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EVES-Rail

**Economic effects of
Vertical Separation
in the railway sector**

Full technical report

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Executive summary

What are the net quantitative effects of historical rail sector reforms in Europe? Is any specific model systematically superior to the others based on the empirical record?

In this study, we look at the potential impact of different forms of vertical organisation of railway markets on costs and mode share. We distinguish between three general models: Vertical Integration, Holding Company and Vertical Separation.

- Several points come out of the literature review: the effects of vertical separation in terms of induced cost increases resulting from misalignment of incentives are likely to be larger than the increased transaction costs. The efficient setting of track access charges is very important, but cannot by itself lead to the correct alignment of incentives regarding both efficient use and efficient development of the rail network. Whilst past studies generally find that increased competition reduces costs, they show no consistent pattern on the impact of vertical separation on costs. The literature also gives us little evidence on the impact of reform on modal split. Finally: There seems to be no evidence that vertical separation is unconditionally superior or inferior to other structures.
- Our new econometric evidence suggests that at higher traffic densities, vertical separation increases costs; whilst at lower densities it appears to reduce them. At mean traffic densities, vertical separation does not significantly change costs, whereas a holding company model reduces them, compared with complete vertical integration.
- We find that a high dependence on freight traffic for revenue appears to increase the costs of vertical separation. For a given level of train density, it seems that freight traffic causes more coordination problems in a separated environment than passenger traffic.
- We find no evidence that vertical separation is superior to the holding company model in its impact on rail's modal share in freight or passenger transport.

Why do certain reforms yield or fail to yield certain effects?

- The literature points to the importance of the analysis of transaction costs in unbundled regimes and at the relatively larger importance of the misalignment costs that may result from an inadequate institutional setup. Existing studies draw different conclusions concerning the desirability of vertical separation, but seem to agree that there does not seem to be a 'one-size-fits-all' solution in term of unbundling.
- Determining elements for the debate include the discussions on fragmentation versus leadership, short-termism versus the need for long-term planning, sub-optimization and misalignment versus whole-system approaches and incentive re-alignment, and transaction costs versus induced system costs.
- Four main planning time horizons, and corresponding coordination circles, need to be distinguished in the discussion on misalignment of incentives: Firstly, long term planning, which is concerned with investments in assets that are characterised by lengthy amortisation periods, both for the moving assets, and even more so for the fixed assets. Secondly, medium term service planning, which is concerned with the development of concrete service concepts and staffing (incl. training). Thirdly, the

timetable cycle, usually one year, representing the shorter term, often complemented by even shorter term planning (freight). Finally, real-time adjustments at the realisation phase to cope for unforeseen events, disruptions, etc. Various issues of misalignment exist within each of these.

- Unbundling is a potential source of detrimental misalignments, which have important technical components and the pivotal point with all these issues is that situations may arise where one actor bears the costs whilst the other one gains all or at least a noteworthy share of the benefits.
- Track-access charging regimes and national performance regimes are regulated contractual market mechanisms that can play an important role but that do not appear to be adequate to solve all misalignment issues. Furthermore, most European IMs are publicly owned and are partly funded by the state. Multi-annual contracts with the government and further regulation are important but might not lead to an efficient identification of what RUs need compared to a direct commercial relationship.
- Additional re-alignment mechanisms are being developed in various countries, and it is noteworthy to mention that these tend to move towards hybrid, cooperative arrangements, rather than simple contractual market mechanisms.
- Whether the combination of vertical separation with additional realignment mechanisms will lead to a similar level of performance to what can in principle be achieved in bundled regimes is doubtful, even though bundled regimes, as an alternative to unbundling, are not in themselves a guarantee for optimal performances (the old pre-reform bundled regimes of the European railways can serve as an example). Additional performance incentives may be helpful here too and various options exist.
- Ultimately the choice of the most appropriate re-alignment mechanisms to put in place will have to depend upon the characteristics of the elements of the value chain at stake, the economic circumstances and the institutional environment. The various elements of the value chain and boundaries between actors may require different coordination mechanisms, depending upon the characteristics of the transactions at stake.
- Seen from the point of view of actual market entry by new entrants, it seems clear from empirical data that substantial entry can occur under any of the reviewed institutional structures, and that one structure does not seem more favourable on grounds of promoting entry. One important condition is the presence of a rail regulator, independent from the Ministry and with adequate resources to enforce its decisions.

What are the potential effects of reforms in view of the 4th Railway Package?

- The evidence does not suggest that vertical separation is necessarily best in cost-benefit terms. We find no evidence that vertical separation increases competition compared with a holding company model and likewise none that such increased competition would reduce costs. Nor do we find any evidence that vertical separation improves rail's modal share compared with a holding company model (although it does improve passenger market share when combined with market opening compared with vertical integration). For freight, there is no evidence that if it did increase competition this would improve market share.
- Regarding the overall impact of restructuring on costs, the position is more complicated. At typical traffic densities, it appears that the holding company model

reduces costs compared with vertical separation. While vertical separation does not have much effect on costs at average train density levels, at high levels of train density it increases costs. However, on less dense systems, vertical separation seems to have lower costs. We particularly warn against extrapolating relationships to organizations which are very different from those for which they were estimated. We do not believe our results to be applicable to small local railways.

- A decision to impose vertical separation throughout Europe would raise costs by at least €5.8 billion/year for no accompanying benefits. If rail traffic density rises, as would be a result of the European Commission's strategy to raise rail mode share, then the costs of imposing complete vertical separation everywhere will rise dramatically.
- Where vertical separation is put in place, additional measures to align incentives should be considered. Vertical separation with enhanced alignment of incentives is assumed to work best where a single railway undertaking is dominant in each region and this operator can form an alliance with the appropriate region of the infrastructure manager (as identified in the British context).
- For the holding company model to work well, the operators which are in the holding would retain a substantial market share over the whole system. Clearly the gains for this form of alignment will be much more limited if the operators in question have only a small share of the market.
- We have examples of institutional separation of essential functions and of enhanced compliance mechanisms that seem to be working well, but we have no clear evidence on their benefits and it is not clear to what extent these experiences are transferable.
- Our overall conclusion must therefore be that there is no evidence to support implementation of a single structure on all railways regardless of their circumstances.

Conclusions

- Misalignment issues are important and need to be paid much more attention
- The need for coordination differs according to the situation of the railway regarding issues such as density of traffic and the need for change.
- There is no clear evidence that additional measures are needed to prevent discrimination in the holding company model, various existing measures seem to be working well in particular circumstances.
- There is no evidence that vertical separation is necessary in order to obtain the benefits expected from competition.
- The most effective model in terms of its impact on costs differs with circumstances, and in particular with traffic density as at high levels of traffic density vertical separation increases costs.
- Overall, different structures work best in different circumstances, without prejudice to the development of competition.

Policy recommendations

- Countries should be free to choose the structural option that best suits their circumstances – thus allowing competition between different organisational models – subject to providing for non-discriminatory access for competitors. This should include both the possibility of switching from a holding model to vertical

separation, and the possibility of switching from vertical separation to a holding model.

- Where vertical separation is adopted careful thought must be given to measures to ensure correct alignment of incentives between infrastructure manager and railway undertakings. This includes, but must go beyond, efficient setting of track access charges and performance regime bonuses and penalties.
- Whatever the structure of the railway, the need for coordination mechanisms must be recognised. Feed-back loops and knowledge exchange between infrastructure manager and railway undertakings would benefit the sector.
- Dense networks need particularly close co-ordination. The importance of dense networks will increase if the goals of European transport policy in increasing the usage of rail are realised.
- The transferability of alternative approaches to vertical separation that allow for a non-discriminatory network access (such as the separation of essential functions and enhanced compliance and regulatory mechanisms within a holding model) should be studied in more depth to allow adapting them to local circumstances.

Introduction

Study goals

The goal of this study is to assess the potential impact of various forms of partial or total vertical separation in the rail sector in the European context. A main policy question is whether a limitation in the choice between structural railway regimes is recommendable or not. Existing economic studies draw mixed conclusions about the impacts of various reforms – hence the need for a thorough assessment of key impacts and mechanisms in order to guide policy-makers ahead of discussions pertaining to the Fourth Railway Package.

The general argument for vertical separation, as assumed in many economic studies and policy documents, is based on the assumption that competition is needed to improve the performances of the railways and that competition may work less well without (full) vertical separation. So this argumentation assumes that there would be gains from separation on the competition side, while any system effects resulting from separation are assumed to be either positive or, if negative, smaller than the gains from the (assumed) higher competition, thus leading to a net positive effect of vertical separation.

The general argument for vertical integration is related to the technical complexity of the railway sector and the need for a close coordination between track and train. In this argumentation, separation is assumed to reduce the possibilities for system-wide (track and train) optimisation of investments and operations, ultimately leading to overall cost increases and a less efficient and competitive railway. Vertical integration is seen as allowing the development of clear integral business-cases for each investment or service idea, enabling the evaluation of its total contribution to the sector and preventing the double sub-optimisation that vertical separation would engender.

On the system efficiency side, there is a growing concern that system fragmentation cuts off crucial links and leads to a misalignment of incentives that then need to be “reconstructed” using other mechanisms, and that those mechanisms, overall, may be less cost-efficient. On the other hand, there is also a view that positive system effects may emerge thanks to the greater clarity and transparency created by separation, and because it opens up possibilities of specialisation. Consequently, the net effect on system efficiency is an open question, both theoretically and empirically, and this question needs to be assessed.

On the competition side, it is not necessarily clear from the empirical record that full separation always yields superior competitive results. In a partially separated system, such as a holding company, there may be effective ways of securing non-discriminatory access and effective market entry. On the other hand, the greater clarity of separation could also help removing conflicts of interest and ensure non-discriminatory access. Therefore the gains on the competition side from further separation are uncertain *ex ante* and need to be assessed.

In order to assess the validity of these arguments, we need to investigate the relationships between different separation models on the one hand, and overall system costs and competition on the other. In doing so, we need to pay attention not only to the interfaces created and the pure transaction costs that may result from vertical separation, but also to the costs that are potentially created throughout the value chain and that

result from incentive misalignment between the actors involved due to the lack of system-wide coordination and optimisation that the interfaces between actors may engender.

In sum, the net effect of a compulsory reform towards further separation for systems that are currently only partially separated could potentially be either positive or negative, and in either case the gains or losses may turn out to be large, or on the contrary very small. Conversely, a possible reform in the direction of partial re-integration of currently fully separated systems may or may not lead to a net positive effect. Such scenarios of potential structural reform need to be evaluated on the basis of a solid research effort.

Approach

This study seeks to contribute significantly to this important discussion both by investigating quantitative effects of previous reforms, and by going further into investigating what structural and institutional mechanisms are involved in driving the quantitative performance of rail systems in Europe.

The study is based on several methodological pillars of high scientific standard. It is not based on interviews and opinions of stakeholders. The study includes a literature review, econometric analysis based on refined data sets and also a value chain analysis, stressing that more than one approach is needed to understand the complexities of the railway sector and the impact of various institutional policies. In developing this new multi-faceted research work, the study goes much deeper than pre-existing studies into the analysis of the railway sector and its value chain, while covering a wide range of institutional configurations of the railway sector.

The study then evaluates the potential impact of further reforms that could be undertaken in some Member States as a result of potential legislation currently under consideration in the context of the Fourth Railway Package. It does so on the basis of the findings presented in the study before presenting relevant lessons for policy-makers.

Structure of the study

Part 1: Quantitative research findings

What are the net quantitative effects of historical rail sector reforms in Europe? Is any specific model systematically superior to the others based on the empirical record?

- What does the academic literature tell us so far?
 - Chapter 1: Literature review
- What can be quantified about the impact of reforms so far?
 - Chapter 2: Impact on rail system costs
 - Chapter 3: Impact on rail's modal share
 - Chapter 4: Value for money from state budgets

Part 2: Quantitative research findings

Why do certain reforms yield or fail to yield certain effects?

- What does the consulting literature tell us about the impacts of unbundling?
 - Chapter 5: Literature review
- What is the structure of the railway value-chain and what are the consequences of unbundling?
 - Chapter 6: Rail sector model: understanding the value chain, where interfaces lie, and what institutional forms exist or may potentially exist

- Chapter 7: What happens at those interfaces? What are the interests (“target functions”) of rail sector actors and where and when do they work well (aligned) or lead to conflicts/losses (misaligned)?
- What are the options for competition and non-discriminatory access?
 - Chapter 8: How is non-discriminatory access supported in different rail sector models? Is competition substantially affected by the vertical separation regime in practice?

Part 3: What are the potential effects of reforms in view of the 4th Railway Package?

- What are the implications of the findings of this study?
 - Chapter 8: What can be said about the (potential) effects of switching from one regime to the other?
 - Chapter 9: Conclusions of the study: what did we learn? (focus: content/analytical)
 - Chapter 10: Policy recommendations (focus: political)

Annexes: including country analyses and country fiches describing the institutional configuration of the railway sector in a selected number of countries.

