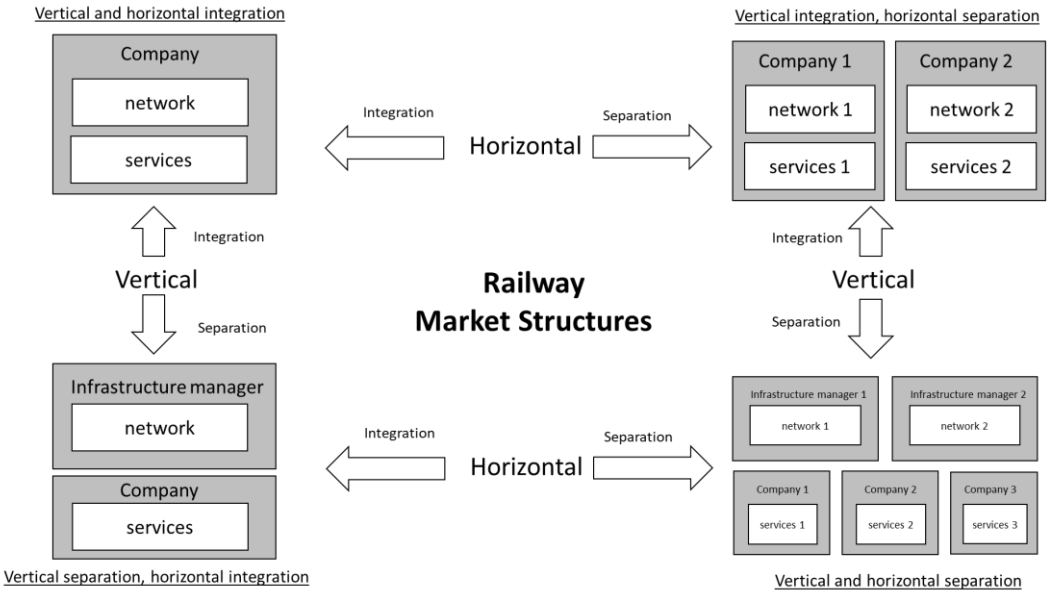

Figure 3 - Overview of the major railway market structures

The traditional railway market structure, and still the most common, is a completely vertically and horizontally integrated structure: a single actor, often a state-owned railway company, is responsible for the whole railway system in the country. This company plays at the same time the role of the infrastructure manager and the operator which has a monopoly of the entire railway market.

Another structure with a long history is one with several distinct railway networks or sub-markets, each of which is vertically integrated (i.e. the same company is responsible for both infrastructure management and providing train services) but which are horizontally separated from each other.

In a vertically separated market, infrastructure management is separated from providing railway services. Both infrastructure management and railway services, respectively, may then be horizontally separated. In Europe, an increasingly common structure is one with a single infrastructure manager but several railway operators providing competing or supplementary railway services. With this setup, infrastructure management is horizontally integrated while railway services are horizontally separated.

For the sake of simplicity, we assume in this that the horizontal dimension is mainly concerned with the infrastructure. This is motivated by the fact that most of the reviewed countries have a horizontally separated structure in terms of operations, we will therefore be interested in looking at the horizontal dimension in terms of infrastructure network which we simply refer to as the horizontal dimension.

In the 1980s, many countries worldwide started vertically separating their railway markets, separating infrastructure management from railway operations. An increasing important aim has been to open access for competing railway operators. This structure is also enforced by the European railway directives (EC 2016), which is intended to foster competition in railway markets. This survey will not analyse the success or failure of these reforms e.g. in terms of efficiency or effectiveness; interested readers are referred to several papers on the subject (Asmild et al. 2009) (Laabsch and Sanner 2012) (Abbott and Cohen 2017).

Railway Markets in Selected Countries

This section provides a review of selected railway markets all over the world. Countries are chosen to illustrate a range of different market structures, presence of competition and capacity allocation mechanisms. The surveyed countries are presented in alphabetical order: Belgium, the United Kingdom, France, Germany, Japan, the Netherlands, Spain, Sweden, Switzerland and the United States.

For each country is presented a brief historical background, the current state and structure of the railway market focusing on the allocation of responsibilities for infrastructure management and railway services, a description of the capacity allocation process, and of the structure of access charges.

1.1 Belgium

Historical background

The first railway in Belgium was established in the 1830s and the private companies owned a major part of the network. The railway system became fully nationalized in 1926 and *SNCB* [1] was created. After 2005, the Belgian government split the company into three entities: the national railway operator *SNCB*, the infrastructure manager *Infrabel* and the agency *SNCB-holding* which oversees all the other entities. The latter was merged into *SNCB* in 2014 (Infrabel 2018).

Current structure

The Belgian railway market is vertically separated, consisting of a single national infrastructure manager and multiple railway operators, including the state-owned company *SNCB* (see **Fel! Hittar inte referenskälla.**). As of 2017, most of the national services are operated by SNCB because the domestic passenger market is not yet open for competition. However, both freight and international passenger services are open for competition.

The state-owned operator *SNCB* operates national and international railway services. The corporate has several subsidiaries such as (SNCB 2014):

- SNCB Mobility mainly manages national railway operations.
- SNCB Europe is concerned with international railway operations and has shares in some international operators such as Thalys and Eurostar.

[1] *SNCB* stands for *Société Nationale des Chemins de Fer Belges* in French. It is also called *NMBS* refereeing to *Nationale Maatschappij der Belgische Spoorwegen* in Flemish.

- SNCB Technics takes care of maintaining, modernizing the trains and training the staff.
- SNCB Logistics is responsible for freight services.

Besides SNCB, there are other railway operators either in freight (from 2003) or passenger services (from 2010). However, their market share is still low compared to the national operator. Under 2016 and according to Infrabel, there were an overall number of 12 freight (such as DB Schenker and Crossrail) and 3 passenger operators, namely *SNCB, Thalys* and *Eurostar* (Infrabel 2016). Until recently, *SNCB Logistics* has been rebranded into *Lineas* in 2017 and most of its shares are now privately owned (Lineas 2017).

The national infrastructure manager *Infrabel* is also a state-owned company. Infrabel is contracted by the Belgian government to maintain, renew and expand the railway network, see the introduction of the network statement (Infrabel 2017a). Infrabel is also responsible for traffic control and allocation of capacity between different railway undertakings (Infrabel 2017b).

Based on the previous information, the Belgian railway market is therefore vertically separated and horizontally integrated.

Capacity allocation

The allocation of railway capacity is performed by Infrabel. The capacity is allocated to the railway operators under the terms and conditions described in the yearly national network statements. The process starts by receiving requests for trains paths and this happens during three periods. It starts at least one year before running the timetable service.

