A survey of railway market organization and regulation

Abderrahman Ait-Ali[a]* and Jonas Eliasson[b]

[a] Department of Transport Science, Royal Institute of Technology KTH, Stockholm, Sweden;

[b] Stockholm City Transport Administration, Stockholm, Sweden

* Corresponding author: abde@kth.se

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 is how access charges are constructed and applied. Several European countries have vertically separated their railway markets, separating infrastructure management from provision of train services, 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

1. Introduction

Railway markets have recently undergone major reforms in many countries. In particular, many European countries have reorganized their markets to allow competition between operators, a development further stimulated by the railway directives from the European Commission (EC) (EC, 2017). This has introduced new challenges for capacity allocation and access charges. The purpose of this paper is to survey the current status of railway market regulation and organization in selected countries, to allow for comparison and (to the extent possible) critical assessment. The countries have been selected to exemplify a broad range of ways to organize railway markets. The survey focuses on regional/national railway networks, rather than local systems.

A particular focus of our survey is the capacity allocation process, including access

charges, since this is crucial for railway markets where several operators compete for capacity. For each country, the survey summarizes:

- 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 or competing commercial operators;
- resolution of conflicting capacity requests from different train operators;
- principles for calculating access charges.

The literature includes many reports, policy and review papers about one or more questions treated in this paper. Yves Crozet (2004) reviewed the charging systems in several European countries and highlighted that there are signs of similar issues even with national differences. Link (2004) focused on the German regional rail passenger transport to analyse track access conditions and access charges, and found that even with an increasing competition, the incumbent is still dominant. Bouf, Crozet, & Lévêque (2005) looked at the conflict resolution systems in vertically separated railway markets and compared the British and French system at the time. Alexandersson, Hultén, Nilsson, & Pyddoke (2012) described the Swedish reforms for opening access to passenger markets, the authors looked at different issues of the reforms such as capacity allocation and access charges and found that legislation and tools to address these issues are to be developed. A policy report from the Centre on Regulation in Europe (CERRE) gave some guidelines on the implementation of competition in European railway markets (Yves Crozet, Nash, & Preston, 2012). Nash, Nilsson, & Link (2013) compared the introduction of competition in Sweden, UK and Germany. Laurino, Ramella, & Beria (2015) reviewed railway models in 20 countries worldwide,

with a focus on regulatory characteristics of each system, finding that states still play an important role as infrastructure manager and frequently also as railway operators.

2. Background and Terminology

Railway markets can be characterized according to the extent of *vertical* and *horizontal separation*, respectively. The vertical dimension involves the division of responsibility for *infrastructure management* and *railway services* (Yeung, 2008), (Makovsek, Benezech, & Perkins, 2015). Infrastructure management refers to the responsibility for the network, including tasks such as development, operation and maintenance of the infrastructure, and usually traffic control and capacity allocation. Sometimes associated real property such as land and stations are included. Railway services refer to running the trains, and related tasks such as ticketing. Actors providing railway services are called *railway (service) operators* or *railway undertakings*.

A typical example of a vertically separated railway market is when a government agency is responsible for infrastructure management, while one or more companies are responsible for providing services, including running the trains, and 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 complementary 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 1.