Definitions

Several concepts are used throughout this study. We provide here a short definition list:

- **Reforms:** All modifications to the institutional configuration of the former state railways. This can cover a wide range of changes, such as: institutional reforms (separation), privatisations, introducing management independence from the state, internal reorganisations to improve efficiency, etc.
- **Separation (institutional, organisational, accounting):** Separation between IM and RU at three different levels of intensity. Accounting separation: IM and RU make up one company but their accounts are distinct. Organisational separation: IM and RU make up distinct organisations (companies) within one company (holding), and their accounts are – thus – separated. Institutional separation: IM and RU constitute totally distinct organisations (companies).
- **Vertical integration** (in short VI): Absence of institutional separation between IM and RU. Both are managed by one management. No unbundling measures are implemented.
- **Vertical separation** (in short VS): Institutional separation between infrastructure manager (IM) and railway undertaking (RU). Both are separate bodies or companies.
- **Holding company model** (in short HC): Intermediate form between VS and VI where IM and RU are distinct companies, but both part of a same holding, or somehow controlled by the same ‘mother’ company. ‘Holding models’ cover a wide variety of arrangements in terms of ownership, management, etc. We use this term here to cover all intermediate arrangements between vertical integration and vertical separation.
- **Essential functions** (EF): Path allocation and determination of track access charges (TAC).
- **Horizontal separation** (in short HS): Institutional separation between passenger operations and freight operations. Also, institutional separation between (vertically integrated) passenger operators, as implemented in Japan.

- **Liberalisation:** Opening the access of the railway to new entrants (besides the incumbent operators). The actual entry to the market can take place in various ways: open access, competitive tendering, direct award or by privatising an existing publicly-owned company.
- **Open access:** Open access to the rail network to licensed train operating companies, allowing for competition ‘on the tracks’ between operators.
- **Competitive tendering** (also franchising): Competitive mechanism to allocate a temporary right of operation of certain train services to an operator. This right can be exclusive or not.
- **Transaction costs:** Costs incurred in making an economic exchange, such as the search costs needed to determine whether the service or good required is available on the market and at what price, the costs of reaching an agreement with the selling party (contracting costs) and the costs related to enforcing the realisation of the transaction, making sure the seller sticks to the contract terms and – if needed – the costs of legal action to enforce the contract.
- **Costs of misalignment:** Costs resulting from the misalignment of incentives between actors created by structural reforms. VS, as structural reform, results in the existence of several actors (RU and IM), each of which submitted to a set of incentives given by the market and/or by the regulatory context. Each of these actors optimises its (economic) position under these constraints. A misalignment of incentives appears when this results in a situation that is not equal to what would be optimal at system-level and best value to society. The resulting ‘costs of misalignment’ are constituted by the difference between the economic balance under VS, compared to what the balance could have been under a system-wide optimisation (example: additional capacity investment needs, additional operational costs or lost revenue opportunity resulting from a lack of coordination between IM and RU).
- **System-level** (also system-wide): Approach considering the total economic balance of the railway sector, irrespective of a distinction between IM and RU.

Part 1: Quantitative research findings

SUMMARY

We look at the net quantitative effects of rail sector reforms in Europe to-date. After a review of the literature we present our research results concerning the impact of different forms of vertical organisation on total rail system costs, on rail's modal share, and on state spending. We distinguish between three general models: Vertical Integration, Holding Company, and Vertical Separation.

Past studies generally found that increased competition reduces costs, but showed no consistent pattern on the impact of vertical separation on costs. The literature also gives us little evidence on the impact of reform on modal split. In sum: there seems to be no evidence that vertical separation is unconditionally superior or inferior to other structural models.

We then carry out our own econometric assessment of rail system cost by estimating a total cost function on a sample of 26 OECD countries observed over 1994-2010. Controlling for output size and input and factor prices, we test for the effects of various structural forms. Our findings are that at higher traffic densities, vertical separation increases costs; whilst at lower densities it appears to reduce them. At mean traffic densities, vertical separation does not significantly change costs, whereas a holding company model reduces them, compared with complete vertical integration. We also find that a high dependence on freight traffic for revenue appears to increase the costs of vertical separation. We then use the model to project the potential effect of a universal imposition of vertical separation in the European Union. We find that this would lead to a net aggregate loss (cost increase) compared to the status quo.

Our second econometric assessment focuses on modal shares. We assess the impact of various structural forms on rail's modal share in both passenger and freight, also on a sample of 26 OECD countries over 1994-2010. We find no evidence that vertical separation is superior to the holding company model in its impact on rail's modal share in freight or passenger transport. This result also holds when controlling for the introduction of competition.

Finally we carry out a more limited assessment of state spending in the railway sector for five selected European countries. We find that there is no clear pattern in terms of value-for-money for state budgets between more or less vertically-integrated rail systems.

1 Review of the literature

In this chapter, we review the literature on quantification of the impacts of alternative railway structures, drawing heavily on Nash (forthcoming). Railway reform has aimed both at reducing costs and at improving quality of service. Thus an overall assessment of the impact of reform would need to measure its net benefits, allowing for the impacts on costs, revenues and other benefits. Because many rail services and fares are heavily regulated, and because of the predominance of externalities, value added is not a good measure of the net benefit of rail services and it is rare for studies to use this as a variable. Instead, the vast bulk of the studies of the impact of railway reform simply look at the impact on costs or physical productivity of providing a specified set of services. We have however found a small number of studies which have looked at the impact on demand or modal split. In the next sections we consider first the likely costs and benefits of vertical separation, then attempt to measure the impact on costs and review studies of the impact on demand and modal split, before reaching a brief conclusion.

Likely costs and benefits

A number of studies (including Nash, 1997; Preston, 2002; Ksoll, 2004 and Drew, 2009) discuss the likely costs and benefits of vertical separation. We base our summary here on that of Mizutani and Uranishi (2012). All these studies argue a priori that the principal benefit of vertical separation is in the promotion of competition, since it removes the incentive of a vertically integrated company to discriminate in favour of its own operations. They argue that increased competition is likely to lead to the provision of better services, raising rail market share, and to the reduction of costs. They claim that vertical separation also simplifies regulation of the infrastructure manager by promoting clarity of relationships and financial flows within the industry, and encourages specialisation, which may improve cost efficiency and marketing. As opposed to that, it is argued that vertical separation may lead to additional costs resulting from complexity of interfaces and duplication of facilities and services, transaction costs of negotiating and enforcing contracts and to misalignment of incentives regarding pricing, investment, capacity allocation and provision of information. Of course, to a degree these misalignments will apply even in a vertically integrated system with open access, particularly where open access operators have a substantial share of the market (for instance Coublucq et al (2012) show that in such a situation the incentive to invest in infrastructure is reduced). The increased competition promoted by vertical separation may take either of two forms. The first is open access or on track competition, where new entrants can compete in the market for business on a commercial basis. This is the form of competition now permitted for freight traffic throughout the European Union; it is also permitted for international passenger services throughout the EU, and for domestic commercial passenger services in a small number of countries. The second form of competition, competition for a franchise, or contract, to run services on behalf of the government through a competitive tendering process, is used for subsidised services in several countries and for almost all services in Britain.

Overall, it seems likely that vertical separation would raise costs and reduce service quality for a given level of competition. The effect is likely to be greater, the more complex and heavily used the system (since the interfaces referred to above, and particularly those relating to capacity allocation, real time traffic control and maintenance, become more

complex when a system is heavily used). The benefits of specialisation may counter this resulting from separation of responsibility for infrastructure and operations (vertical separation) and also for freight and passenger services (horizontal separation). The benefits of vertical separation largely flow from the postulated increase in competition, leading to lower costs and higher quality of services. It should however be noted that both British (Wheat and Smith, 2010) and US (Caves et al, 1987) evidence suggest that rail systems are subject to roughly constant returns to scale but increasing returns to density. The former shows that this applies to vertically separated train operators so the effect is not solely in the infrastructure. Thus simply having more operators in a country should not raise costs, but splitting services on a particular route between operators will, other things being equal. This result tends to favour franchising rather than on track competition provided that both forms of competition exert a similar pressure on costs. It will make it likely that there will remain a single dominant operator for a particular type of traffic on a particular route whatever the approach to competition, making at least a degree of vertical integration feasible as a long term solution provided that the problem of discrimination can be dealt with and especially where a single type of traffic is dominant.

Impact of reforms on costs

As noted above, there are various reasons to suppose that reforms may affect all aspects of costs, but transaction costs may be particularly influenced by vertical separation. By transaction costs we refer to the costs of negotiating, monitoring and enforcing contracts. In this section we will first consider studies specifically of transaction costs, but then go on to studies of total costs.

A couple of papers have tried to quantify directly the additional transaction costs arising from vertical separation. Merkert (2010) takes a top down approach looking at the proportion of total rail systems staff classified as managerial and administrative in three countries with different structures – Germany, where infrastructure and operations are separate subsidiaries of the same holding company, Sweden, where there is total vertical separation and Britain, where there is total vertical separation and an attempt to deal with misalignment of incentives by means of complicated track access charging and performance regimes. He finds this category of staff costs to be around 10% of total system costs in Sweden and Britain but only 4% in Germany. However, this figure will reflect the transaction costs of all the differences between Britain and Sweden, and Germany, not just vertical separation, and also be very susceptible to differences in the classification of staff. In a further paper, Merkert et al (2012) provide the only direct estimate of the level of transaction costs involved in interactions between the infrastructure manager and train operators that we have found. By means of interviews, they collected data bottom up on the staff time involved in interactions between infrastructure managers and train operating companies in the same three countries. They found that the most time consuming areas of interaction were train planning and day to day operations, but that at most transaction costs were 2-3% of total cost, and vertical separation added less than 1% to total costs compared with the holding company model. Transaction costs were highest, as a proportion of total cost, for freight operators, perhaps reflecting the fact that freight services operated vary on a day-to-day basis, unlike passenger services which are usually the same for a whole timetable period.

In Britain, the McNulty study (McNulty, 2011) was set up jointly by the Department for Transport and the Rail Regulator to examine why rail costs in Britain have increased since reform. Overall McNulty concluded that the costs of the British rail system could be

reduced by 30% by 2018/9. Of this some 2% might be achieved by reduced transaction costs, and 2-20% (according to different case studies) by better-aligned incentives. At present, the only way in which train operators in a vertically separated system are incentivised to take account of costs of the infrastructure manager in their decisions is through the track access charges they pay. In a vertically integrated system, direct management action can achieve this. The current position in Britain is that track access charges to train operators are designed to reflect the marginal cost of the wear and tear caused by different types of vehicle and (very roughly) the contribution trains make to congestion on the system. Train operators other than passenger franchisees only pay marginal cost. Although passenger franchisees also pay a fixed charge to contribute to the total cost of the system, a share of total costs is paid direct to the infrastructure manager (Network Rail) by the government, whilst changes in the track access charges paid by franchisees lead to equivalent changes in their payments from or to the government under the terms of the franchises, thus completely protecting franchised passenger operators from any changes in track access charges. Thus, although train operators may have some incentive (e.g. through performance regimes) to help or pressure Network Rail to deliver rail capacity, they have no incentive to induce Network Rail to realize this in the most cost effective way from a whole-system perspective.

It should be stressed that the solution here is not simply to move to variable charges covering full cost for track access, as that would lead to distorted decisions about what train services to run. Evidence suggests that the marginal cost of an additional train using the infrastructure is well below average cost. Efficient decisions on whether to run more or fewer services rely on comparing the revenue or benefit of an additional service with its marginal costs (or the extra costs it causes). A vertically integrated company will take decisions this way. If a vertically separated infrastructure manager charges substantially above marginal cost in order to cover the fixed costs of the infrastructure, railway undertakings will withdraw services even though they are more than covering their marginal cost.

Charging according to a two part tariff, whereby the train operator paid a fixed charge equal to the avoidable cost of the infrastructure capacity requested under a long term framework contract and a variable charge equal to the short run marginal cost of the services actually run might reconcile the need to incentivise efficiency both in the provision of capacity and in its use (Nash, 2005). But except in the case of a monopoly franchise, such a two-part tariff would be seen as discriminatory under EU legislation. Therefore, it may be impossible to design a track access charging system that simultaneously provides for non-discrimination, appropriate incentives for efficient development of the network and appropriate incentives for its use. In this case, alternative policy instruments must be used to achieve at least one of these aims.

The solution to this problem was seen by McNulty as being closer arrangements between Network Rail zones and franchised train operating companies, taking the form of alliances, joint ventures or even the leasing of infrastructure to the franchisee. Different solutions were seen as appropriate for different circumstances; for instance, the latter was only seen as appropriate where in isolated cases such as on rural lines which could function as 'stand-alone' community railways or perhaps where there was a single dominant train operator, as there are in some parts of Britain given the comprehensive franchising system and the dominance of passenger services.

In a study specifically of the Swedish experience, Jensen and Stelling (2007) estimate cost functions with time series data for Sweden for 1970-99, and find that vertical separation

there raised costs, but that this is more than outweighed by the favourable impact of competition, particularly through passenger franchising. A number of studies of individual countries have shown reductions in subsidy of 20-30% as a result of passenger franchising (Alexandersson, 2009), with the big exception being Britain where costs have risen sharply (Smith, Nash and Wheat, 2009). Where savings through competitive tendering have been achieved, they have been similar in Germany (with a holding company structure) and in Sweden (with complete separation) (Brenck and Peter, 2007). Thus from this evidence there is no reason to prefer full vertical separation to the holding company model.

But most of the relevant literature on costs comes from estimation of an overall production or cost function on a panel of European railways over time. Many of these studies are now quite old, so they do not take account of the major changes in the rail market in recent years. Most of them use data from the UIC International Rail Statistics, supplemented to some extent from other sources such as individual company accounts. This source of data has some known deficiencies. Firstly it generally only covers the main state owned operator in each country, and Britain – the country where reform has been carried furthest – is excluded. Secondly some of the physical data is incomplete or misleading. For instance, Abate et al (2009) shows the inconsistency of the data on rolling stock; this appears to be the only study to systematically correct for this. Thirdly, in some cases (certainly for Germany) the data includes subsidiaries in other countries, so the geography of the infrastructure and operations added together is inconsistent. Fourthly, there is a general problem with physical data such as staff numbers, in that subcontracted activities, such as track and rolling stock maintenance and cleaning in some countries, are not included. Subcontracting should be included in the cost data, and for that reason we consider it is generally more reliable, although it may have problems of its own particularly in the calculation of depreciation and financial charges given different assumptions about amortization, and variations in interest rates and capital write offs.