There are two types of path requests: national and international. Each is requested using different rules and on different computer platforms. International paths are requested using the path coordination system (PCS) on the *RailNetEurope* (RNE) website. All the path requests include all the necessary details about the train characteristics and path properties (Infrabel 2017a).

For both types of path requests, if the requested path is available, it is directly allocated to the railway operator. However, competing path requests may exist and, in this case, Infrabel starts a coordination process with the concerned railway operators. For international path request, other infrastructure managers and RNE (if involved) can also be included in the process. The aim is to propose a different capacity for the requested paths by changes the routes and/or times according to the specifications in the path request and depending on the available capacity. If these proposed alternatives do not solve the conflict, Infrabel applies the priority criteria in Table 1. For international paths, RNE requires *Infrabel* to do feasibility studies and to establish the service timetable within the deadlines. Late path and ad hoc requests are also handled outside these deadlines but have lower priority and Infrabel can reject these late requests or can make major adaptations to them.

Table 1- Priority criteria for conflicting path requests in Belgium (Infrabel 2017a)

Essential Criteria	RU did not under-utilize the allocated capacity before.	
1st Priority Criteria	Adapted for high speed lines	1. Passenger trains (by speed) 2. Others
	Freight lines	1. Freight trains (by speed) 2. Passenger trains (by speed) 3. Others
	Passenger or mixed lines	1. Domestic passenger trains (by speed) 2. Other passenger trains (by speed) 3. Freight trains (by speed)

		4. Others
2nd Priority Criteria	Highest monthly access charge on Belgian railway infrastructure.	

For conflicting late and ad hoc path requests, simple methods are employed such as the principle of first come first served (Infrabel 2017a). The part of the infrastructure where the conflict happened is declared congested and Infrabel must take actions to improve the capacity there.

Access charges

Track access charges depend on whether the requested path is available or not. If available, the access charge is paid in full, if the path is used. Modified or cancelled paths have a charge of 0%, 15%, 30% or 100% of the original charge depending on when the modification or cancellation happens. For modified paths, the train operator pays a modification charge plus the charge of the new path. In addition to these charges, all applicants must pay administrative costs. If capacity is not sufficient to accommodate a requested path, Infrabel and the applicants discuss possible variations of the paths to use the available capacity.

Access charges consist of several elements such as train line charges, installation and platforms charges, taxes and other administrative charges. Other special train paths such as train formation and marshalling are also charged. There are additional charges for other services such as ticketing, and penalties for instance for cancelling or not using allocated capacity. An interesting point is that there are no congestion charges for using congested parts of the infrastructures. However, these access charges are expected to be revised after 2019 in view of the developments in the EU regulations (Infrabel 2017a).

1.2 United Kingdom

Historical background

The British railway system is one of the oldest and busiest systems in the world. Early services started in the 19th century when small private companies, called the "big four", built and operated local lines. These were nationalized around 1947 to form *British Railways*, later called *British Rail*. The railway system was re-privatized in 1994-1997, and the private infrastructure manager *Railtrack* was separated from operations. In 2002 *Railtrack* was replaced with *Network Rail* as a non-profit infrastructure management company.

Current structure

The current British railway market consists of several actors. *Network Rail* owns, maintains and operates railway infrastructure in eight local units corresponding to geographical areas: Anglia, London North Eastern and East Midlands, London North Western, Scotland, South East, Wales, Wessex and Western.

Railway operators in Britain include passenger operators, locally called train operating companies (TOCs), and freight operators, are called freight operating companies (FOCs). These are private companies that use the railway infrastructure that is allocated by *Network Rail*. They generally bid for to run franchises, i.e. awarded contract for the right to operate trains on certain routes for a certain period of time (typically several years) on specific lines. On some unprofitable passenger routes, the government contracts TOCs in the form concession contracts where they are paid for their services (NetworkRail 2014). Some are operated based on open acess contracts, e.g. international services. The freight market includes several FOCs competing between each other and using the same routes that are allocated by *Network Rail.*

Railways in Northern Ireland is operated separately, and is left out of this review.

Network Rail is the national infrastructure manager and is a governmental body in agreement with the Department for Transport (DfT) and is regulated by the Office of Rail and Road (ORR). One of its major tasks are the management of the train traffic and the creation of the working train timetables. ORR monitors the performances of *Network Rail* on a regular basis, and specifies the terms and conditions for access to the network (ORR 2017a). There are also a few smaller infrastructure managers responsible for certain lines, such as Eurotunnel responsible for the Channel tunnel.

The British national railway market is vertically separated since services are separated from the network. Besides, the market is horizontally separated since there are several infrastructure management units led by a central government body acting as the infrastructure manager. Moreover, several private passenger and freight railway operators run services on the network that is separated into eight different geographical regions managed by different units of the infrastructure manager.

Capacity allocation

The capacity allocation process is specified in the network statement, published by *Network Rail,* describing the terms and conditions of track, stations and depots access for all the railway undertakings applying for capacity (NetworkRail 2017).

All operators require a track access contract from ORR which specifies, with the help of *Network Rail,* the slots in the working timetable to operate the train services (NetworkRail 2017). Once this is done, the first period for timetable planning and initial consultation starts where a prior timetable is planned. Then the final working train timetable is prepared in the next phase after receiving responses and consultations with the applicants. During the working timetable period, ad hoc path requests can also be accommodated within the available reserve capacity. International path requests are applied for on the RNE web platform.

Once the track access right is granted, e.g. franchise or open access, *Network Rail* translates these rights into the timetable construction. If there are conflicting path requests after the consultation phase, certain decision criteria are used based on the network code rules (NetworkRail 2018). For instance:

- Improvement of the network capability
- Reflection of the demand
- Short journey time
- Commercial interest of Network Rail

If the conflict is not resolved using these decision criteria, a dispute resolution process starts, and a timetable panel and the Access Disputes Resolution Committee (ADRC) takes over. The latter uses Access Dispute Resolution Rules to set options to settle the dispute. According to these rules, the procedure is as follows (ADRC 2016):

(1) Mediation where a neutral mediator helps to settle the dispute.
(2) Arbitration according to Arbitration Act 1996.
(3) Expert Determination

Once all the disputes are settled and the final working timetable is established, Network Rail announces the infrastructure to be congested, based on the conflicts in the allocation process, and actions are taken to improve infrastructure capacity in the congested areas (NetworkRail 2017).

Access charges

Principles for access charges are specified by ORR and aims at ensuring that Network Rail recovers the costs of operations, maintenance and upgrading its network. ORR,

therefore, develops the charging framework and *Network Rail* is responsible for calculating and applying the track access charges to railway undertakings (ORR 2015). Charges are applied differently depending on the market segment: franchised passenger (subject to franchising contracts), open-access passenger (not subject to any franchising contract) or freight services. The basic charges include fixed charges (for the franchise) and variables charges (for all) which together constitutes the so-called minimum access package. Additional charges also apply depending on the services and facilities that are used, such as stations or depots. There are neither financial penalties nor discounts in the access charges framework (ORR 2017b).