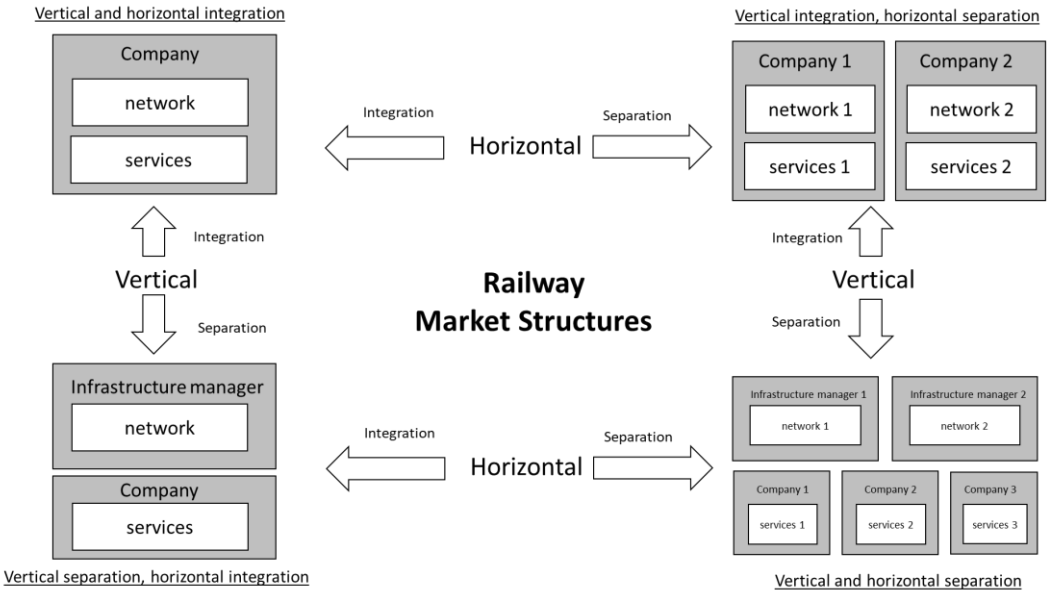

Figure 1 - Overview of the major railway market structures

The traditional railway market structure, and still the most common, is a completely vertically and horizontally integrated structure, see top-left in Figure 1. 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 with a monopoly on the entire market. Another variant with a long history is one with several distinct railway networks or sub-markets, see top-right in Figure 1. Each is vertically integrated but are horizontally separated from each other.

In a vertically separated market, infrastructure management is separated from railway services, see bottom-left in Figure 1. Both infrastructure management and railway services, respectively, may then be horizontally separated, see bottom-right in Figure 1. An increasingly common structure in Europe is one with a single infrastructure manager but several operators providing competing or complementary railway services. With this setup, infrastructure management is horizontally integrated while railway services are horizontally separated.

In the 1980s, many countries worldwide started vertically separating their railway markets. An increasingly important aim has been to open access for competing

operators. This structure is also enforced by the European railway directives (EC, 2016), which is intended to foster competition in railway markets. The effects of these reforms are analysed in (Asmild, Holvad, Hougaard, & Kronborg, 2009), (Laabsch and Sanner, 2012) and (Abbott and Cohen, 2017).

Railway operators can be 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. Passenger services can either be primarily market-based (commercial and profit-driven) or primarily under public control (usually subsidized, and with the purpose to generate societal benefits), even if this distinction is sometimes blurred. There are no general rules as to which train services should be non-market-based. 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.

3. Railway Markets in Selected Countries

Our survey includes ten countries, chosen to illustrate a range of different market structures, presence of competition and capacity allocation mechanisms: 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.

3.1. 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 (SNCB, 2014). 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 and has several subsidiaries (SNCB, 2014):

- *SNCB Mobility* for national railway operations.
- *SNCB Europe* for international railway operations with shares in some international operators, e.g. *Thalys* and *Eurostar*.
- *SNCB Technics* for maintaining, modernizing the trains and training the staff.

[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 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 small compared to SNCB's. In 2016, 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). Recently, *SNCB Logistics* has been rebranded *Lineas* and is 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 (Infrabel, 2017a). Infrabel is also responsible for traffic control and allocation of capacity between different railway undertakings (Infrabel, 2017b).

Capacity allocation

The allocation of railway capacity is performed by Infrabel. Capacity is allocated to railway operators under the terms and conditions described in the yearly national network statement. The process starts by receiving requests for train 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 (Infrabel, 2017a). Path requests are directly allocated to the railway operator if the requested path is available. However, competing path requests may exist and, in this case, Infrabel starts a coordination process with the concerned railway operators. For international path requests, other infrastructure managers and RNE may 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 major adaptations to them.

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

Priority criteria	Type of the line with the conflict	Operator which gets the path request
1st	All lines	RU did not under-utilize previously allocated capacity.
2nd	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
3nd	All lines	Highest monthly access charge on Belgian railway infrastructure.

For conflicting late and ad hoc path requests, simple principles such as first come-first served are used (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. The access charges are expected to be revised after 2019 in view of the developments in the EU regulations (Infrabel, 2017a).

3.2. 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. Railways in Northern Ireland is operated separately, and is left out of this review. *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, called train operating companies (TOCs), and freight operators, called freight operating companies (FOCs). These are private companies that use the railway infrastructure that is allocated by *Network Rail*. They generally bid for franchises, i.e. a right to operate trains on certain routes for a number of years on specific lines. On some unprofitable passenger routes, the government contracts TOCs through 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*.

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). *Eurotunnel* has a different infrastructure manager.

The British national railway market is both vertically and horizontally separated: services are separated from infrastructure management, and there are several regional infrastructure managers under a central agency.

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), such as “improvement of the network capability”, “reflection of demand”, “short journey time” and “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, 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 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).

3.3. France

Historical background

In 1938, the national railway company *SNCF*[2] was formed by merging several small railway companies. *SNCF-infra* and *RFF* were government regulatory bodies that were responsible for infrastructure management until 2015.