A further issue is the actual measurement of the reforms. Ideally we would like to account separately for the impact of different degrees of competition in passenger and freight markets and different degrees of vertical separation (at least using the three different categories identified in the Rail Market Monitoring Study – complete institutional separation, the holding company model and hybrid systems). Most studies take account of the date of legal reforms, such as rights of access, introduction of competitive tendering on one route or establishment of a regulator, but these often happened many years before any significant entry took place and in a situation when it was known that there were still effective barriers to entry.

Finally, there is a risk that the reforms carried out may be correlated with other variables relating to the operating conditions of the railway concerned. This is particularly a problem given that vertically separated railways tend to be clustered around the periphery of Europe and vertically integrated ones in the core. Thus it is necessary to introduce variables to control for these factors.

Given all these problems, it is not surprising that no consistent pattern emerges from past studies. For instance, Wetzel (2008) found that separation has no significant impact on technical efficiency, whereas Growitsch and Wetzel (2009) found significant diseconomies from separation of infrastructure and operations in most countries. Friebel et al (2010) find that in general introduction of open access, vertical separation (whether as a holding company or total separation) and creation of a regulator improve efficiency, but the results depend on the sequencing of the various reforms; undertaking all together is

damaging. All these studies rely on physical data, fail to take account of different operating conditions in different countries, and rely on dates of legal changes rather than actual reforms. Thus for instance Friebel et al (2010) date open access in France as 1997, while in practice the first private operator only launched its activity in 2005.

Asmild et al (2008) had available an independent source of cost information from another study, and went to considerable lengths to clean up the UIC data used for other variables; exceptionally they also included Britain. However, their data only covered the period 1995-2001. They found both competitive tendering for passenger services and freight open access to improve efficiency, as did accounting separation of infrastructure and operations. There was no significant further effect of complete vertical separation.

The most recent studies are those of Cantos et al (2010, 2011) and Mizutani and Uranishi (2011) and these will be discussed in a little more detail.

Cantos et al (2010) uses data envelopment analysis on physical data for 16 railways for the period 1985-2005. In a first stage they use two outputs (passenger-km and freight tonne-km) and four inputs – employment, number of passenger carrying vehicles, number of freight wagons and route-km – to compile measures of efficiency. They then regress these measures on variables reflecting the operating conditions of the railway concerned (percentage of train-km that are passenger, traffic density in terms of train-km per route-km, mean passenger train load and mean freight train load) and on variables reflecting vertical separation and mean passenger and freight train loads. They find separate beneficial effects of vertical separation and introduction of competition in the freight market, whereas passenger franchising has no such effect. However, of the four countries in their sample in which passenger franchising has been introduced only in Sweden and Germany has it covered a significant proportion of regional services and in none has it covered commercial services. That vertical separation has improved efficiency over and above the impact of competition is surprising; we worry that this may be because vertically separated systems undertake more subcontracting and that this has not been picked up in the physical data, but we have no evidence on this issue.

Cantos (2011) uses a greater sample of 23 countries and a more up to date period of 2001-8. It repeats the data envelopment analysis approach of the earlier paper, but also applies a stochastic frontier approach, showing that this leads to much lower efficiency scores although the ranking of countries in terms of efficiency is similar. The results of the second stage analysis are rather different however. Vertical separation has no significant effect on efficiency, whilst the strongest positive effect on efficiency comes from passenger tendering. Freight open access has a positive effect on efficiency that is significant in one of the models. Unfortunately, perhaps because of problems acquiring the data, they seem to have a less adequate set of variables as controls in the second stage of their analysis. They only include population density and rail route length. The results could be considerably biased by the lack of data on passenger and freight train loads, which tend to be heavily influenced by the geography of the country and government policy, but which are major determinants of efficiency.

Mizutani and Uranishi (2011) estimate a translog cost function on data for 30 companies in 23 countries, adding together train operating companies with the infrastructure manager over which they run. Their sample includes companies in Japan and South Korea, as well as Europe. They conclude that vertical separation leads to cost reductions in particular for railways with low train density, while railways with higher train density experience cost increases. They explain this in terms of the transaction costs of operating

a complex system with conflicts over the use of capacity. They also conclude that horizontal separation of freight from passenger operations has been beneficial. They do not separately measure the benefits of competition, so to the extent that vertical separation increases competition, the measured impact is the net effect of these two factors.

Impact of reforms on demand and modal split

Turning to the evidence on impacts on demand, there is far less evidence to go on.

There are a couple of specific studies of franchising in Britain. Wardman (2006) concludes that whilst most of the major growth in rail passenger demand in Britain since the introduction of franchising is due to external factors such as rising incomes and increased road congestion, there is a small unexplained element that may be attributed to improved marketing and other 'soft' service quality attributes following franchising. He has already taken out the effect of increased train kilometres and the holding down of regulated fares over this period. Preston and Robins (2011) find a much greater increase in demand due to franchising taking these factors into account, but to the extent that these were government decisions presumably government could have chosen to impose them on the former rail operator.

There is much less evidence on open access passenger operations as they have been very limited to date. Griffiths (2009) reviews British experience and Seguret (2009) German. In both cases competition to date has been mainly in niche markets, running at low frequencies on routes not served by the incumbent operator, but open access entrants do invariably offer lower fares than the incumbent as well as through services to places not otherwise served by through trains. Head-on competition at high frequencies on key routes has now started in a number of countries, including Italy, Austria and the Czech Republic, but too recently for results to be available. So for the effects of this form of competition we are forced to rely on modelling. A number of studies using the Praise model (Preston et al, 1999; Preston et al 2002) conclude that head on competition is only feasible where demand is strong and/or track access charges low, and even then it tends to lead to excessive service levels and therefore costs.

Fowkes and Nash (2002) reach similar conclusions to those on franchising regarding the growth of rail freight in Britain, that it was mainly due to external factors such as the increased use of imported coal, but that the fact that rail modal share had risen in most commodities suggested some improvement due to privatisation and the introduction of competition in freight.

Looking more widely across Europe, Drew and Nash (2011) make simple comparisons of vertically integrated (holding company) and vertically separated railways. They find that there is more competition in the freight market in vertically separated railways (15% of the market on average held by new entrants as opposed to 12% in vertically integrated countries). But on average vertically integrated railways have seen substantial growth, and vertically separated countries none. They acknowledge that this comparison is heavily influenced by the case of France, which is in any case a hybrid with many of the functions of an infrastructure manager (track maintenance, signalling) performed by the state owned train operator. But even taking France out, vertically integrated railways still perform significantly better.

In the passenger sector, vertically separated railways do perform better in terms of passenger growth on average than vertically integrated railways. But here the countries

that have performed best are Britain, France and Spain. In Britain, part of the growth does appear to be due to the reforms, as commented above. But in France and Spain, there has been no competition in the passenger market. In these countries, it is clear that a high level of investment, particularly in high-speed rail, is at least part of the explanation for the growth.

Laabsch and Sanner (2012) test these relationships further by means of a regression model relating modal split to various explanatory variables, including rail industry structure and market opening (measured by the IBM/Kirchner liberalisation index) as well as measures of public spending on rail, strength of regulation and GDP per capita. In the passenger sector, both vertical integration and liberalisation are found to have a significant positive impact on rail modal split. In the freight market no significant effect of either industry structure or liberalisation can be found. They hypothesise that this may be because of the importance of international traffic in the freight sector, which depends on conditions in more than one country.

Conclusions

In summary, then, there are many inconsistencies in the results of studies of the impact of European rail policy, and these may partly be explained by the difficulty of getting appropriate and consistent data. Table 1 summarises the studies of the general impact of reforms on costs. There seems to be no evidence that vertical separation is unconditionally superior or inferior to other structures. It appears that most studies find a beneficial impact of competition on costs, but the results on changes in structure are far more variable, and in some studies vary between countries, for instance according to train density. Specific studies of competitive tendering of passenger services have also shown reductions in costs everywhere except Britain. On the demand side, the only convincing evidence is for a positive impact of competitive tendering on demand.

We believe that one major reason for these inconsistent results is deficiencies in the data. In later chapters we seek more conclusive results with the improved data available to this study.

TABLE 1 IMPACT OF RAIL REFORM ON COSTS

Authors (year)	Countries covered	Effect of vertical separation	Effect of competition	Combined effect
Jensen and Stelling (2007)	Sweden	Negative	Positive	Positive
Friebel et al. (2010)	Europe	Positive if appropriately phased	Positive if appropriately phased	Positive if appropriately phased
Cantos et al. (2010)	Europe	Positive	Positive	Positive
Cantos (2011)	Europe	Not significant	Positive	Positive
Wetzel (2008)	Europe	Not significant	-	-
Growitsch and Wetzel (2009)	Europe	Negative for most countries	-	-
Mizutani and Uranishi (2012)	Europe and Japan	Depends on train density	-	-

2 Econometric assessment of costs

The purpose of the analysis conducted in this chapter is to draw conclusions on the impact of vertical and horizontal separation (as well as intermediate forms), and on the introduction of competition (in both passenger and freight) on rail costs. The chapter comprises a write up of the cost econometric modelling work used. A technical annex (Annex D) provides some further details of the modelling approach and the variables used. However, for transparency purposes, as much detail as possible is provided in the main text.

The remainder of the chapter is divided into four sections: Section 2.1 summarises the key findings of this chapter. Section 2.2 summarises the objectives of the analysis, the approach and the questionnaire sent out to CER members (the questionnaire sent out to members is included in Annex C). Section 2.3 sets out the model and results. Section 2.4 offers an interpretation of the results from a policy perspective and also sets out some important caveats regarding the data and the method that need to be taken into account in drawing conclusions.

2.1 Summary of key findings

The key findings of this chapter of the report are as follows:

- Imposing vertical separation on those EU countries which have not yet separated (and thus are either currently vertically integrated or have adopted the holding company model) would increase costs by around €6 billion/year at current train density levels, and by up to €15 billion/year if EU railways achieve the sorts of growth targets envisaged by the Commission. Thus it does not seem appropriate to adopt a policy of requiring all railways to be vertically separated, as this will increase costs, based on the results of the modelling exercise undertaken as part of this project.
- Further, horizontal separation appears to have led to a very substantial reduction in costs (of around a quarter). This aspect of the structural reforms implemented by European railways therefore seems to have led a large reduction in costs, though it could in part reflect the fact that in a number of cases cost reductions took place because freight divisions were sold to new owners rather than as a direct consequence of horizontal separation.
- However, it does not appear that actual competition in passenger and freight has much effect on costs over and above the effects of industry structure (holding company or vertical separation) or horizontal separation. This finding is surprising, though it might reflect the problem of specifying appropriate competition measures (see below) and it may be that the impacts of competition are in part being picked up by other variables because of this problem.

2.2 General approach

The approach

The analysis is an update of a previous paper by Mizutani and Uranishi (2012). As set out in the literature review, the previous literature is dominated by studies that utilise physical measures that may not adequately capture the inputs used by railways (in

particular, the use of track or route length to measure the capital input). Moreover, it is subject to distortion, particularly in terms of staff numbers, from the very different degrees of subcontracting found in different railway companies. A cost based study, such as that conducted in Mizutani and Uranishi (2012) thus has a number of advantages, potentially (though see the discussion of emerging data issues below).

For this project for CER it was decided to update and enhance this Mizutani and Uranishi (2012) study in a number of important ways, by:

- Adding the British data to that sample; the exclusion of Britain from previous studies has been a major disadvantage of earlier work;
- Updating the analysis beyond 2007, up to 2010 where possible. Most previous papers have not extended beyond 2005, with the exception of Mizutani and Uranishi (2012) and Cantos et al (2011), which extend as far as 2007 and 2008 respectively;
- Asking CER members to check and improve the data that had previously been collected and used by Mizutani and Uranishi (2012), which was predominantly based on UIC data (as is the case for other studies in the literature)¹;
- Using improved information collected from CER members on the timing of vertical and horizontal separation and on the dates for and extent of opening up of passenger and freight competition. Thus the exact timing of the dates for the separation and market opening dummy variables has been changed as compared to those included in the most recent paper in the academic literature, Cantos et al (2011), based on the responses to the qualitative questionnaire established for this project and knowledge contained within the project team (that is, some mistakes contained in the previous literature have been corrected);
- Enhancing the modelling of industry structure on costs. The previous literature, including Mizutani and Uranishi (2012), only considered two forms, namely vertical separation or vertical integration. In our analysis we consider two intermediate forms, namely the holding company model, and one in which essential functions are separated in either a vertically-integrated or holding company model;
- Enhancing the modelling of market opening. Previously, Mizutani and Uranishi (2012) only looked at the impact of vertical integration / separation, and did not consider the separate impact of competition. Whilst Cantos et al (2011) included competition effects, these were based (for freight) on potential rather than actual entry, and for passenger were based on actual entry (tendering only), but did not distinguish between degrees of entry (i.e. that in some countries the proportion of services tendered is small, whereas in others a much higher proportion of services is subject to tendering such as in Germany). In our sample, we also have a case (Britain) where all services are tendered. In our modelling we therefore include freight competition dummy variables that reflect whether actual entry (rather than potential entry) has occurred. We also develop a passenger competition index that reflects the extent of entry (tendering and open access). We did not have sufficient information on rail freight market shares to develop the freight competition analysis beyond use of simple dummy (i.e. some entry or no entry) variables.