1.3 France

Historical background

In 1938, the national railway company *SNCF*[2] was formed by merging several small railway companies. Since then, *SNCF*, and thus the French railway market, has undergone several changes and restructurings. However, *SNCF* has remained the only railway operator with a monopoly on the railway market. Under the pressure of the European railway directives (EC 2001, 2004), which strongly emphasized easing entry for new operators and railway market liberalization, operators providing freight and international passenger services were allowed to enter the market. *SNCF* remained the only passenger operator in the country, however, and still has a large market share for freight services. *SNCF-infra* and *RFF* were government regulatory bodies that were responsible for infrastructure management until 2015, when significant changes were made to the market structure.

[2] SNCF stands for “Société Nationale des Chemins de Fer Français” in French or "French National Railway Corporation" in English.

Current structure

The recently created *SNCF Group* consists of three *EPIC*[3] agencies and five different business units. Each business unit falls in the scope of one of the three *EPIC* agencies of the *SNCF Group* (SNCF 2015):

- *SNCF EPIC* develops the group strategies and support its work through the real estate unit of *SNCF Immobilier*.
- *SNCF Réseau EPIC* is responsible for managing the railway infrastructure through the business unit *SNCF Réseau.*
- *SNCF Mobilité EPIC* is responsible for freight (through the business unit *SNCF Logistics*) and passenger operations (through the business units *SNCF Voyageurs* and *Keolis*).

SNCF Mobilité EPIC acts as the national railway operator through its business units. The business units also have shares in several other private railway companies operating nationally and internationally, such as *Eurostar*, *Lyria* and *Thalys.* The *SNCF Voyageurs* unit operates several national and multinational railway services under different brand names such as *Intercités*, *TER*, *Fret SNCF* and *TGV*. Apart from a few freight operators, the French market has few or no real alternative railway operators than the incumbent operators of the business units of the group.

SNCF Réseau EPIC, with its business unit *SNCF Réseau,* is the national railway infrastructure manager. It is responsible for infrastructure related tasks such as building,

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[3] EPIC stands for *Établissement Public à Caractère Industriel et Commercial* in French which is a category of legal entities that undertakes a public service. This term is mainly used in France and some former colonies.

maintaining and planning the national railway infrastructure. It is also responsible for capacity allocation, traffic management and control, and setting track access charges. The unit is distributed regionally with 11 smaller units working on local regions (SNCF-Réseau 2015). There are some railway lines (mostly high-speed lines) that are managed by other infrastructure managers (e.g. LISEA) under concession agreements with *SNCF Réseau (SNCF-Réseau 2017)*.

The French railway market is hence vertically separated to some extent, since infrastructure management and railway operations are handled by different business unit – although belonging to a common group structure. Infrastructure management are to some extent horizontally separated, since there are infrastructure managers independent of SNCF, although these operate under concession agreements. Railway operations can be said to be horizontally separated, since there are several independent operators providing freight and international passengers services, and there appears to be a possibility for competing operators to enter the market for domestic passenger services, at least in principle.

Capacity allocation

The infrastructure manager *SNCF Réseau* is responsible for allocating railway capacity to railway operators. The allocation process is described in the network statement (the DRR[4]). The allocation process starts around 3 years before services commence, by capacity restructuring and timetable preconstruction based on needs expressed by railway operators (or applicants in general) – in practice mostly from *SNCF Mobilité*.

[4] DDR stands for *Document de Reference du Reseau* in French, refereeing to the French network of statement.

This include timetables for maintenance work, and long-term frequent train paths covering all year.

The timetable construction phase aims at drawing the final timetable based on train path requests by integrating them in the preconstructed timetable, taking capacity requirements of stations into account. Details of the train path requests are provided using computer platforms such as PCS for international paths. Once this is done, adaptations are made to the final timetable based on remaining capacity and last-minute requests.

Capacity conflicts are first handled within the coordination procedure, where *SNCF Réseau* responds to requests by prioritizing certain requests during each phase of the allocation schedule. Priorities are not weighted. They include for instance traffic on European freight corridors, distance covered by the path, commercial importance for the applicant, financial importance for *SNCF Réseau,* and robustness of the timetable (SNCF-Réseau 2017).

The division of Capacity and Train Paths within *SNCF Réseau* resolves any remaining capacity conflicts by either upholding requested paths or reassessing the capacity with the applicants. If the coordination procedure ends with some path requests not being allocated, *SNCF Réseau* declares the corresponding network section to be congested. Other divisions of *SNCF Réseau* then perform capacity analysis, and take appropriate actions to improve the capacity.

Access charges

French access charges are established based on national decrees, and are also explained in the DRR (SNCF-Réseau 2017). Train paths are charged based on the allowance for infrastructure costs, characteristics of supply and demand and the need to optimize the

use of the infrastructure. Special charges apply for lines related to the national rail plan and for requests providing incentives to develop new improved traffic.

Access charges generally include minimum service charges for costs directly incurred such as tracks maintenance, electric traction and for costs indirectly incurred such as market, access and special charges and sometimes congestion charges. Access charges also include charges for basic service such as use of sidings, marshalling, terminals. They can also include charges for additional services such as information systems and unscheduled services. Penalties can be charged for cancelling or not using allocated capacity (SNCF-Réseau 2017).

1.4 Germany

Historical background

The national railway operator DB [5] was formed in 1994 by merging the two former national railway companies[6] in Germany. After the European railway directives, DB was divided into several divisions and business units under one state-owned holding company called *DB Group* (EC 2001, 2004). Other restructuration within the holding group has continued since then.

Current structure

DB Group is currently the main railway company in Germany and has four different divisions (or "arms") (DB 2016):

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[5] DB stands for *Deutsche Bahn* (German Railway in English).

[6] Deutsche Bundesbahn (German Federal Railway) in West Germany and Deutsche Reichsbahn (German Reich Railway) in East Germany.

- *DB Bahn* is responsible for railway passenger services, operated by a number of different business units. *DB Fernverkehr*[7] is a unit that provides national and international long-distance services such as *InterCity (IC)*, *EuroCity (EC)* or *InterCityExpress (ICE).* Another unit is *DB Regio* which operates regional and commuter train services.
- *DB Schenker* is responsible for freight and logistic services inside and outside Germany by its business units such as *DB Cargo.*
- *DB Netze* is responsible for railway infrastructure management. It comprises a number of different business units such as *DB Netze Track*, *DB Netze Stations* and *DB Netze Energy*.
- *DB Arriva* is responsible for passenger transport services (such as trains, trams and buses) in many countries outside Germany.

DB Bahn is the main passenger railway operator in Germany. It has a large market share of commercial long-distance passenger services, and also provides various subsidized passenger train services. There are a few competitors within the commercial long-distance passenger market, such as *Transdev*, but their market share is small compared to the *DB Bahn* operators.