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

Current structure

SNCF Group consists of three *EPIC*[3] agencies with five business units. Each unit falls in the scope of a certain *EPIC* (SNCF, 2015):

- *SNCF EPIC* develops the group strategies with *SNCF Immobilier* for real estate.
- *SNCF Réseau EPIC* for managing the railway infrastructure with *SNCF Réseau.*
- *SNCF Mobilité EPIC* is responsible for freight (with *SNCF Logistics*) and passenger operations (with *SNCF Voyageurs* and *Keolis*).

SNCF Mobilité EPIC acts as the national operator and also has shares in many private railway companies such as *Eurostar*, *Lyria* and *Thalys. SNCF Voyageurs* operates national and multinational railway services under different brand names such as *Intercités*, *TER* and *TGV*. Apart from a few freight operators, the French market has almost no alternative operators than the incumbent operators.

SNCF Réseau, the national infrastructure manager, is responsible for infrastructure related tasks, and also for capacity allocation, traffic management and control, and setting track access charges. It is divided into 11 regional units (SNCF-Réseau, 2015). Some railway lines (mostly high-speed) 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 units,

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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.

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). The allocation process starts around 3 years before services commence, by capacity restructuring and timetable preconstruction based on needs expressed by railway operators and other applicants, in practice mostly from *SNCF Mobilité*. This include timetables for maintenance work, and long-term frequent train paths covering all year.

The final timetable integrates train path requests in the preconstructed timetable, taking capacity requirements into account. Details of the train path requests are provided using computer platforms. 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 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 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. Charges for basic service such as use of sidings and terminals are included. Charges for additional services such as information systems and unscheduled services can be added. Penalties may be charged for cancelling or not using allocated capacity (SNCF-Réseau, 2017).

3.4. Germany

Historical background

The national railway operator DB[4] was formed in 1994 by merging the two former national railway companies[5] in Germany. After that, DB was divided into several divisions and business units under one state-owned holding company called *DB Group* (EC, 2001, 2004).

Current structure

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

- *DB Bahn* for railway passenger services with different units. *DB Fernverkehr*[6] provides long-distance services such as *InterCity (IC)*, *EuroCity (EC)* or *InterCityExpress (ICE)*. *DB Regio* operates regional and commuter train services.
- *DB Schenker* for freight and logistic with *DB Cargo.*
- *DB Netze* for infrastructure management with different business units such as *DB Netze Track*, *DB Netze Stations* and *DB Netze Energy*.
- *DB Arriva* for local passenger transport services (e.g. trams and buses).

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[4] DB stands for *Deutsche Bah.* i.e. German Railway.

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

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

DB Bahn is the main passenger operator and has a large market share of commercial long-distance and subsidized regional passenger services with few competitors, e.g. *FlixTrain* and *Transdev*.

The German railway infrastructure manager is *DB Netze* with several units. *DB Netze Track* owns and operates most of the German railway network in 7 regional divisions, responsible for capacity allocation and timetabling for operations and maintenance in their regions. *DB Netze Energy* is supplying power to the network and *DB Netze Stations* manages the train stations, terminals and hubs (DB, 2017).

The German railway market is 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 regions.

Capacity allocation

DB Netze Tracks within *DB Netze* is responsible for the capacity allocation process which is specified in the network statement or SNB[7] (DB-Netze, 2017).

The process starts with train path requests, using the TPN[8] 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 with a tolerance principle of +/- 3 minutes for passenger train paths and +/- 30 minutes

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

[8] TPN is the train path application portal of *DB Netze*, link: https://trassenportal.dbnetze.com

for other paths allowing to design alternative paths without the need to consult the applicant (DB-Netze, 2017).

Conflicts are resolved during the coordination phase. Otherwise, *DB Netze* uses priority rules to settle the dispute, see Table 2. The last criterion resolves the conflict using a charging mechanism, with the highest bidder being awarded the train paths subject to the conflict. In this case, the infrastructure 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)

Priority Criteria	Operator which gets the path request
1st	1. Regular interval services 2. Cross-border services 3. Freight services.
2nd	1. At least two connections to other services 2. 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 resulting in a catalogue of paths on the national and cross-border lines (DB-Netze, 2017).

Access charges

Principles for access charges are specified in the network statement. There is a minimum access package which includes basic utilization charges. Potential charges or discounts may be applied such as new service discount, noise-related or delay-related charges. Additional charges are added according to the services that are used. Incentives

and penalties are sometimes applied to encourage or deter the operators. There are also additional charges for congested railway lines which are periodically updated after capacity analysis studies (DB-Netze, 2017).