¹ UIC-data is our predominant source of information, but it has been checked and improved by CER-members. However, as discussed further below, some inconsistencies remain.

- Enhancing the modelling of the relationship between industry structure and train density to reflect the fact that railways with a high proportion of freight traffic could be considered different to those with a lower proportion in respect of the impact of vertical separation and the holding company model on costs.

Further details are provided below.

The research represents a major contribution to the literature, where there is currently much uncertainty on the impact of rail reforms on costs, and substantive concerns over the data and methodologies used in previous studies (see also our literature review).

It should be noted, however, that the research carried out is only a relatively small part of a larger project and as such there are limits to what can be achieved within the scope of the project. Some issues still remain, therefore, for example, regarding data definitions, and the results need to be interpreted accordingly. Caveats to the results are discussed in section 2.4 at the end of this chapter.

The questionnaire

We started by sending out our questionnaire to those CER members included in the original list of companies used in Mizutani and Uranishi (2012) and, at the request of CER, operators in Latvia and Bulgaria. Further, a major undertaking was the compilation and addition of the British data to the study, given the extent of vertical and horizontal separation that occurred in Britain. This was undertaken by the Institute for Transport Studies (ITS), University of Leeds using industry sources. The aim of sending out the questionnaire was primarily to ask companies to update the data beyond 2007 and comment on and correct the data for the earlier years where necessary. Thus we aimed to secure a higher quality dataset and also to appreciate its strengths and weaknesses better, with obvious implications for the degree of confidence we might have in the findings. Prior to sending the questionnaire to all CER members a pilot exercise was conducted in which a draft questionnaire was sent to two companies, DB and NS. Helpful feedback was received and the questionnaire then revised before being sent out to participants. The detailed questionnaire is included in Annex C.

After sending the questionnaire we had an email exchange with a number of companies to clarify what was required in terms of data. We also had telephone conversations with representatives from SBB to provide further clarification and discuss the data issues and aims of the modelling exercise, and with representatives with DB (and VDV, an association representing non-DB operators in Germany) concerning the data for Germany.

In terms of the coverage, ideally we aim to have a measure of total costs for the railway system in each country. More precisely this means the total infrastructure costs of the main infrastructure manager (in the case of Switzerland, there are two) plus the costs of all passenger and freight operators running on that main system. For Switzerland, we understand that, although the two main operators, SBB and BLS, do run over each other's infrastructure, regarding each as a separate vertically integrated company does not distort the number of train kilometres assumed run on each system). We do not include small vertically integrated systems, of which there are many, particularly in Switzerland and Germany. Whilst the Mizutani and Uranishi (2012) study is based on a sample of companies, not countries – and does not typically include small, new entrants (train operators) – we make some adjustments to address this issue based on data from CER members (though it was only possible to do for those which had seen the most entry). Further discussion of this point is set out in sections 2.3 and 2.4 below.

The resulting dataset

Table 2 shows the data that has been used in our econometric estimations as well as the coverage by year for each company. This shows that, in addition to including data for Britain for the first time, we have also been able to update the dataset beyond 2007 for a number of countries based on the good response that we received on the questionnaire. In addition, some of the data for the earlier years has been corrected through this process, which is a further step forward relative to the previous literature. For some countries we either did not receive new data / data corrections or the data could not be used (for example, if it is incomplete), as reflected in the countries and years included in the model set out in Table 2.

TABLE 2: MAIN RAILWAY NETWORKS AND OBSERVATIONS

No.	Country	Year	# Observations
1	Austria	1994 - 2010	17
2	Belgium	1994 - 2007	14
3	Bulgaria	2002 - 2010	9
4	Switzerland (SBB network)	1994 - 2010	17
5	Switzerland (BLS network)	1994 - 2010	17
6	Czech Rep.	1994 - 2007	14
7	Germany	1994 - 2010	17
8	Denmark	1994 - 2007	14
9	Spain	1994 - 2007	14
10	Finland	1994 - 2010	17
11	France	1994 - 2007	14
12	Great Britain	1996 - 2009	14
13	Greece	1994 - 2007	14
14	Hungary (GySEV network)	1994 - 2007	14
15	Hungary (MAV network)	1994 - 2007	14
16	Ireland	1994 - 2007	14
17	Italy	1994 - 2007	14
18	Japan (JR Hokkaido network)	1994 - 2009	16
19	Japan (JR East network)	1994 - 2009	16
20	Japan (JR Central network)	1994 - 2009	16
21	Japan (JR West network)	1994 - 2009	16
22	Japan (JR Shikoku network)	1994 - 2009	16
23	Japan (JR Kyushu network)	1994 - 2009	16
24	South Korea	1994 - 2009	16
25	Latvia	2008 - 2010	3
26	Luxembourg	1994 - 2007	14
27	Netherlands	1994 - 2010	17
28	Norway	1994 - 2009	16
29	Poland	1994 - 2010	17
30	Portugal	1994 - 2007	14
31	Sweden	1994 - 2007	14
32	Slovakia	1994 - 2007	14
33	Turkey	1998 - 2009	12
All observations		1994-2010	481

2.3 Model

Reminder of objectives and definitions

Before presenting the results we first explain our definition of costs (and some of the resulting issues), and then explain the key policy variables included in our preferred model. Finally we present the results of the preferred model. A fuller discussion of the interpretation of the results from a policy perspective is contained in section 2.4.

As noted above, the purpose of the analysis is to explore the impact of industry organisational structure and competition on rail industry costs. We seek to capture in the model a set of variables that reflect genuine differences between railways, for example, passenger-km, freight tonne-km, route-km and other variables such as input prices (e.g. labour wage rates); see Mizutani and Uranishi (2012) and Annex D for further details. These variables allow, inter alia, the model to take account of any economies of scale and/or density, and then to estimate the impact of competition and industry structure after having taken account of those important features of rail production. We then include variables to capture the impact of industry structure and competition effects, after having accounted for the other differences between railways noted above.

We have already noted above that our analysis includes the costs of the infrastructure manager and the incumbent passenger and freight operator, but not in most cases smaller operators. Of course, where entry is limited or non-existent (particularly in passenger), the lack of data for smaller operators is of little concern. The problem is further mitigated by the fact that both the costs and train-km of the new entrants are excluded. Nevertheless, in cases where there is significant market entry, the exclusion of smaller operators probably makes the railway system appear less efficient than is truly the case. The reasons are as follows:

- To the extent that new entrants have lower costs than the incumbent, this effect will not be picked up in our analysis. However, any impact that competition has had in restraining incumbent train operating (or, in turn, infrastructure) costs will be reflected.
- Whilst the train-km and costs are correctly aligned in respect of train operating costs, since we are including only incumbent operator costs and incumbent operator train-km, for infrastructure, this is not the case (we include all the infrastructure costs, but only the incumbent operator train-km). This second problem is partly mitigated by the relatively low marginal costs of increased usage on rail infrastructure costs, where a large proportion of the costs are fixed in any case.

We sought to address the above issue, at least to some extent, by (where necessary) scaling up incumbent train operating costs based on passenger and freight market share data; the aim being to get an estimate of what total industry costs might be, with the model then including total industry train-km, rather than only incumbent train-km (expressed as a density number) as an explanatory variable. However, in most cases we did not have sufficient data to carry out this adjustment, either because of lack of data on market shares or lack of data on the split of incumbent costs between train operation and infrastructure costs (for integrated or holding systems). Ultimately, we were able to make the adjustment for two of the most liberalised systems (Sweden and Germany), and the British data already includes actual data for all operators in any case (thus covering the three most liberalised countries). We did have the data to make the adjustment for the

Netherlands, but the scale of the entry and the freight costs was not considered sufficiently large to make this worthwhile. Unfortunately, we were not able to include an adjustment for France where the market share of new entrants in the rail freight market has reached about 30% in 2011.

It should be noted, of course, that even the scaling up approach is not perfect, since it assumes that new entrants have the same costs as the incumbent, which seems unlikely to be the case. However, as noted in section 2.2, the aim of this part of the project was to update the previous Mizutani and Uranishi (2012) study – which was based on company data, not industry data – and we could not endeavour to address all possible data and other issues within the timescales and budget of the project. Inevitably, international cost modelling exercises require considerable input over a longer time frame. However, for the reasons outlined above, overall we consider that our results should not be overly impacted by this issue.

Key policy variables vertical separation, integration and intermediate forms

In respect of industry structure, in our estimation we are seeking to test the cost impact of the following forms:

- Vertical integration (VI);
- Holding Company (HC);
- Holding Company or Vertical Integration plus separation of essential functions (VIef; HCef); and
- Full vertical separation (VS).

This is achieved by including a series of dummy variables that take the value unity when a country has a particular form (for example, vertical separation) and zero otherwise. In order to enable estimation to proceed one of the dummy variables has to be excluded from the model and thus the effects are then measured relative to the excluded structural form. In our estimations we exclude the vertical integration dummy variable, so that all effects are measured relative to the vertically-integrated structure. Table 3 shows which countries in our sample are assumed to fall into each of these structures.

It should be noted that the third dummy variable on the separation of essential functions was intended to be included in the model as a “sub-dummy” variable such that companies which take the value 1 for that dummy also have a value of 1 for the Holding Company or Vertical Integration variable (depending on which is relevant). Companies with full vertical separation have a value of 0 for the separation of essential functions variable since this variable only takes the value of unity when this separation is combined with either the Holding Company model or the Vertical integration model. Through this method we are seeking to capture the effect of the existence of separated essential functions (path allocation and determination of track access charges) as a separate institution – separate from both the RU and the IM – whereas in the full vertical separation model the separate functions are also part of the IM. However, we consider that there were insufficient numbers of observations on this functional form to include this variable in our preferred model (see, further, below).

We considered trying to reflect in the dummy variables differences in the degree of coordination amongst those countries classified as having the Holding company model. However, we do not consider that we have enough information at present to make this judgment, so we did not take forward this aspect of the research.

TABLE 3: COUNTRIES AND STRUCTURAL SEPARATION FROM 1994 TO 2011

Country Network	Vertical Integration		Vertical Separation	Horizontal Separation	Separation of Essential Functions
	Full Integration	Holding Company			
Austria	- 2004	2005 -	-	-	-
Belgium	- 2004	2005 -	-	-	-
Bulgaria	- 2001	-	2001 -	-	-
Switzerland (SBB network)	- 2008	2009 -	-	-	2006 -
Switzerland (BLS network)	- 2011	-	-	-	2006 ⁻²
Czech Rep.	- 2002	-	2003 -	-	-
Germany	- 1999	2000 -	-	-	-
Denmark	- 1997	-	1998 -	2001 -	-
Spain	- 2004	-	2005 -	-	-
Finland	- 1994	-	1995 -	-	-
France	- 1996	-	1997 -	-	-
Great Britain	- 1994	-	1994 ⁻³	1996 -	-
Greece	- 2006	2007 - 2009	2010 -	-	-
Hungary (GySEV network)	1994 -	-	-	-	2004 -
Hungary (MÁV network)	- 2006	2007 -	-	2008 -	2004 -
Ireland	1994 -	-	-	-	-
Italy	- 2000	2001 -	-	-	-
Japan (JR Hokkaido network)	1987 -	-	-	1987 -	-
Japan (JR East network)	1987 -	-	-	1987 -	-
Japan (JR Central network)	1987 -	-	-	1987 -	-
Japan (JR West network)	1987 -	-	-	1987 -	-
Japan (JR Shikoku network)	1987 -	-	-	1987 -	-
Japan (JR Kyushu network)	1987 -	-	-	1987 -	-
South Korea	1994 -	-	-	-	-
Latvia	- 2006	2007 -	-	-	-
Luxembourg	1994 -	-	-	-	2009 -
Netherlands	- 1994	1995 - 2001	2002 -	2001 -	1995 - 2001
Norway	- 1996	-	1997 -	2002 - 2009	-
Poland	- 2000	2001 -	-	-	-
Portugal	- 1996	-	1997 -	-	-
Sweden	-	-	1988 -	2002 ⁻⁴	-
Slovakia	- 2001	-	2002 -	2006 -	-
Turkey	1994 -	-	-	-	-

In addition to the above dummy variables, we also include an interaction term relating the industry structure forms to total train density (this is simply the relevant dummy variable multiplied by train density, where the latter is defined as total train-km divided by route-km). This follows the approach set out in Mizutani and Uranishi (2012) and reflects the

² Path allocation was separated in 2006. The setting of track access charges was already separated in 1999 for TAC. This is valid for both BLS and SBB.

³ Note that a degree of horizontal separation into various business units already occurred in the erstwhile BR organization in 1992.

⁴ Post-estimation of the model we received information that 2001 is the first full year of horizontal separation. The model results are based on the data in the table above.

fact that the cost effects of, for example, vertical separation, could plausibly vary with the intensity of usage on the network. This is because increased traffic on a fixed network in a separated environment is likely to lead to increased transaction and other costs since capacity constraints will be more of an issue than when the network is used less intensively (see Mizutani and Uranishi (2012)).

We also included an interaction between industry structure and the proportion of total revenue made up by freight (we also tried the proportion of freight train-km as an alternative variable, though this model performed less well; see results section below). This variable reflects the fact that networks with a high proportion of freight traffic could differ from those with little freight on the network in terms of the impact of industry structure on costs. Our thinking here is that the task of timetabling and of real time traffic control (major areas of transaction costs according to Merkert et al, 2012) are more complex when the network is intensively used, and possibly for freight traffic, which is less likely to follow exactly the same timetable every day than passenger. Thus increased freight is likely to lead to higher costs in a separated environment.