The German railway infrastructure manager is *DB Netze* and has several business units. *DB Netze Track* owns and operates most of the German railway network in seven regional divisions, it is responsible for capacity allocation in these regions and for creating the timetable for the different railway undertakings as well as maintenance and upgrading the network. *DB Netze Energy* acts as the energy manager responsible

[7] *DB Fernverkehr* is called DB Bahn Long Distance in English.

for supplying power to the operators. As part of the infrastructure management, *DB Netze Stations* is the unit responsible for managing over 5400 railway stations, terminals and hubs in the German network stations (DB 2017).

The Germany railway market is hence both vertically and horizontally separated in a sense: railway services are vertically separated from infrastructure management, although infrastructure managers and the dominating service operators belong to the same holding company; services are horizontally separated between a number of operators that are partly competing for markets shares, and at least compete for capacity to some extent; and infrastructure management is horizontally separated by region and part of the infrastructure system (stations, energy, tracks etc.).

Capacity allocation

The allocation of railway capacity is performed by *DB Netze*. The allocation process, part of the responsibilities of *DB Netze Tracks*, is specified in the network statement or SNB[8] and is performed according to German and EU laws (DB-Netze 2017).

The process starts with train path requests, using the TPN[9] internet platform. Based on the path requests, *DB Netze* designs a working timetable that responds best to the requests while ensuring best utilization of the infrastructure. This process is carried out without consulting the applicants. The timetable design process is based on a tolerance principle of +/- 3 minutes for passenger train paths and +/- 30 minutes for other paths (DB-Netze 2017). This allows *DB Netze* to design alternative paths without the need to consult the applicant railway operator.

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[8] SNB stands for Schienennetz-Benutzungsbedingungen, Rail Network Statement in English.

[9] TPN is the train path application portal of *DB Netze*.

Remaining conflicts are resolved in cooperation between *DB Netze* and the involved railway operators during the coordination phase. If mutual negotiations do not solve the conflicts, *DB Netze* uses priority rules to settle the dispute (presented in Table 2). In the most competitive case, conflicts are resolved using a charging mechanism, with the highest bidder being awarded the train paths subject to the conflict. The area of the infrastructure subject to this conflict is declared congested and *DB Netze* performs capacity analysis and takes relevant actions (DB-Netze 2017).

Table 2 - Priority list for dispute settlement in the railway capacity allocation process in Germany (DB-Netze 2017)

1st Priority Criteria	1. Regular interval services 2. Cross-border services 3. Freight services.
2nd	4. At least two connections to other services 5. Forming a circuit with return service
3rd	At least 70% use of awarded train paths in the last two years.
4th	Highest access charge to the overall train path.
5th	Highest bid procedure.

A final draft of the working timetable is prepared before ad hoc services and late requests start being included. Cross-border train path requests are treated with the help of RNE. The process results in a catalogue of train paths on the national and cross-border lines. There are special regulations to the allocation of congested railway lines and further congested lines are detected every year. Capacity for maintenance, extension or renewal of the infrastructure is also allocated in the train path catalogue (DB-Netze 2017).

Access charges

Charging principles for using the allocated capacity are specified in the network statement. Like many other European countries, there is a minimum access package which includes basic utilization charges which depend on the market segment, such as the specific train service and in which state the train operates. Potential charges or discounts may be applied such as new service discount, noise-related or delay-related charges. Additional service costs are added according to the services that are used by the railway undertaking such as information system, data acquisition, , administrative procedures and compatibility and navigability studies. There are some special scenarios where incentives and penalties are applied to encourage or deter the railway undertaking in their operations, such as train path cancellation. There are also additional charges for congested railway lines which are periodically updated after capacity analysis studies (DB-Netze 2017).

1.5 Japan

Historical background

After the nationalization of the Japanese Government Railways (JGR) in 1949, the new state-owned public company was renamed the Japanese National Railways (JNR). In 1987, the JNR and hence the railway system was reprivatized and the Japan Railways Group (JRG) was created. JRG is a group of several private railway companies.

Current structure

The railway system in Japan is mainly organized around the JR companies, which are corporations with the Japanese government as the sole shareholder These companies are responsible for both infrastructure management and railway operations in their

respective regions of operations. JR companies consists of the following railway operators:

- Six private passenger companies, organized by region: JR Hokkaido, JR East, JR Central, JR West, JR Shikoku, JR Kyushu.
- One national private freight company *JR Freight.*

The JRG consists of the companies above and some additional functions: a research and development centre (The Railway Technical Research Institute, RTRI), a business unit for information systems (JR Systems), and some regional and local train companies.

The six JR companies own and manage their infrastructures and run passenger services on them. Other operators are also allowed to run their trains on the infrastructure, such as the freight company *JR Freight*. In many cases, such as long-distance services, companies run services beyond its geographical region. There are other private railway operators as well, both for passenger and freight services, but the JR companies have by far the dominating market shares (trafikanalys 2014). Most of the railway market is hence vertically integrated but horizontally separated (into six geographical regions), although the fact that other operators can use a company's network introduces elements of vertical separation.

Capacity allocation

The vertical integration of the Japanese railway market means that capacity allocation within a region is the responsibility of the JR company of that region. Capacity allocation and timetable design is therefore integrated in the companies' business plans, and there is no public information on how this is performed.

In the cases of cross-regional services, railway companies have agreements on conditions of access and operations. These clearly state the responsibilities and revenues of each company under different scenarios. Companies have freedom to develop their standards and agreements under supervision of the Railway Bureau of the Japanese MLIT[10] (trafikanalys 2014). Similarly, companies also ensure allocation of capacity in cooperation with JR Freight.

Access charges

The vertically integrated structure also means that there are few explicit access charges. The private companies use their revenues to improve and maintain their infrastructure. In some cases, JR cross-border services may apply access charges for the use of the infrastructure, based on agreements between the railway companies. JR Freight pays access charges to JR passenger companies, and also to some small freight companies which own small freight networks.

1.6 Netherlands

Historical background

The Dutch railway system was managed by the government through the state-owned company NS[11]. NS was founded in 1938 by merging the two largest railway companies at the time. NS continued to manage the railway infrastructure until 1995, when *NS Railinfratrust (RIT)* was created to take care of maintenance and extension of the infrastructure, while *NS* remained as the national railway operator. In 2004, *RIT* became *ProRail* and turned into an independent.

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[10] MLIT stands for Ministry of Land, Infrastructure, Transport and Tourism.

[11] NS stands for Nederlandse Spoorwegen in Dutch, Dutch railways in English.

Current structure

The Dutch railway system is vertically separated, with the government agency *ProRail* owning and managing railway infrastructure, and a number of operators running railway services. Services are hence horizontally separated, although the state-owned company *NS* is the largest operator by far.