3.5. Japan

Historical background

After the nationalization of the Japanese railway in 1949, the Japanese National Railways (JNR) was created. In 1987, JNR was reprivatized and renamed JRG (Japan Railways Group).

Current structure

JRG consists of six private passenger companies, organized by region: JR Hokkaido, JR East, JR Central, JR West, JR Shikoku, JR Kyushu. These are corporations with the Japanese government as the sole shareholder and are responsible for both infrastructure management and railway operations, hence vertically integrated, in their respective regions of operations. One national private company JR Freight is responsible for freight services. The group also includes a research centre (The Railway Technical Research Institute, RTRI), a business unit for information systems (JR Systems), and some small companies.

The six JR companies own and manage their infrastructures and run passenger services on them. *JR Freight* is allowed to run their trains on their infrastructure. There are small private railway operators as well, both for passenger and freight services, but the JR companies dominate the 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[9] (trafikanalys, 2014). Similarly, companies also ensure allocation of capacity in cooperation with JR Freight.

Access charges

The vertical integration 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 companies. JR Freight pays access charges to JR passenger companies, and also to some small freight companies owning small freight networks.

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

3.6. Netherlands

Historical background

Dutch railways were managed by the government through the state-owned company NS[10] from 1938 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*.

Current structure

The Dutch railway market is vertically separated, with the government agency *ProRail* as the infrastructure manager, 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 traffic control, capacity allocation, and infrastructure maintenance and extension. *NS* has several subsidiaries operating different services (NS, 2018). The Dutch railway market is dominated by passenger services, operated by *NS* with some freight services, mostly operated by *DB Cargo*.

Capacity allocation

Capacity supply for railway operators is governed by the rules and conditions stated in the network statement (ProRail, 2017). It is part of the annual timetabling process which starts with *ProRail* receiving path requests information from the operators. Scheduling and coordination follow, converting all requests into a timetable before the final allocation of the capacity. Ad hoc requests are taken care of once the working timetable is established using the one-stop-shop principle recommended by *RNE*. *ProRail* checks

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

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 using deviation flexibility principles such as +/- 3 minutes for passenger, -10/+20 minutes for freight, use of alternative tracks, relocation or cancellation of stops for freight and speed adjustments. If an agreement has not been reached, *ProRail* applies what is called the *statutory priority rules,* which specify which type of services (passenger or freight) to prioritise on certain routes (ProRail, 2017).

Parts of the network with conflicts after the coordination are declared congested, and *ProRail* takes capacity enhancement measures for the future timetables (ProRail, 2017).

Access charges

ProRail is responsible for determining access charges based on principles described in the network statement (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).

3.7. Spain

Historical background

The national railway company *Renfe* [11] was created in 1941. In 2005, *Renfe* was split into *Renfe-Operadora* (or simply *Renfe*) responsible for railway operations and *Adif*[12] responsible for infrastructure.

Current structure

Adif, a public company part of the Ministry of Public Works and Transport company, oversees different infrastructure management tasks, e.g. administering tracks, stations and freight terminals, traffic control and capacity allocation. The company is structured into 5 directorates: Strategy and Transformation, Operation and Construction, Corporate Business Development, Personnel Management, and Financial and Management Control (Adif, 2017a).

Renfe, a state-owned company, operates freight and passenger services and is structured into 4 units: Suburban and Medium Distance, Long Distance Services, Freight and Logistics Services, and Manufacturing and Maintenance. It has several subsidiaries, e.g. *Renfe Feve* which operates the narrow-gauge lines. *Renfe* has no monopoly rights anymore, and has several competing operators, such as *Eusko* and *FGC*.

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

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

Adif manages the Spanish railway infrastructure and *Renfe* performs most of the railway operations. The system is hence vertically separated, while infrastructure management is horizontally integrated.

Capacity allocation

Adif is responsible for allocating capacity following conditions specified in the 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 are, in order of priority: public services, international services, services with framework agreements, frequent services and overall system efficiency. Sections of the infrastructure with conflicts are dealt with as congested in future planning tasks (Adif, 2017b).

Access charges

The access charges are set by *Adif* according to the Spanish railway law and are specified in the network statement (Adif, 2017b). The charges consist of direct rail fees, tariffs and charges for supplementary services. Rail fees charge the use of safety control systems. Rail tariffs charge the use of the infrastructure depending on traffic volume (per km and train -year) plus charges for reserving capacity depending on its availability. Additional tariffs are added for using stations and rail facilities (Adif, 2017b).

3.8. Sweden

Historical background

The government agency *SJ* [13] managed the Swedish railway until 1988 when infrastructure management was transferred to the Swedish Rail Administration, *Banverket*. *SJ* was split into several state-owned companies in 2001 and *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 in 2010.