The cost impact of vertical separation could come from a number of sources. There is a belief that several effects may or may not take place. Vertical separation could increase cost transparency within the railways in terms of where money is spent, thus potentially leading to cost savings, although transparency can also be achieved within the holding company model. It could also lead to improved management focus. On the other hand, coordination problems may cause costs to increase. Further, reforms in themselves can sometimes lead to cost reductions as they represent a major shakeup of the industry. In addition to the above effects, to the extent that vertical separation leads to greater competition on the network, this could bring downward pressure on costs.

It is worth noting that one outcome of the questionnaire was an ability to update our evidence on the actual level of competition by industry structure. For freight in 2010 we have data for 8 vertically separated countries, with a mean of 15% new entry (range 0-28) and 6 holding companies, mean of 23% (range 10-50). For all of these countries freight market competition was allowed. This does not offer any evidence for the view that vertical separation necessarily leads to more competition than a holding company.

For passenger, we only have 6 countries (4 vertically separated, 2 holding) with competition in 2010, and for two of these it was permitted in 25% or less of the market. Generally entry was not possible in the other countries. We can observe that Germany has significant passenger market competition, proving that passenger market competition can be introduced into a holding company model.

In short, then, if we believe that vertical separation will lead to cost reductions compared with the holding company model only by means of increased competition, then at present there is little evidence to show that vertical separation does indeed lead to increased competition - thus causing problems for this hypothesis.

Key policy variables horizontal separation and competition effects

In addition to the dummy variables representing industry structure from a vertical separation / integration perspective, we also included a dummy variable to capture whether countries had adopted horizontal separation. By horizontal separation we mean that passenger operations and freight operations are carried out by institutionally separate companies (see Table 3).

For competition effects we adopted two approaches. In the first, dummy variables for passenger and freight actual competition are included (taking a value of unity when some actual entry has occurred, and the value zero when no entry has occurred). The passenger dummies are based on whether competitive tendering and/or open-access entry has occurred. The assumed years for actual entry in passenger and freight for each country in the sample are shown in Table 4.

TABLE 4: COUNTRIES AND COMPETITION FROM 1994 TO 2011

Country Network	Passenger entry	Freight entry
Austria	- ¹	1999 -
Belgium	-	2006 -
Bulgaria	-	2007 -
Switzerland (SBB network)	-	2004 - ²
Switzerland (BLS network)	-	2004 -
Czech Rep.	- ³	1995 -
Germany	2000 - ⁴	1994 -
Denmark	*2003 -	1999 -
Spain	-	2007 -
Finland	-	-
France	-	2006 -
Great Britain	1996 -	1994 -
Greece	-	-
Hungary (GySEV network)	-	2006 -
Hungary (MÁV network)	-	2004 -
Ireland	-	-
Italy	*2001 -	2002 - ⁵
Japan (JR Hokkaido network)	-	-
Japan (JR East network)	-	-
Japan (JR Central network)	-	-
Japan (JR West network)	-	-
Japan (JR Shikoku network)	-	-
Japan (JR Kyushu network)	-	-
South Korea	-	-
Latvia	-	2007 -
Luxembourg	-	2007 -
Netherlands	*1999 -	1998 -
Norway	*2005 -	2007 -
Poland	*2008 -	2003 -
Portugal	*1999 -	-
Sweden	1990 -	1996 -
Slovakia	-	2004 -
Turkey	-	-

NOTES

- In this approach we consider entry on national markets. International markets were opened in line with EU-rules in all EU-countries.
- *: Denotes those countries where only a minor part of the network is subject to competitive tendering.
- Post-estimation we received additional information on first market entries. The results in this report are based on the data in the table above. The missing information refers to rather minor entries and/or minor divergences in date of entry. 1: CAT (partly owned by ÖBB) entered in 2002. In December 2011, major new entry occurred in the long-distance market, but this is outside of the period covered by our database. 2: SBB began operating over BLS in 1999. The results in this report are based on the date of entry of a third operator. 3: Viamont Co. entered this market in 1996 this was a small-scale entry. Larger-scale open-access entry took place very recently, but this is outside of the period covered by our database. 4: The first entry by competitive tendering was in 1996 (Vogtlandbahn). 5: Entry first took place in 2001.

Second, with respect to the method, we note that the above approach does not adequately capture the competitive threat in the passenger sector, since all countries with a non-zero

market share obtain a dummy variable of unity, even when the degree of market opening is very different. We therefore implemented a model which we think better reflects differences in competition between countries. The set of revised dummy variables for passenger are as follows:

- Level 1: competition is possible, equivalent to the competition announcement effect (dummy 0-1);
- Level 2: competition has happened but is minor compared to the whole network, it can be through minor open access or a small proportion of the network that was submitted to competitive tendering, around 10% (dummy 0-1);
- Level 3: competition has happened and is major compared to the whole network (around or more than about 25%, a (dummy 0-1);
- Level 4: all services are submitted to competition (e.g. the British case) (dummy 0-1).

In order to make the analysis tractable in our preferred model we sum the dummies to produce an overall measure. Whilst this is to some extent arbitrary, it may be preferable to a simpler approach whereby countries with very different levels of competitive threat are given the same value (0 or 1) for the competitive dummy.

It should also be noted that within the time period of our data no country had more than 1% of its passenger train-km provided by open access services⁵, so it is not possible from the econometric analysis to distinguish these from competitive tendering.

For freight competition, we tried to obtain data on market share, in place of a competition dummy, however we did not obtain enough information. We have therefore continued to use the simple dummy, though we recognise that this limits the analysis.

Control variables

The most obvious differences between railways that we need to allow for are differences in output (passenger-km and freight tonne-km) and differences in factor prices (wages, energy, materials and capital). We introduce a simple measure of traffic density (train-km per route-km) as a control variable and interact this with the structural dummies to test whether the most cost-effective solution is different on more and less dense systems. The intuition here is that more densely used systems involve more instances of incentive misalignment between operators and infrastructure managers, and thus the appropriate structure for such systems may be different from that for less densely used systems.

We accept that this variable is a crude simplification of a complicated reality. Systems with mostly double track or more will have less capacity conflicts than systems with mainly single track. Systems with a large diversity of train speeds, for instance high-speed passenger trains sharing tracks with regional passenger and freight trains, will potentially have more path conflicts than systems with a single type of train all travelling at similar speeds. Systems with a lot of junctions will have more path conflicts than systems with a simpler route structure. In any case, the issues at stake here are not so much related to

⁵ Italy is the country with the strongest open-access competition since early 2012 when Nuovo Trasporto Viaggiatori (NTV) started open-access operations on the high-speed network. This effect could not be included here as the study takes into account data only up until 2011.

the transaction costs implied, but more with the costs resulting from incentive misalignment when arbitration between different types of track usage needs to be realised.

Nevertheless, after some experimentation with different measures of density, we decided, in work of this degree of aggregation, to stick with the simple measure of train-km per route-km (see the results section below).

We also used the proportion of revenue from freight traffic as a control variable interacted with the structural dummies. The proportion of revenue takes account of both volumes of passenger and freight traffic and what they pay, so a system with higher value freight traffic will have a higher value of this variable, and vice versa for passenger. The intuition here is that freight service patterns may be more complex (less regular) than passenger service patterns and that this will be particularly so for high value traffic which requires a high quality of service. It could also reflect the increased capacity requirement linked to the handling of more mixed traffic, reducing the possibilities for optimal track usage.

Results

The results of our preferred model are set out in Table 6. We first explain the model and define the variables in Table 5 before then explaining the results. The interpretation from a policy perspective is discussed in section 2.4 below.

As noted earlier the model seeks to include a set of variables that capture differences between railways and thus to model the relationship between costs⁶ and these variables (control variables). Having taken account of the control variables the model then seeks to test the impact of vertical separation and the holding company model (the test variables). In simple terms the model can therefore be written in equation form as:

$$\text{Total Rail Industry Cost} = \text{Function}(\text{Control Variables}; \text{Test Variables})$$

The control and test variables are listed below in Table 5. The list of variables is in line with the literature. In the model estimation we take the natural logarithm of all of these variables (as well as the total cost variable). Further, a translog functional form specification is adopted such that squared terms and interaction terms on the control variables are added to the model in order to allow as flexible a “shape” for the cost function as possible. The translog functional form is the standard form adopted in the academic literature. We tried alternative specifications that included total train-km as the main output but these models did not fit the data as well (they did however produce similar results in terms of suggesting an overall cost of imposing vertical separation).

⁶ A correction for purchasing power parities was also carried out.

TABLE 5: CONTROL AND TEST VARIABLES

Control variables (variable name in brackets)	Test variables (variable name in brackets)
<ul style="list-style-type: none"> • Passenger output (passenger-km; Q_P) • Freight output (freight tonne-km; Q_F) • Route length (route-km; N) • Technology index (percentage of electrified lines) • Wage rate (labour cost per employee; W_L) • Energy price (energy price per 1000 TOE; W_E) • Materials price (Material costs per rolling stock; W_M) • Capital price (capital costs per route length; W_K) 	<ul style="list-style-type: none"> • Vertical separation dummy variable (D_{VS}) • Vertical separation dummy variable times train density ($D_{VS.V}$) • Vertical separation dummy variable times freight revenue as a proportion of total revenue ($D_{VS.R}$) • Holding company dummy variable (D_{HC}) • Holding company dummy variable times train density ($D_{HC.V}$) • Holding company dummy variable times freight revenue as a proportion of total revenue ($D_{HC.R}$) • Horizontal separation dummy variable (D_{HS}) • Passenger competition measure (CMP) • Freight competition dummy variable (D_{CF})

Further description of the test variables is set out below:

- D_{VS} is a dummy variable taking the value unity when full vertical separation has taken place; zero otherwise.
- D_{HC} is a dummy variable taking the value unity when a holding company structure is in place; zero otherwise.
- V is the natural logarithm of train density, normalised to the sample mean. This is multiplied by the vertical separation and holding company dummies so that we can see how the effects of these industry structures are affected by the level of train density. We note that the train density variable is measured relative to route-km⁷.
- R is the natural logarithm of the proportion of revenue made up by freight (revenue freight proportion), normalised to the sample mean. This is multiplied by the vertical separation and holding company dummies so that we can see how the effects of these industry structures is affected by the relative level of freight running on the network⁸.
- D_{HS} is a dummy variable taking the value unity when horizontal separation has taken place; zero otherwise.

⁷ We had concerns over the quality of the track-km data and thus preferred the route-km based density measure. Since the UIC data on track-km is highly volatile for a number of countries, we tried incorporating a train density variable in the preferred model based on an estimate of track-km (1*single track plus 2*double track lines), whilst recognising the limitations of this measure. The results were directionally the same and the route-km specification was preferred because of its link back to the Mizutani and Uranishi (2012) study, and because of concerns about introducing data error.

⁸ Along with the re-definition of density to be based on track-km noted above, we also tested the proportion of freight in terms of train-km but we found no improvement relative to the preferred model. Further exploration of the relationship between the proportion of freight and the effects of separation would be a useful line of future research.

- CMP is the overall passenger competitive threat variable described above, thus capturing not just whether competition has occurred, but the differing degrees of competition in different countries.
- D_{CF} is a dummy variable taking the value unity when actual freight entry has occurred; zero otherwise.

As noted earlier, the dummy for separation of essential functions is not included in our preferred model due to the relatively small number of observations for this form. Further, the model with the dummy included indicated a very strong cost reducing effect of the order of 30% (which we also consider to be implausible)⁹.

The full model equation can therefore be written as¹⁰:

$$\begin{aligned} \text{Ln TC} = & a_1 + a_2 \text{Ln } Q_P + a_3 \text{Ln } Q_F + a_4 \text{Ln } N + a_5 \text{Ln } T + a_6 \text{Ln } W_L + a_7 \text{Ln } W_E + a_8 \text{Ln } W_M + \\ & a_9 \text{Ln } W_K + a_{10} D_{VS} + a_{11} D_{VS.V} + a_{12} D_{VS.R} + a_{13} D_{HC} + a_{14} D_{HC.V} + a_{15} D_{HC.R} + a_{16} D_{HS} + \\ & a_{17} \text{CMP} + a_{18} D_{CF} + \text{error} \end{aligned}$$

where the $a_1..a_{18}$ are parameters to be estimated and the error term is a statistical noise term that captures measurement errors, potential errors in the model specification, as well as other effects such as the weather that might impact on costs. The parameters estimated on the separation and holding company dummies (a_{10} to a_{15}) are used to compute the impact of imposing vertical separation as compared to the status quo (see below).

The model therefore includes a set of variables that reflect genuine differences between railways, for example, route-km, train density (train-km divided by route-km) and other variables such as input prices (e.g. labour wage rates), in addition to the structural / competition dummy variables described above. In the results below, only the coefficients on the dummy variables are shown for tractability (the full results of the preferred model are shown in Annex D).

⁹ It should be noted that when essential functions are separated we do not include the costs of the separated functions in our model, due to lack of data. However, these are very small as a proportion of total industry costs so this omission should not be the cause of any bias here.

¹⁰ The squared and interaction terms for the translog are not shown for tractability. The model is also estimated as a system with two further factor share equations to maximise the efficiency of estimation (and thus improve the precision of the parameter estimates). See Annex D for further details and also Mizutani and Uranishi (2012).