ProRail is responsible for the traffic control, capacity allocation, and infrastructure maintenance and extensions. Capacity supply for railway operators are governed by the rules and conditions stated in the network statement (ProRail 2017).

NS is a state-owned company with several subsidiaries operating different services, including both railway services and other modes, and both national and international services (NS 2018). The Dutch railway market is dominated by passenger services. There are some freight services, mostly operated by *DB Cargo*, a subsidiary of the German operator *DB*. In addition to this, there are some smaller private companies providing passenger service (such as *Arriva* and *Keolis*) and freight services (such as *ACTS* and *Veolia Cargo*) services.

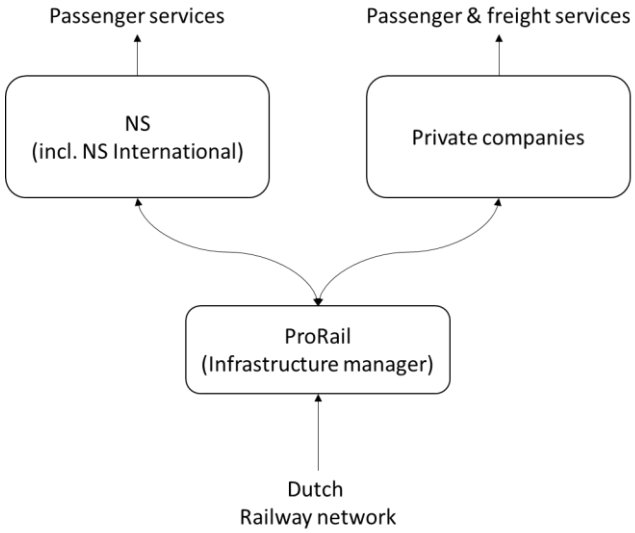

Figure 4 – An overview of the structure of the Dutch Railway system

Capacity allocation

Capacity allocation is part of the annual timetabling process, which is carried out in several steps with specific deadline dates. The process starts with submission of path requests, where ProRail receives full information about the path requests from the railway undertakings. This is followed by scheduling and coordination, aiming at converting all the requests into a working timetable before the final allocation of the capacity. An additional phase handles ad hoc requests, which are taken care of once the working timetable is established. The capacity allocation during the ad hoc phase is made according to the recommended One-Stop-Shop principle by RNE. ProRail checks the new requests, and any request resulting in conflicts is not allocated if the conflict cannot be resolved (ProRail 2017).

In the case of conflicting path requests, coordination starts to resolve the conflict with the aim of optimizing the use of the network capacity using some general flexibility principles such as deviation from the requested path (up to +/- 3 minutes for passenger path requests, and up to -10/+20 minutes for freight path requests), use of alternative tracks, relocation or cancellation of stops (for freight path requests), and speed adjustments. If an agreement has not been reached, ProRail applies what is called the *statutory priority rules* in order to resolve the conflicts. These rules specify which type of services, passenger or freight, to priorities on certain routes (ProRail 2017). Parts of the network where there are remaining conflicts after the coordination step are declared congested, and *ProRail* has to take capacity enhancement measures such as infrastructure or timetable improvements for the future timetables (ProRail 2017).

Access charges

ProRail is also responsible for determining access charges. The rules and principles for access charges are described in the network state (ProRail 2017). Any operator with

train path requests is required to pay a minimum access package, which depends on the train path (per km and ton), stabling and shunting (per train and minute), transfers (per stop) and traction power (per kWh). Operators are also required to pay charges for using service facilities such as stations and freight terminals. Agreements can be signed to pay for the use of some congested lines. Financial penalties apply to non-usage of capacity or train path cancellation. Train operators can also get discounts for using higher quality rolling stock (e.g. silent trains) (ProRail 2017).

1.7 Spain

Historical background

The Spanish national railway company *Renfe* [12] was created in 1941. In 2005, *Renfe* was split into two separate units: *Renfe-Operadora* (or simply *Renfe*) which is responsible for railway operations and *Adif*[13] which is responsible for infrastructure management.

Current structure

The Spanish railway system is currently managed by *Adif* as the national infrastructure manager. *Renfe* with its different subsidiaries performs most of the railway operations. The system is hence vertically separated, while infrastructure management is horizontally integrated.

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[12] *Renfe* stands for Red Nacional de los Ferrocarriles Españoles which translates from Spanish as National Network of Spanish Railways.

[13] *Adif* stands for Administrador de Infraestructuras Ferroviarias in Spanish or Railway Infrastructure Administration in English.

Adif is a public company that is part of the Ministry of Public Works and Transport company. It oversees different infrastructure management tasks, such as administering tracks, stations and freight terminals, traffic control and capacity allocation. The company is structured into five different directorates: Strategy and Transformation, Operation and Construction, Corporate Business Development, Personnel Management and Financial and Management Control (Adif 2017a).
Renfe is a state-owned company that operates freight and passenger services. It is structured into four business units: Suburban and Medium Distance, Long Distance Services, Freight and Logistics Services and finally Manufacturing and Maintenance. It has several subsidiaries, for example *Renfe Feve* which operates most of the narrow-gauge railway services. *Renfe* does not have monopoly rights anymore, and there are several other competing operators, such as *Eusko* and *FGC*.

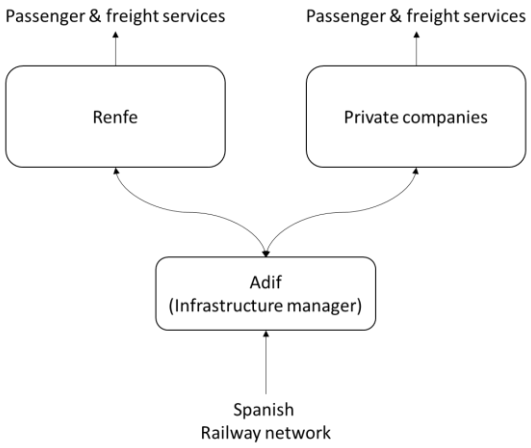

Figure 5 - An overview of the structure of the Spanish Railway system

Capacity allocation

Adif is responsible for capacity allocation, based on the rules and conditions specified in the national network statement (Adif 2017b). The timetabling process allows Adif to adjust and modify the requested train paths to accommodate them in the working timetable.

In case of conflicting path requests, the allocation process uses priority criteria. Some of the main elements of these criteria, in order of priority, are:

- Public interest service
- International service
- Services with framework agreements
- Frequent services
- Overall system efficiency

When conflicts arise in a certain section of the infrastructure, it is dealt with as a congested section in future planning tasks (Adif 2017b).