Current structure

Trafikverket is a government agency responsible for the management of the Swedish railway infrastructure, including capacity allocation and traffic control. It is divided into several units that operate in different fields (Trafikverket, 2015).

The main operators are the incumbent *SJ AB* for passengers and *Green Cargo,* formerly part of *SJ*, for freight services. Several private companies have started operating in recent years since the market was deregulated such as *MTR*, *Tågkompaniet* and *Snälltåget.* Local and regional commuter trains are controlled by regional-level governments (counties and municipalities), often by competitive tendering to operators. The freight market also includes several operators, e.g. DB Schenker.

The Swedish railway market is vertically separated. It is also horizontally separated in terms of operations with several operators providing different services, whereas infrastructure management is horizontally integrated with one national network manager.

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[13] *SJ* stands for “Statens Järnvägar”, i.e. the State Railways.

Capacity allocation

Trafikverket is responsible for capacity allocation as described in the network statement (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 with operators aiming to accommodate most of the path requests. Ad hoc requests can be submitted any time and can be 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 based on socio-economic cost calculations described in the network statement (Trafikverket, 2017). Lines with conflicts are declared congested, and capacity analysis is conducted.

Access charges

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

3.9. Switzerland

Historical background

The Swiss railway network was nationalised in the 1890s, leading to the creation of the Swiss Federal Railways *SBB*[14] in 1902. SBB started as a government agency before becoming a state-owned company in 1999 (SBB, 2017b).

Current structure

SBB is both the national infrastructure manager and the main train service operator with several divisions, e.g. passenger services, freight services, infrastructure and real estate (SBB, 2017b).

SBB operates different passenger train services such as regional trains *Regio* and *RegioExpress*, commuter trains *S-Bahn*, intercity trains *InterRegio* 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 other companies owning infrastructure and running train services, for example *BLS*, *SOB* and *RhB*.

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

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[14] 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.

Capacity allocation

Capacity allocation is performed by *Trasse*[15], 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 in the yearly network statement (SBB, 2017a). After receiving train path requests, they are accommodated in the annual timetable. If there are conflicts, a coordination process starts to 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 actions are taken to improve capacity.

Access charges

Trasse sets access charges where basic services fees are charged for any operator with train paths in the timetable. These include a minimum price, contribution margin and electricity costs. Discounts are provided for low-noise trains and use of new ETCS train control system. Additional charges may apply for using certain services, and penalties are charged for cancellations and non-usage of capacity (SBB, 2017a).

[15] also known as Swiss Train Path Ltd.

3.10. 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. The network kept expanding with the construction of the transcontinental line in the late 1860s. After a sharp decline the market share, the government intervened to regulate and nationalise parts of the railway system, resulting in the creation of the national passenger operator *Amtrak* [16] in 1971.

Current structure

The railway system in the US is dominated by freight services; 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 to ensure safety and efficiency of both passenger and freight rail services. FRA is also responsible for developing the system and 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 with 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

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

the new high-speed companies, and the Alaska Railroad Corporation operating passenger services in Alaska.

Freight services are mainly operated by 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 used by Amtrak, subject to 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.

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

Amtrak uses infrastructure owned by private freight companies and pays usage fees. This is mostly decided by discussions and negotiations, rather than any formal method.

4. Summary and discussion

4.1. 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 ones. This led to vertically and horizontally integrated railway markets. 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 incumbents, 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, responsible for capacity allocation, and allowing several service providers to compete on commercial grounds. The EU railway directives have obviously contributed to this trend in Europe, but as we have seen, it started earlier than that and is partly driven by other considerations than the necessity to conform with the 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.

4.2. Competition

The railway market model affects the degree of competition that is allowed. For instance, the traditional vertically integrated model does not allow competition. A typical case is Japan, where a potential competing railway operator would have to use

the infrastructure owned by the incumbent operator which 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 freight markets, as well as the US freight market, are highly competitive, with several freight operators having sizeable 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 UK and to some extent Sweden. 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 are 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 with a low degree of competition have a railway market structure in which the capacity-allocating infrastructure manager 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 a major obstacle for a more competitive railway market.

4.3. 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 under the ministry of transportation, performing capacity allocation on behalf of the government (e.g. in Sweden, the UK and the Netherlands). It can also be a state-owned company with the state or government holding most shares or ownership of the company. (e.g. 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 small adjustments of path requests, so the framework often specifies certain time intervals in which the infrastructure manager is allowed to do adjustments without negotiating 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. 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 the 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 an incentive to efficiently use the capacity that is allocated for their railway operations. In most 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 are 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. 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.

5. Conclusions

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 entering 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, and the last step 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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