TABLE 6: MODEL ESTIMATION RESULTS

Variable name	Variable description	Parameter Estimate
D_{vs}	Vertical separation dummy variable	0.0041
VD_{vs}	Vertical separation dummy variable x density (V)	0.3760 ***
RD_{vs}	Vertical separation dummy variable x freight proportion (R)	0.1222 ***
D_{hc}	Holding company dummy variable	-0.0546 *
VD_{hc}	Holding company dummy variable x density (V)	0.0391
RD_{hc}	Holding company dummy variable x freight proportion (R)	-0.0132
D_{hs}	Horizontal separation dummy variable	-0.2718 ***
CMP	Passenger competition (sum of dummies measure)	-0.0081
D_{cf}	Freight competition dummy	0.0388
	Break-even point train density ratio	0.99
	Train density at the break-even point	62.7
	R squared (cost equation)*	0.980

Train density is defined as total train-km per route-km. "Ratio" refers to each company's train density relative to the sample mean
Average train density in the sample = 63.35

* See Mizutani and Uranishi (2012) for comparisons with the models in that study and other studies

In the table above, *, **, and *** mean that the result is statistically significant at the 10%, 5%, and 1% level, which represent increased degree of confidence that the findings are statistically significant, that we can be increasingly confident that the coefficient is not simply zero and that there is in fact a relationship between costs and the relevant policy variable.

Based on the preferred model we conclude the following:

- The effect of vertical separation on costs at the sample mean is not significantly different from zero (coefficient close to zero and not statistically significant). Note that this effect is relative to a model of vertical integration. However, the interaction term ($V.D_{vs}$) is statistically significant at the 1% level, which means that the affect of separation varies with train density. For average train density levels (more precisely, 0.99 times the sample mean; see Table 6), vertical separation has little effect. Below that level of train density, vertical separation reduces costs and above that level, vertical separation increases costs. This finding is in line with that of Mizutani and Uranishi (2012) and is discussed further below.
- The effect of the holding company model is to reduce costs by around 5% at the sample mean. However, this effect is not statistically significant at the 1% or 5% levels, but only at the 10% level. We can therefore say that this effect is only weakly significant. The interaction term ($V.D_{hc}$) is not statistically significant, indicating that the Holding Company effect on costs does not vary with traffic density, unlike the case of vertical separation. Thus the cost effects of the holding company model do not seem to vary with traffic density.
- The interaction term ($R.D_{vs}$) is positive and statistically significant at the 1% level, indicating that where there is a higher proportion of freight on the network, vertical separation tends to increase costs. It seems reasonable to suppose that freight services, which are not subject to a timetable in the same way as passenger

services, could raise transaction and other costs in a separated environment. We thus consider that the positive sign on this variable is intuitively reasonable.

- Horizontal separation reduces costs. The effect is computed as $\exp(-0.2718)-1$, which means that the effect of horizontal separation is to reduce costs, other things equal, by 24%. This effect is statistically significant at the 1% level¹¹. It might appear surprising that horizontal separation alone causes such a strong reduction in the costs for the entire rail system. An explanation might be that in a number of cases cost reductions took place because freight divisions were sold to new owners rather than as a direct consequence of horizontal separation.
- The variables representing the introduction of freight and passenger competition do not have any statistically significant impact on costs. This finding is surprising, though it might reflect the problem mentioned earlier of specifying appropriate competition measures and it may be that the impacts of competition are in part being picked up by other variables because of this problem.

The cost of imposing vertical separation across the EU (for those countries that are not already vertically separated) is estimated to be around €6 billion/year at current traffic levels (see Table 7). Bearing in mind the Commission's aims for future traffic growth (as stated in the 2011 Transport White Paper), we also show the cost of imposing vertical separation assuming that traffic density levels increase by 10%, 20% and 50% respectively. Since the model shows the cost of separation increasing with density levels, the cost of vertical separation at these higher density levels is correspondingly higher, at nearly €8 billion, €10 billion and €15 billion respectively on a yearly basis.

TABLE 7: COST CHANGES RELATIVE TO THE STATUS QUO OF IMPOSING VERTICAL SEPARATION ON ALL EU-RAILWAYS (AT CURRENT TRAIN DENSITY LEVELS AND THREE SCENARIOS FOR FUTURE TRAIN DENSITY LEVELS)

Billions of Euros (2005 constant prices)	Current density levels	Current density levels + 10%	Current density levels + 20%	Current density levels + 50%*
Yearly cost of imposing vertical separation across EU (for those countries not already separated)	5.8	7.8	9.6	14.5

Note: * It is recognised that higher growth would at some point require increased capacity

Further, to guard against the possibility that this result is being overly influenced by the presence of non-European countries, and in particular Japan, we re-ran the model excluding Japan, South Korea and Turkey. The parameter estimates of the model were little changed as a result, and the cost of imposing vertical separation across EU-countries is likewise largely unaffected, increasing slightly from around €6 billion to approximately €7 billion per year.

¹¹ An obvious question that might be asked is that this effect results simply from the exclusion of freight operations in horizontally separated systems. However, this is not the case since we include the costs of the dominant passenger and freight operator (with scaling up for new entrants at least for some countries) for both horizontally integrated and separated railways.

2.4 Policy interpretation

The first conclusion is that whilst vertical separation does not have much effect on costs at average train density levels, at high levels of train density it increases costs. The latter finding is intuitive in that the coordination problems associated with vertical separation might be expected to be more severe when there are high levels of traffic relative to the size of the network. Whilst transaction costs have not been found to be very high in previous work (see the literature review), such work does not capture the full costs that may occur in separated systems relating to the knock-on effects of sub-optimal decisions due to various types of incentive misalignment between actors resulting from a vertical separation (see chapter 7 for a more detailed analysis of these issues).

It may be less clear why vertical separation reduces costs on more lightly used networks, where competition may also be limited, though this might be simply associated with the increased cost and public payment transparency brought about by separation (although we have no evidence of this); or simply cost reductions associated with change/reform of the system. Again, restructuring is often associated with a careful examination of staffing and costs. However, we particularly warn against extrapolating relationships to organisations which are very different from those for which they were estimated. We do not believe our results to be applicable to small local railways.

Moreover, our density variable is a simple mean for the railway as a whole. The traffic density of a whole country usually masks very substantial differences between regions. And while some railways may have a similar density of traffic over most of the system, in other cases there may be enormous differences, with a few main lines carrying the bulk of the traffic and a large low-density system off this network. For instance in France 70% of the traffic is on 15% of the network, whilst in Italy the train density in Lombardy is 34% above the mean for Italy and that on Sicily 43% below the mean. The appropriate organisation for such cases may be very different from the case of a hypothetical country with the same average level of density but with much smaller differences in regional densities.

The second conclusion is that the higher the proportion of freight running on the network (measured in our model by the proportion of revenue made up by freight) the smaller any cost reduction effect from vertical separation (or the larger any cost increase). Thus, for a given level of train density, it seems that freight traffic causes more coordination problems in a separated environment than passenger traffic. This finding appears to be intuitive, and could result from the fact that typically passenger services on a route are provided by a single operator, whereas freight may involve multiple operators. Further, freight services are not set by a rigid timetable but vary from day to day. It could also reflect the increased problems of handling mixed traffic¹².

The third conclusion is that the Holding Company model seems to produce a small (ca. 5%) cost reduction as compared to the vertical integration model (which is also only weakly significant from a statistical perspective; it is not statistically significant at the 5%, but only at the 10% level). This effect does not appear to change either with traffic density

¹² We tried including a traffic diversity variable but this did not improve our model so this variable was excluded from the final model.

or with the proportion of freight volumes. The reduction could result from increased transparency resulting from the internal separation, whilst any loss of coordination benefits is avoided (though here we should also recognise that in practice the degree of coordination within the holding model varies considerably from country to country).

Taking the above three conclusions together, and computing the cost of imposing vertical separation on those EU countries which have not yet separated (and thus are either currently vertically integrated or have adopted the holding company model), Table 7 shows that such a policy would increase costs by around 6 billion Euros at current density levels, and by up to 15 billion Euros if EU railways achieve the sorts of traffic growth targets envisaged by the Commission.

Thus it does not seem appropriate to adopt a policy of requiring all railways to be vertically separated as this will increase costs, based on the results of the modelling exercise undertaken as part of this project. Of course the numbers quoted in Table 7 are based on an extrapolation from an econometric model and should be viewed as indicative rather than a precise finding. More precise modelling of the cost implications of vertical separation in individual countries would require more detailed, bottom-up modelling work which would be a much larger exercise than could have been attempted as part of this study.

Finally, the results show that horizontal separation appears to have led to a very substantial reduction in costs (of around a quarter). Horizontal separation has usually come into being as a result of the selling off of freight operations (or in the case of Japan of integrated passenger companies). This process may have entailed a careful examination of the staffing and costs of the freight operator and shedding of unprofitable traffic. Certainly this was the case in Britain. Thus, the reduction, at least in that case, was not solely caused by separation itself. It could also be the case that horizontal separation may have occurred disproportionality in countries where a positive result was expected; such positive results should then not automatically be expected for all countries. The cost reduction may also be driven by the increased cost and transparency resulting from the separation of the passenger and freight businesses. However, it does not appear that actual competition in passenger and freight has much effect on costs over and above the effects of industry structure (holding company or vertical separation) or horizontal separation. This finding is surprising, though it might reflect the aforementioned problem of specifying appropriate competition measures and it may be that the impacts of competition are in part being picked up by other variables because of this problem.

What do the results not mean (and important caveats)?

In contrast to most previous studies in the literature, which rely on published data, as part of this study we have had the opportunity to have our data (which is predominantly based on UIC-data) verified by members and then extended. In addition, we have added Britain to the analysis for the first time. Nevertheless, as discussed further below, some data issues remain. Here we comment on possible weaknesses in the data and also the methodology that might affect the results and the degree of confidence that we have in them:

- The econometric analysis essentially shows whether or not a statistical relationship exists. If such a relationship does exist, it does not of itself explain why. If a relationship does not exist, this does not prove that the two variables are not related, but only that with the data at our disposal we cannot detect it.

- We particularly warn against extrapolating relationships to organisations which are very different from those for which they were estimated. Our sample comprises main line railway companies with a mean output of 147 million train-km p.a. and a range from 2 million to 954 million. We do not believe our results to be applicable to small local railways.
- We found a clear relationship at the aggregate level between the cost of vertical separation and the mean train density on the network, which we presume arises because of the increased costs and importance of coordination on more densely used networks. However, all railways, and particularly larger ones, have a variety of densities of traffic on the network. Clearly such an aggregate relationship cannot be used to make specific recommendations as to the best form of organisation for individual countries or parts of them. Examining the cost implications of vertical separation in individual countries would require more detailed, bottom-up modelling work which would be a much larger exercise than could have been attempted as part of this study.
- During the pilot phase of the project, NS highlighted issues concerning the definition of rolling stock numbers in international data sets. We attempted to clarify this in the revised questionnaire. Still it may be that this remains an issue in the data. Further, even if all the data was reported entirely consistently, we are still obtaining a measure of total rolling stock by adding together heterogeneous vehicle-types. There could therefore be problems based on computing input prices for materials using a simple measure of “total number of rolling stocks” as the denominator. This problem is one that is shared with previous papers in the literature, however.
- DB also highlighted the issue, which we tried to address in the revised questionnaire, that in Germany the depreciation figure only includes depreciation on assets that are not paid for by government grants (i.e. only the net, post-subsidy, costs of assets are included in the DB accounts). This could potentially be an issue in other countries. Indeed, the comparability of depreciation costs across country could be a wider issue. It was beyond the scope of the current study to fully address this data issue, although it is in part addressed through the inclusion of capital input prices as explanatory variables (which mean that some of the variation in policy is captured in the input price variable, rather than as an effect of industry structure). This latter point is reflected in large variation in capital input prices (see Annex D). Indeed, the labour input price variation also seems large. However, a large part of the data has been checked by CER members, so our current dataset is the best that can be achieved at the present time.
- With better data further exploration of models that define train density relative to track length rather than route length would be interesting, as would further exploration of the relationship between separation effects and the proportion of freight running on the network (and perhaps the extent of mix of services more generally).
- In the time available we were not able to compute total costs for countries where cost data for small operators was not available. This point was discussed at length earlier in this section of the report. Ultimately, we were able to make the adjustment for two of the most liberalised systems (Sweden and Germany), and the British data already includes actual data for all operators in any case (thus covering the three most liberalised countries), as noted earlier, for France, which has seen significant entry, we were unable to make this adjustment. Overall, however, we

consider any bias caused by the inability to include smaller operators for all countries to be small, for the reasons set out above.

- Despite these remarks, as compared to previous studies, the approach taken here, and the fact that we have verified data directly with companies, should have produced a much higher quality dataset than in previous studies, therefore making this study a major step forward in this area of research, where data quality has been a major issue.

The above list of issues would form a useful basis for developing a future research programme.

3 Econometric assessment of modal shares

The main aim of this chapter is to assess the effect of several forms of separation on the modal share of rail. This is done by developing an econometric analysis of rail modal shares in passenger and freight transport. The analysis covers 26 OECD countries over the period 1994-2010. To provide a reliable image of this effect, we correct for other factors affecting the modal share of rail. Our modelling work looked into international freight transport, national freight transport and passenger transport¹³. We discuss the relevant indicators for the analysis in section 3.1, followed by a description on the data used in section 3.2. Section 3.3 presents the econometric results and section 3.4 concludes.