Access charges

The access charges are set by *Adif* according to the Spanish law of the railway sector and are specified in the chapter about charging principles in the annual network statement (Adif 2017b). The charges consist of direct rail fees, tariffs and charges for supplementary services. The rail fees correspond for example to the use of safety control systems. Rail tariffs account for use of the infrastructure and depends on the levels of traffic volume (per km and train -year). They also include charges for reserving capacity, and then depend on the capacity availability. Rail tariffs also include running tariffs which depend on the type and level of services (per train-km). Additional tariffs are added for using stations and rail facilities such as sidings, gauge changers etc. (Adif 2017b).

1.8 Sweden

Historical background

Until 1988, the Swedish railway system was managed by the government agency *SJ* [14]. In 1988, the system was reformed, and infrastructure management was transferred to the newly created Swedish Rail Administration, *Banverket*. At first, *SJ* was solely responsible for all railway services, but the service market was gradually opened for competitors – the freight market in 1996 and the passenger market in 2010. SJ was split into several state-owned companies in 2001, providing different services and operations. In 2010, *Banverket* was merged with *Vägverket* (the Swedish Road Administration) and *Rikstrafiken* (the agency responsible for procuring nationally subsidized transport services) to form *Trafikverket*, the Swedish Transport Administration. The latter became the infrastructure manager of the Swedish railway system.

Current structure

Trafikverket, the infrastructure manager, is a government agency responsible for planning, construction, maintenance and operation of the Swedish railway system, including capacity allocation and traffic control. It is divided into several units that operate in different fields (Trafikverket 2015).The state-owned corporation *Jernhusen* is responsible for train stations and real estate management. Several competing operators run services on the Swedish network, although the market is dominated by *SJ AB* for passenger services and *Green Cargo* (which was formed by separating the part of *SJ*

[14] *SJ* stands for Statens Järnvägar in Swedish which translates to The State Railways.

running freight services) for freight services. The Swedish railway market is hence vertically separated but horizontally integrated market structure.

The market for railway services is deregulated, and several private companies have started operating in recent years. In addition to *SJ AB*, passenger services are run by *MTR*, *Tågkompaniet* and *Snälltåget*, focusing on different market segments such as high-speed services, intercity and night trains. Local and regional commuter trains are controlled by regional-level governments (counties and municipalities), often by procuring specified services from operators such as *SJ* or *MTR*. The freight market also includes several operators; in addition to the incumbent Green Cargo, DB Schenker and several smaller operators compete. Some large retail companies and industries run their own services as part of their logistics system. Thishas led to an increasing competition for capacity.

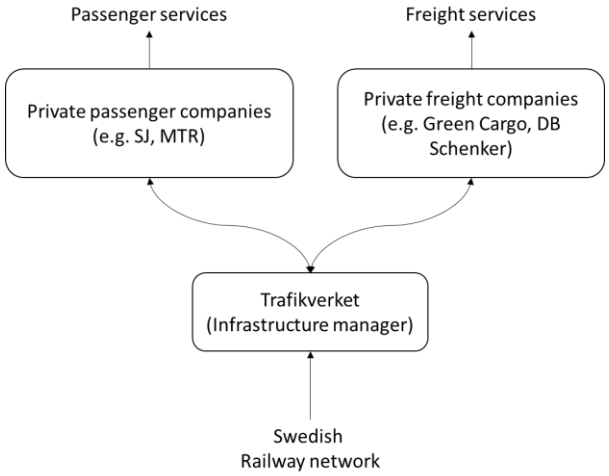

Figure 6 - An overview of the structure of the Swedish railway system

Capacity allocation

The national infrastructure manager *Trafikverket* is responsible for capacity allocation. Each year, the network statement describes the conditions and terms for using the railway infrastructure (Trafikverket 2017). The allocation process starts with the submission of train path requests, to establish a proposed timetable. Conflicts between

path requests are resolved through coordination and negotiations with the train operators, with the aim to accommodate all or most of the path requests. After the timetable is established, ad hoc requests can be submitted at any time, and these are granted or rejected based on the remaining capacity.

If there are remaining conflicts after the coordination process with operators, *Trafikverket* decides the final timetable using priority criteria. Priority is given to the path request with the lowest socio-economic cost according to the calculations described in the national network statement (Trafikverket 2017). Lines with conflicts are declared congested, and capacity analysis is conducted determining how capacity may be improved.

Access charges

Trafikverket imposes access charges for the use of the Swedish railway network and specifies its guidelines each year in the network statement (Trafikverket 2017). Charges relate to the use of the infrastructure, investment projects, reservation, performance and services. There is a minimum access charges package for all train operators. These charges include track charges (per ton-km), train path (per train-km and train service), emission charges and a special city passage charge. Additional charges also apply when using other infrastructure facilities and services such as marshalling yards, stations, freight and holding terminals. Financial charges such as reservation fees and delay-cancellation fees are also imposed on train operators.

1.9 Switzerland

Historical background

The Swiss railway network was run by private companies during the 19th century. The nationalization of a major part of the Swiss network started in the 1890s, leading to the

creation of the Swiss Federal Railways *SBB*[15] in 1902. SBB started as a government agency for managing the national railway system, but was converted to state-owned limited company in 1999 (SBB 2017b).

Current structure

SBB is a state-owned company owning and operating the Swiss railway system. It is both the national infrastructure manager and the main train service operator. The company has several operational divisions and management supporting groups. The main divisions are passenger services, freight services, infrastructure and real estate. There are also group-level units such as IT, communications and finance (SBB 2017b). *SBB* operates different passenger train services such as the regional trains *Regio* and *RegioExpress*, the commuter trains *S-Bahn*, the intercity trains *InterRegio* and *IC*, and night trains *CityNightLine*. It also operates international passenger services such as *EuroCity* and *EuroNight* alongside other international companies and services such as *ICE* services from *DB*, *TGV* from *SNCF*, *TGV Lyria* and *Railjet*. *SBB* runs freight services through its subsidiary *SBB Cargo*. In addition to *SBB*, there are a number of other companies owning infrastructure and running train services, for example *BLS*, *SOB* and *RhB*. The latter controls the narrow-gauge railway network.

The Swiss railway market is hence vertically integrated, since each of the companies own their infrastructure and runs train services. Since there are several such companies, the system as a whole is horizontally separated railway, see Figure 7.

[15] SBB stands for Schweizerische Bundesbahnen in German, Chemins de fer fédéraux suisses (CFF) in French or Ferrovie federali svizzere (FFS) in Italian. It is thus often referred to as SBB-CFF-FFS.