3.1 Relevant indicators

The choice of transport modes, whether in freight or passenger transport, depends mainly on three groups of factors, i.e. factors related to the money costs of transport, factors related to the time costs of transport and factors affecting the valuation of time. Below, we discuss how we derive national indicators that might affect the market share of rail for each of these groups of factors. We also discuss the possible impact of separation and competition. Since it would be impossible to measure all differences between countries correctly, we use fixed effect regressions to account for country-specific variables that are unobserved or hard to measure numerically.¹⁴

Modal share in this study is interpreted as the share of rail in total transport using road and rail. This implies that we exclude other modes (air, inland waterways, short sea shipping) from the analysis (and correct rail's modal share accordingly)¹⁵. This is basically because of limitations in the data. We recognise that the excluded modes are important in the domestic market in a number of countries, for instance air in Spain or France, and coastal shipping in Britain. To the extent that this competition is constant over time, it will be picked up in the country specific constant as mentioned below, but we accept that changes in air or water competition will not be reflected in our results. Omission of these variables will only bias our results if they are correlated with the variables we are interested in.

Money costs of transport

The money costs of transport generally consist of fuel costs, vehicle costs, operator fees or ticket costs, taxes and public payments. The indicators we have considered to compare these costs between countries on a national level are gas, diesel and electricity prices (all including taxes), infrastructure levies and public sector payments. Car ownership affects

¹³ A distinction between national and international passenger transport could not be made due to data limitations.

¹⁴ After some tests, we preferred a linear specification over a log-log specification.

¹⁵ Moreover, it lowers the burden of data collection for modes that are likely to be mainly influenced by geographical factors and country specific factors anyway.

the money costs of a single trip as well, and is therefore likely to be associated negatively with the modal share of rail.

Time costs of transport

The time costs of transport generally consist of in-vehicle time, waiting time and access and egress time in the case of a nodal system. Many of the indicators that determine time cost differences between countries are geological (e.g. rivers and mountains causing detours) and are hence captured by our fixed effects approach. The indicators referring to this that we have considered include railway, high-speed railway, motorway and other roads density and, investments on road and rail infrastructure. These are supposed to provide a proxy for relative door-to-door speed for either mode. If the railway density in a country is relatively high, it is more likely to be a viable alternative for cars or trucks compared to a country with a low rail density. Similarly, if a country is (either locally or overall)¹⁶ densely populated, the rail mode may be more successful, as more people and companies reside closer to the nodes. Moreover, in densely populated areas, roads are more likely to be congested, whereas train passengers may benefit from increased frequency of service. Similarly, if a country has a high level of employment per capita, the share of commuting in total transport will be higher, leading to more congestion and increased peak train frequencies, which could increase the train's modal share

Factors affecting the valuation of travel or transport time

Both in passenger and freight transport, the relative value of monetary versus time costs may differ strongly between users. Heavy goods and bulk goods are easier to transport by train compared to truck and generally have a lower value of travel time attached. Perishable goods have a higher value of time, as do valuable goods. This may affect the modal share of rail, as rail transport is overall slower (from door to door) and less expensive than road transport. We have constructed several indicators based on international trade statistics and national production statistics to take this aspect into account.

In passenger transport, the level of income (per capita) is positively related to the value of time and, given that rail transport is often slower from door to door, therefore negatively related to the modal share of rail.¹⁷

The influence of separation and competition

The influence of vertical or horizontal separation on time and money costs of (rail) transport is ambiguous and may run through widely different mechanisms. There is a belief that several effects may or may not take place. Separation (both horizontal and vertical) may increase the money costs of train transport through an increase in

¹⁶ To account for local and global density, we collected several population density measures i.e. average population density, population density in urban areas, population density in rural areas and percentage of population living in urban areas.

¹⁷ The opposite may hold for routes between cities. In an effort to take this into account, we added a cross term of income and percentage population living in rural areas. The coefficient of this cross term did have the expected positive sign, but the fit of the model was lowered considerably.

transaction costs and through misaligned incentives (as discussed in the other chapters of this report). However, another view is that increased independence of passenger, freight and track operations could lead to more competition and better products for the clients of the operators and hence increases the modal share of rail despite the increase in costs.

The impact of competition is ambiguous as well. Firms may increase their level of service as the force of competition makes them more aware of the wishes of their customers. Moreover, competition is likely to lower costs over time, as firms have a stronger incentive to reduce inefficiencies within their organization. On the other hand, if rail operates under economies of scale or density, competition could lower efficiency and raise costs, due to duplication of indivisible capital goods. The net impact on market shares is therefore an empirical question. Theory, however, clearly suggests that - in the absence of natural monopoly characteristics - the positive effects of competition on efficiency, supply and social welfare outweigh any counter-effects.

3.2 Data

Data on modal shares in freight are collected from transport statistics from the International Transport Forum (ITF), and are defined as the share of rail in transport (measured in tonne-km) by train and truck. Transport by air, inland waterways, pipelines and short sea shipping is excluded from the analysis. For some countries, international freight transport by road and rail is non-existent (e.g. Korea, Japan) or missing (Ireland, Poland, Spain, Turkey, UK). Passenger data have the same source, but shares are obtained directly from the data.

Data on population density, production and trade by type of good, road and rail density, investment, energy prices, income per capita, employment, public budget contributions, investments and infrastructure levies were obtained from databases of several international agencies (OECD, Eurostat, EU KLEMS, World bank, WTO and GTZ) and supplemented by data from research publications or national statistics when definitions were consistent. Even after adding national statistics, many gaps in the data remain. This implies that taking into account some of the variables would come at the cost of a much smaller coverage, which in most of the time did not yield better statistical results. We would therefore like to stress that the fact that a variable does not provide statistically meaningful results, does not mean that the variable does not have any influence; its influence can simply not be established empirically given the limitations of the dataset. Annex E provides descriptive statistics for selected variables.¹⁸

The dummies used to describe the separation regimes are the same as the ones used in the cost study (see chapter 2) and were available for all countries in our analysis (see Annex E for an overview).

The figures below graph the modal share of rail for each country in 2008, grouping the countries by structural option: vertical integration (VI), holding company (HC) and vertical separation (VS).

¹⁸ The high maximum value for GDP per capita relates to Luxembourg, which has a large financial sector and a small population. We tested whether excluding Luxembourg's income data from the analysis affected the results and concluded that it did not.

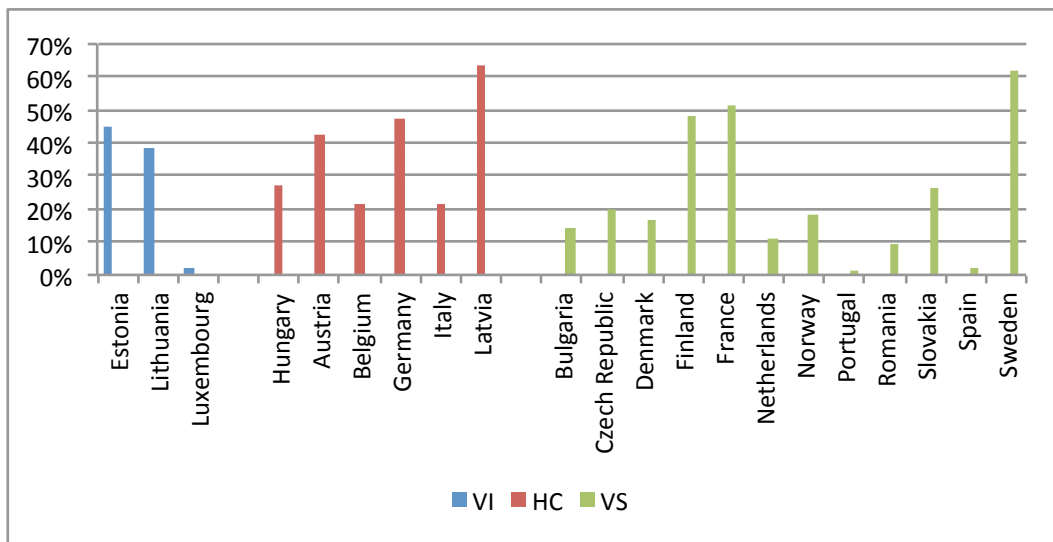


FIGURE 1 MODAL SHARE (2008) BY COUNTRY FOR INTERNATIONAL FREIGHT

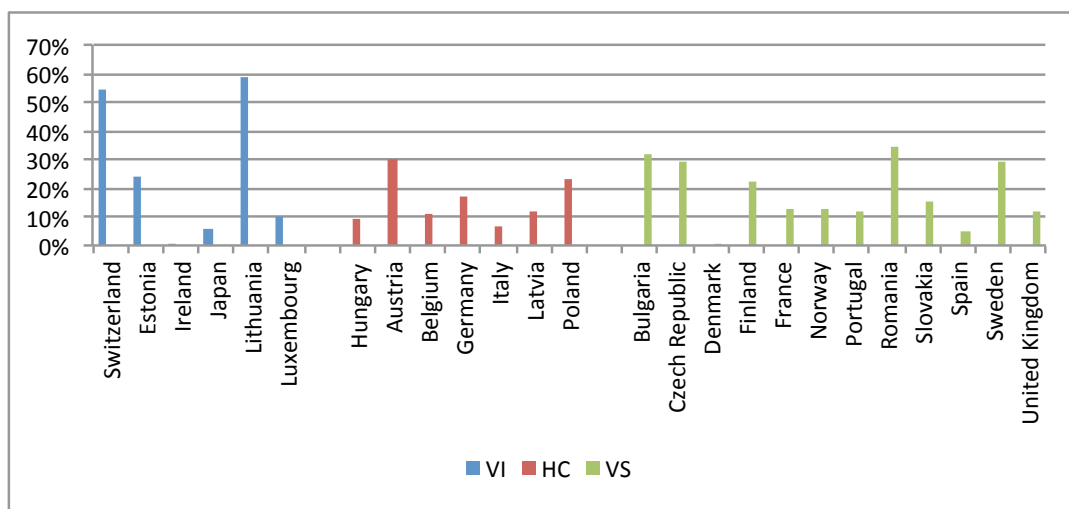


FIGURE 2 MODAL SHARE (2008) BY COUNTRY FOR NATIONAL FREIGHT

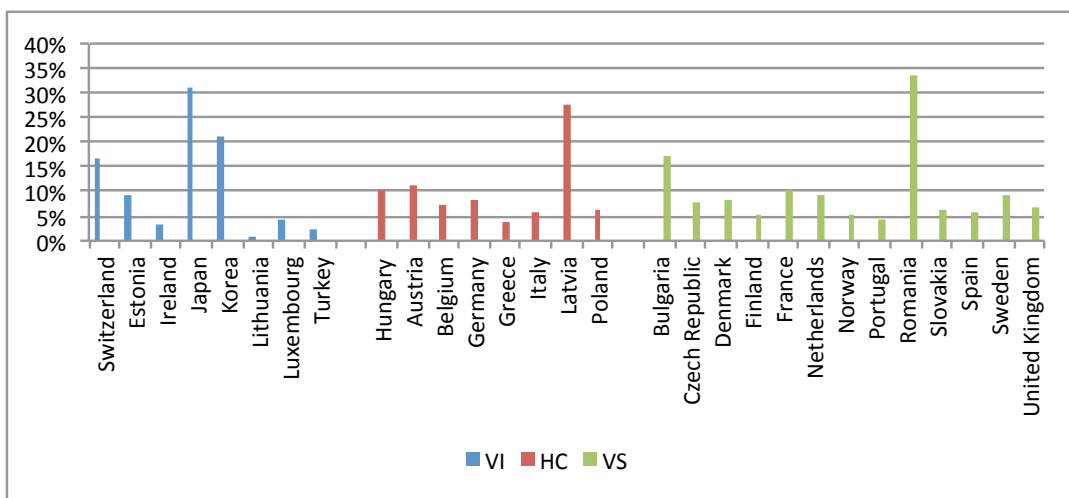


FIGURE 3 MODAL SHARE (2008) BY COUNTRY FOR PASSENGERS

It is clear from the figures that the differences between countries within regime groups are larger than the differences between regime groups. This suggests that other factors

play a role in determining modal share as well. In the following section, we will try to isolate the other factors influencing modal shares.

3.3 Empirical results

Table 8 presents the results from the empirical analysis¹⁹. There were many missing observations for the competition indicators. In order to cope with these, we split the empirical analysis into a version without competition indicators and a version with competition indicators. The overall results from the latter estimation are more robust since the former suffers from an omitted variable bias, but its validity is limited to the countries for which we have reliable indicators of competition. The results from both versions are qualitatively consistent and lead to similar conclusions. We present the results including the competition indicators in Table 8 (20). We also add a trend variable, which increases by one unit every year. This trend variable is meant to capture developments that take place over time.

TABLE 8 FIXED EFFECTS ESTIMATION RESULTS OF RAIL MARKET SHARES

Market share rail in:	National Freight	Passenger	Passenger (incl. HC/comp.)
Constant	0.148***	0.714**	0.712**
Rail length / motorway length	0.006***		
Employment / capita		0.589**	0.580**
ln (GDP/cap)		-0.092**	-0.091**
Trend		0.002**	0.003**
Regulatory and competition indicators			
Separation of essential functions	-0.003	0.013*	0.014**
Holding company	0.011	0.007	-0.002
Vertical separation	-0.076	-0.011*	-0.012
Horizontal separation	0.057	0.013	0.015
Competition possible	0.002	-0.005	-0.002
Entry occurred (some)	-0.039	-0.037*	-0.038*
Entry occurred (major)		-0.040	-0.045
Cross term of VS and competition possible		0.037**	0.044*
Cross term of HC and competition possible		-	0.021
R ² (between)	0.5305	0.284	0.289
Rho	0.800	0.923	0.922
#obs (#countries)	317 (24)	402 (26)	402 (26)

*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level; (levels based on robust standard errors)

Below follows a brief interpretation of the results found

International Freight:

¹⁹ We tried several other specifications, including several variables besides the regulatory and competition indicators. As these other indicators are not the focus of our analysis, we dropped them if they were not statistically significant. This also holds for the trend variable.