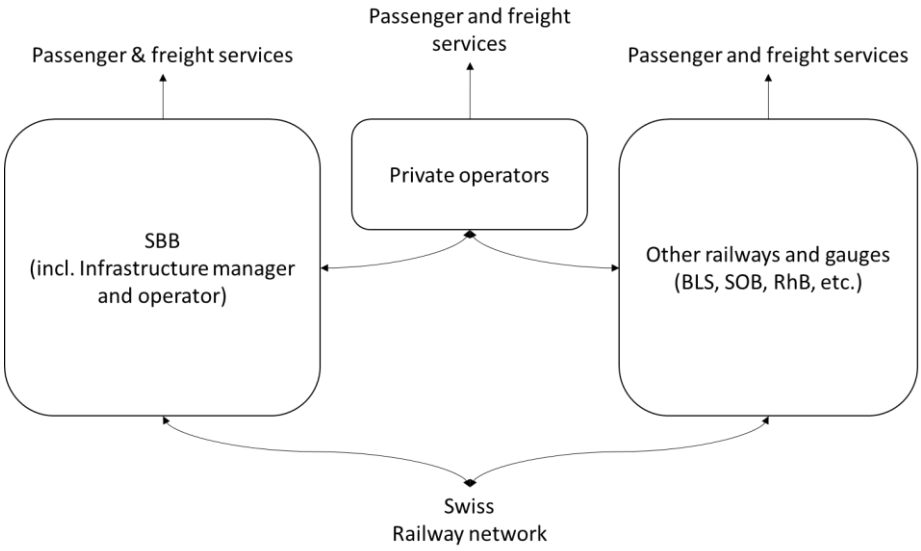

Figure 7- An overview of the structure of the Swiss railway system

Capacity allocation

Capacity allocation is performed by *Trasse* (also known as Swiss Train Path Ltd), a non-profit independent agency responsible for train path allocation for SBB and the major railway companies in Switzerland (Trasse 2008).

Trasse compiles the allocation process and access conditions in the yearly network statement (SBB 2017a). After receiving train path requests, these are studied with framework agreements to perform the allocation of capacity to establish the annual timetable. If there are conflicts among path requests, a coordination process starts find an agreement between competing operators. If no agreement is found, conflicts are resolved based on so-called network usage plan, which safeguards capacity for certain types of traffic. If the network usage plan leads to a tie between the conflicting path request, *Trasse* uses a prioritisation process which allows to prefer one path request rather than the other(s) depending on the type of traffic that is involved in the conflict. If this process does not resolve the conflict, a bidding mechanism is used where the winner pays the second-highest bid plus a surcharge (SBB 2017a). The infrastructure

subject to the conflict is declared congested and improvement actions are taken for the timetable of the following year.

Access charges

Access charges are also the responsibility of Trasse. Basic services fees are charged for any operator with train paths in the timetable. These fees include a minimum price, contribution margin and electricity costs. Discounts are provided for low-noise trains and use of new ETCS train control system. Charges are applied for using additional services, and penalties are charged for cancellations and non-usage of capacity (SBB 2017a).

1.10 The United States

Historical background

Railway transport (or railroad, to use the American term) in the United States started in the middle of the 19th century in the East, with the construction of the transcontinental line in the late 1860s as a milestone. The railway network kept expanding for both long distance freight and passenger trains. The lines were mostly constructed and operated by private companies. After 1920, the prospering automobile industry and the construction of the national highway system caused a sharp decline in railway transport. The government eventually intervened, regulating and nationalising parts of the railway system, resulting in the creation of the national passenger operator *Amtrak* [16] in 1971. Most private railway companies at the time joined *Amtrak*.

[16] Amtrak is the business name of The National Railroad Passenger Corporation.

Current structure

The railway system in the US is dominated by freight services, while passenger services have a relatively small market share. Freight services are operated by several private freight companies, whereas passenger services are operated by Amtrak. The Federal Railroad Administration (FRA), an agency under Department of Transportation, oversees passenger and freight train services, ensuring safety, reliability and efficiency of both passenger and freight rail services. FRA is also responsible for developing the railway system, for example the High-Speed Intercity Passenger Rail program. FRA also administers federal grants and loans to *Amtrak* and other railway corporations (FRA 2017).

The Surface Transportation Board (STB) is responsible for regulatory oversight of railways, which includes the construction, operation, acquisition and abandonment of certain railway lines. It is also responsible for resolving disputes, and reviewing of proposed railway mergers (STB 2017).

Amtrak is a commercial, quasi-public corporation that has a monopoly on medium- and long-distance passenger services. It also serves as a contractor for several local commuter services. In addition, there are a few private passenger companies, such as the new high-speed companies, and the Alaska Railroad Corporation operating passenger services in Alaska.

Freight services are mainly operated by different competing private freight operators under the oversight of the FRA. Services are divided into three classes by the STB based on their annual revenues. The freight market is highly competitive due to the large number of private operators. Most freight companies have their own railway infrastructure, which is sometimes also used by Amtrak at certain usage fees (ORPD-FRA 2015).

Most operators hence own the infrastructure they use, so the US railway market is largely vertically integrated. Since the railway system consists of several distinct railway systems, it is horizontally separated, see **Fel! Hittar inte referenskälla.**.

Capacity allocation

Capacity allocation is carried out internally within railway companies, due to the high level of vertical integration and horizontal separation. Capacity allocation is hence essentially a train timetabling task within each railway company.

Access charges

As noted before, Amtrak uses infrastructure owned by private freight operators. For this, Amtrak pays usage fees, but the size of the fee decided by discussions and negotiations, rather than any formal method. Similarly, there is no clear formal charging system for using capacity owned by another company; instead, it is handled through informal discussions.

Summary and Discussion

Railway markets

During a long period, from the late 19th century to the early 20th century, most countries created single national railway corporations by merging existing small railway companies. This led to railway systems which was highly integrated both vertically and horizontally. The consequences of this is still clearly visible in most countries, even where railway systems have been separated vertically or horizontally. In almost all countries which have deregulated the markets for railway services, markets are still dominated by large incumbents which are remnants of the older national monopolies.

The review shows that there is a clear trend towards opening the market for railway services for competition, usually by vertically separating the system into a publicly controlled infrastructure manager which is also responsible for capacity allocation, and allowing several service providers to compete on commercial grounds. The EU railway directives have obviously contributed to this trend, but as we have seen, it started earlier than that and is partly driven by other considerations than the necessity to conform with the EU directives.

Vertical separation can be done in different ways. For instance, Sweden and the United Kingdom adopted complete separation whereas France has an accounting separation, i.e. the infrastructure manager has a separate accounting from the railway operator. Germany adopted an institutional separation where the infrastructure manager and the railway operator are two separate institutional units.

Competition

The railway model of each country affects the degree of competition that is allowed in the railway market. In fact, the traditional horizontally and vertically integrated model does not allow competition in the railway market. A typical case is Japan, where a potential competing railway operator would have to use the infrastructure owned by the incumbent operator. This obviously prevents competition between operators.

The vertically separated structures allow a certain degree of competition, as seen in some of the European countries. For instance, Sweden and the UK have highly competitive markets, at least in certain market segments. While Sweden is still dominated by large incumbent operators for passenger and freight services, the UK has several operators of comparable sizes.

Even in vertically separated railway models, the presence of the incumbent operator as the main actor in the market can sometimes prevent competition, since this

makes it harder for new operators to enter the market. For instance, *DB* in Germany, *SNCF* in France, *SNCB* in Belgium, *NS* in the Netherlands and *Renfe* in Spain all have large market shares, and scale benefits make it difficult for entrants to compete. One way to increase the degree of competition in the national market can be the entry of a multinational or incumbent in another country such as DB Schenker in freight services in Europe.

Most of the competition in the reviewed railway markets is for freight services. For instance, most European markets, as well as the US freight market, are highly competitive, with several freight operators each with considerable market shares. The difference is that most of the freight operators in the US own the infrastructure they use which is not the case in Europe. Japan is the one reviewed country which is the exception, since JR Freight has the monopoly of all the freight services in the country. Competition in passenger markets is generally less intense. The exception is the British market, and to some extent the Swedish market. In Japan, Switzerland and the US, there is no competition for commercial railway passenger services at all. Several countries also have publicly controlled subsidized passenger services. However, there is no clear rules as to which service to make commercial and which to subsidize. The general rule of thumb seems to be that intercity services are usually commercial, whereas local and regional services are often subsidized. There is a substantial grey area here, and drawing a clear line between these types of services is often virtually impossible.

Most of the reviewed countries, especially in Europe, with a low degree of competition have a railway market structure in which the infrastructure manager which allocates the capacity to the different competitors is somehow linked to the incumbent operator. This can be noticed in countries such as France, Belgium, Germany and the

Netherlands even if they have different market structures. This conflict of interest might be one major obstacle for a more competitive railway market.

Capacity allocation

In several railway market models, especially the vertically separated ones, the infrastructure manager is responsible for allocating the capacity. It is usually a government agency that is part of the ministry of transportation and performs the allocation of capacity on behalf of the government. This is for example the case in Sweden, Britain and the Netherlands. It can also be a state-owned company with the state or government holding most shares or ownership of the company. This is the case in Spain, Switzerland and Belgium.

In countries such as Japan and the US, the vertically integrated market structure means that capacity allocation takes place in the internal timetabling process within the company owning the infrastructure, usually a monopolistic operator in that network. Therefore, capacity conflicts never become explicit or public.

Some countries, such as Germany and France, include the infrastructure manager within the structure of the incumbent operator, as part of a holding company (Germany) or a publicly controlled company group (France). The capacity allocation process may present a conflict of interest, since the incumbent operator is present within the same structure. As shown in the review, this might have led to the incumbent operators holding a major part of the railway market, reducing the incentives to enter the market even if it is legally open for access.

In many countries, infrastructure managers have developed an advanced capacity allocation process. It generally starts with operators submitting path requests with all information needed to construct a proposed timetable. Minor conflicts can usually be resolved by minor adjustments to the path requests, so the framework often

specifies certain time intervals in which the infrastructure manager is allowed to adjust the without having to negotiate or consult with operators. Major conflicts are usually solved in a coordination process where the different applicants conduct informal discussions with the infrastructure manager to settle conflicts. However, conflicts remaining after the coordination process are usually resolved by the infrastructure manager taking a unilateral decision based on certain priority criteria or decision rules, and the applicants have the right to appeal. In such situations, the infrastructure manager declares the part of the network subject to the conflicts as congested and actions are taken to improve the capacity for the next timetables.

Access charges are often used in vertically separated railway models to cover the cost of using the infrastructure. Most of reviewed charging schemes attempt to capture the cost incurred by running trains on the infrastructure and the railway undertakings must pay this cost to the infrastructure manager. This is not the case for vertically integrated models where the railway company can reinvest parts of the revenue from its operations back to improving its infrastructure. In both cases, the railway companies have incentive to efficiently use the capacity that is allocated for their railway operations. In almost cases, access charges are designed simply to recover the costs for infrastructure operations and maintenance. With a few minor exceptions, it is uncommon that access charges is used as a capacity allocation instrument, i.e. charging a higher price where capacity is scarce. This appears to be a severely underused opportunity; it is difficult to understand why this is not more common than it is. One hypothesis is that it is because most railway markets were vertically integrated until recently, and it simply takes time to develop the capacity allocation instruments necessary in a vertically separated market.

Several countries aim to introduce or increase competition among operators, both for passenger and freight services. For this to succeed, the capacity allocation process is central. It needs to be transparent and predictable to allow operators considering to enter the market to foresee what capacity they will be allocated. It needs to be efficient from a market perspective, ensuring that the operator able to provide the best value for money for consumers also get the capacity to provide its services. Few if any countries have capacity allocation processes that satisfy these criteria. As to transparency and predictability, most countries have processes where it is difficult to understand which path requests get priority when a conflict occurs, and it is even more difficult for a potential new operator to understand how it should act in order to get the capacity it needs to provide its services. There are a few exceptions where it is relatively clear how priority is given: for example, the UK allocates well-defined concessions on specified sub-markets through a transparent bidding process; the last sept in the German allocation process is an auction where a path request is allocated to the highest bidder. But there are many more cases where capacity conflicts are resolved through various kinds of priority criteria, where it is often difficult for an outsider to understand how they are applied. For example, a number of countries have several priority criteria or decision rules which are not necessarily consistent or mutually exclusive, or where it is obvious in what order they take precedence.

An additional concern is that the agency responsible for capacity allocation (usually the infrastructure manager) has organisational links to the incumbent, dominating operator. A new operator considering entering the market may have reasonable concerns that this may bias the judgment of priorities in a capacity conflict in favour of the incumbent operators – especially if the capacity allocation process is informal and non-transparent.

Finally, the capacity allocation process is absolutely crucial for a railway market to function efficiently. The purpose of operator competition is to ensure, in the long run, that operators provide the services which give the best value for money to consumers. For this to work, it is essential that the most efficient operator, i.e. the one providing the most attractive services from the market's point of view, also gets priority in a capacity conflict. Form our review, we can conclude that such considerations are surprisingly absent. With a few exceptions (most prominently the UK with its concession/auction procedure), priority criteria have at best a vague relation to consumer demand and market efficiency. A vast majority of priority criteria and decision rules instead relates to simple "technical" criteria, for example that longer train paths have higher priority than short ones, or that passenger services get priority over freight services. There appears to be no explicit arguments grounded in market efficiency for how such criteria have been formulated.

Opening up the market for railway services to competition can in principle yield substantial social benefits, partly because operators get more incentives to become more cost efficient and more responsive to consumer demand, partly because evolutionary selection will ensure that services are weeded out whenever production costs exceed the market's willingness to pay. But for this to work, it is necessary that the process for resolving capacity conflicts between different operators is efficient and transparent. Our survey indicates that most countries still have some way to go in this respect.

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