²⁰ For comparison purposes, the right hand column provides the result including the cross term of the holding company dummy and the dummy reflecting that competition is possible.

- We attempted to estimate a model, but the explanatory power of that model was too low to base any conclusions on it.

National Freight:

- Rail length/motorway length has a positive impact on modal share of rail;
- None of the structural indicators has a statistically significant impact;
- The parameters of vertical separation and a holding company are not statistically different from each other.

Passengers:

- The high value for rho implies that a large part of the differences are country-specific and fixed in the short run (e.g. geography, culture);
- The negative impact of income/capita reflects the impact of income on value of time; the effect is saturated at higher income levels (hence the logarithmic specification used);
- The positive impact of employment/capita is a proxy for heavy peak traffic;
- With respect to the combined effect of opening a market for competition and the vertical structure, the estimates in Table 8 show the following:
 - The parameter estimate for the combined effect of the possibility of competition and vertical separation is positive compared with vertical integration, but only weakly significant (10% level).
 - The parameter estimate for the combined effect of the possibility of competition and the holding company model is positive compared with vertical integration, but not significantly different from zero.
 - However these estimates overlap with the dummy variables for vertical separation and for the holding model. For example, the parameter for vertical separation is negative (would reduce modal share) and weakly significant in the first specification, but not significant in the second one. It is therefore difficult to see the exact combined effects, for the combination of vertical separation and market opening on the one hand, and for the combination of the holding model and market opening on the other.
 - In order to disentangle these effects, we re-estimated the passenger model with the two cross-terms but without the vertical separation and holding model dummy variables. This ensured that the difference between the two cross-terms would pick up the correct net difference between the two categories described in the previous bullet point. The difference between them was tested statistically (F-test) and found to be not significantly different from zero. This implies that, if one assumes that competition is introduced, one cannot state with confidence whether modal share would fare better or worse with vertical separation or with a holding model.
- There is some evidence that separation of essential functions raises modal share by a small amount compared with vertical integration (the baseline), and by a larger amount compared with vertical separation. More detailed investigation would however be necessary on this point.
- In addition, the estimates for the holding company dummy variable display relatively high levels of variance (notably compared to the vertical separation variable), possibly reflecting a greater underlying heterogeneity in the holding company group of countries. This point would also warrant further research.

3.4 Conclusions

For national freight traffic, no statistically significant effect of any of the structural or competition indicators was found. Moreover, the difference between the parameters for the holding company and vertical separation is also statistically insignificant.

For passenger traffic, the key result is that there is no statistically significant difference between the vertical separation model and the holding company model when the passenger market is open to competition.

In short, then, we find no evidence that vertical separation is superior to the holding company model in its impact on rail's modal share in freight or passenger transport.

Two of our findings give rise to further questions. First, the wide confidence intervals of the holding model variable in most specifications suggest that this structural option is too heterogeneous to be captured in a simple dummy variable. Further research could shed light on the factors that determine the success of this model in terms of modal share. Chapter 8 in this report also discusses this issue in more detail. Second, we find that in passenger transport, the combined effect of the introduction of a possibility for competition and vertical separation is positive compared with vertical integration. This combined effect could have several explanations, such as the mechanism that (local) transport authorities have taken a stronger role in serving the customers, or the mechanisms that the incumbent train operators feel the threat of future competition and enhance their client orientation. The contribution of these effects to the total effect found could be better detailed in a bottom-up approach than can be done in the analysis performed here. Such an approach could also shed more light on the counterintuitive finding that we find no evidence of market entry in international freight markets where entry has occurred on a larger scale, whereas we find an effect of market opening in passenger markets, where there has been much less entry.

4 Value for money for state budgets

Railway systems in Europe receive substantial amounts of public funding. These are provided to finance investments, subsidize non-profitable operations and to support restructuring of railway organisations, as part of these costs cannot be recovered from farebox or other commercial revenues.

The objective of this chapter is to carry out a simplified assessment of the contribution of taxpayers' money to the railway system, concentrating on one question "How many Euros of taxpayers' money can yield a certain output?" The railways of several countries with a variety of structures will be compared.

The quantitative output of a railway system can be expressed in absolute values such as passenger-km and tonne-km. These metrics do not, however, reflect the qualitative performance and the role railway transport plays in a country. To understand the importance and performance of rail in different countries further aspects need to be assessed as well, such as its modal share, the evolution of its usage per inhabitant, and characteristics of quality, such as punctuality or customer satisfaction. We have been able to include some of these characteristics in our assessment, looking into the developments of France, Germany, Great Britain, The Netherlands and Switzerland.

More comprehensive approaches that would allow drawing richer conclusions could not be realized within the scope of this chapter. Such approaches would have had to investigate several other factors, which would enable us to qualify the findings further. This could include looking at the share of income directly paid by users through ticket sales (we do, however, look at the average farebox revenue per passenger-km), it could also include a differentiation of the findings according to the level of track access charges in a country, and it could also be enriched by taking account of geographical and other differences between countries. The size of a country should, e.g., influence the reading of statistics on passengers-km. For a similar amount of passenger-km, smaller countries are more likely to have many passengers travelling on shorter distances, whereas larger countries are more likely to have more passengers travelling on longer distances. While the one does not necessarily represent a 'better' or 'worse' performance than the other, this could, however, point to substantial differences in the role played by rail in a country's mobility.

Output and performance

All countries in this sample have seen a substantial and partially also impressive growth in passenger transport over the last decade. Traffic volumes in Germany and the Netherlands have grown by around 10%²¹, while Britain and Switzerland had an overall growth of 33% and 42% (see Figure 4).

²¹ Passenger-km and tonne-km include all operators.

Absolute traffic volume and percentage change (2000-2010)

bn passenger-kilometres

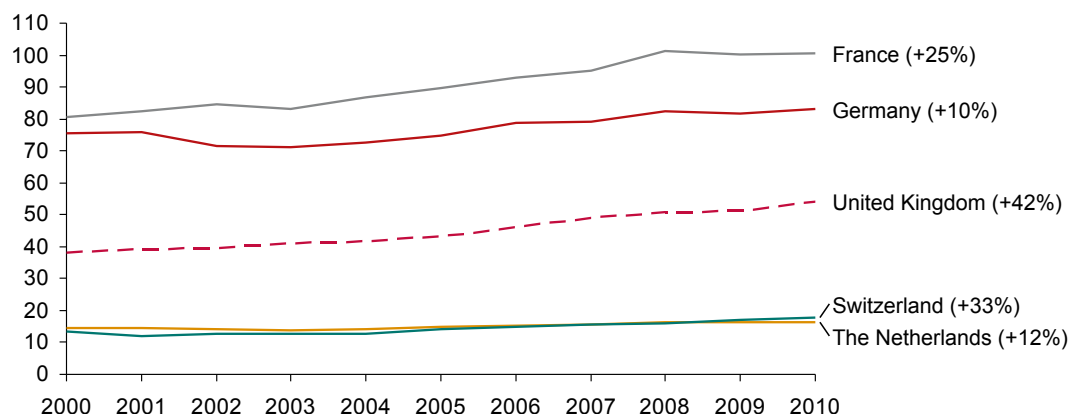


FIGURE 4 DEVELOPMENT OF TRAFFIC VOLUMES IN PASSENGER SERVICES

Nowadays Swiss inhabitants use passenger transport by rail most intensively, compared to the other countries in the sample. On average a Swiss inhabitant travels more than 2.000 km per year by rail. Since 2000 this demand has increased by 22% (see Figure 5). The UK, too, has seen a strong growth since 2000 and increased passenger rail travel per inhabitant by 34%. But the starting point has been the lowest in this sample with only 649 passenger-kilometres per inhabitant.

Relative traffic volume

passenger-kilometres / inhabitant

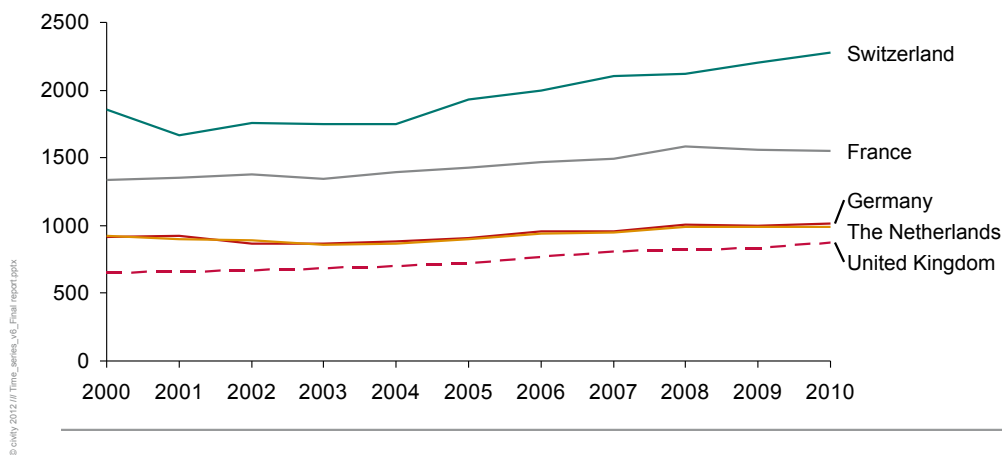


FIGURE 5 DEVELOPMENT OF RAIL TRAVEL PER INHABITANT

The modal split in each country confirms this picture and follows similar trends. In 2010, France, Germany and the Netherlands reached a share of rail passenger traffic of 8.6% to 10.1%, whilst the UK was at 6.8%. Switzerland had the highest share with 16.1%²²

²² Modal split for Switzerland: Federal Office of Statistics; modal split for other countries: Eurostat

In contrast to passenger transport, the development of rail freight follows diverse trends (see Figure 6).

Absolute traffic volume and percentage change (2000-2010)

bn ton-kilometres

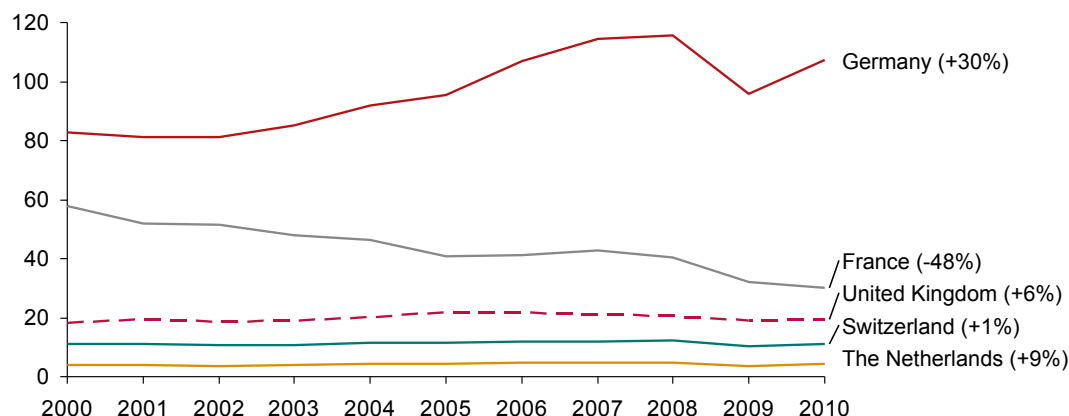


FIGURE 6 DEVELOPMENT OF TRAFFIC VOLUMES IN RAIL FREIGHT

Germany has been able to push freight to a level of around a 100 billion tonne-km per year. Comparing passenger and rail freight volumes by country, it can be stated that in Germany rail freight plays a much more important role than in other countries, but this is also influenced by its central location in Europe, which is likely to lead to more transit traffic than in more peripheral countries. France has about the same level and development in passenger-kilometres as Germany but a much smaller volume in rail freight, and the freight sector has lost significant volumes since 2000.

Summarizing the developments by country it can be stated that

- In France the demand for passenger rail services and the modal split in passenger services have increased whilst freight has very much lost in volumes and market share.
- Germany has seen a slight growth in rail passenger services, whereas rail freight has constantly grown and relatively speaking plays a more significant role than in most other railway networks reviewed in this chapter.
- Switzerland has not only seen a considerable growth in passenger services but also a further increased rail's market share to the highest in the sample. Freight has declined but still holds the highest modal share of all the countries.
- The Netherlands have experienced the most moderate growth rates in rail passenger and freight.
- The UK has started with the lowest modal split in 2000 and seen quite an increase in rail passenger transport. However, with respect to its market share the country has the lowest modal share in rail.

Funding and revenues

The cost at which the overall positive trends have been achieved are covered through revenues (with very different levels of for example farebox income, ancillary revenues from other business activities etc.) and by a broad spectrum of funding sources, including grants and other public sector payments from national, regional and local governments, raised through various sources and directed to the various actors. Whether public sector

payments are directly provided to infrastructure managers or through train operators (via track access charges) largely depends on each country's funding principles.

Figure 7 depicts the development of funding per transport unit. A transport unit represents the total transport volume by adding up passenger-kilometres and tonne-km. The data has been adjusted to 2011 price levels and normalised by purchasing power parities.

Funding includes all state contributions to the railway system such as operating subsidies, investment grants and the take-over of pension and health insurance costs, as these means also led to an increased level of performance and competitiveness. Some railways also pay back dividends to the state; these have also been taken into account.

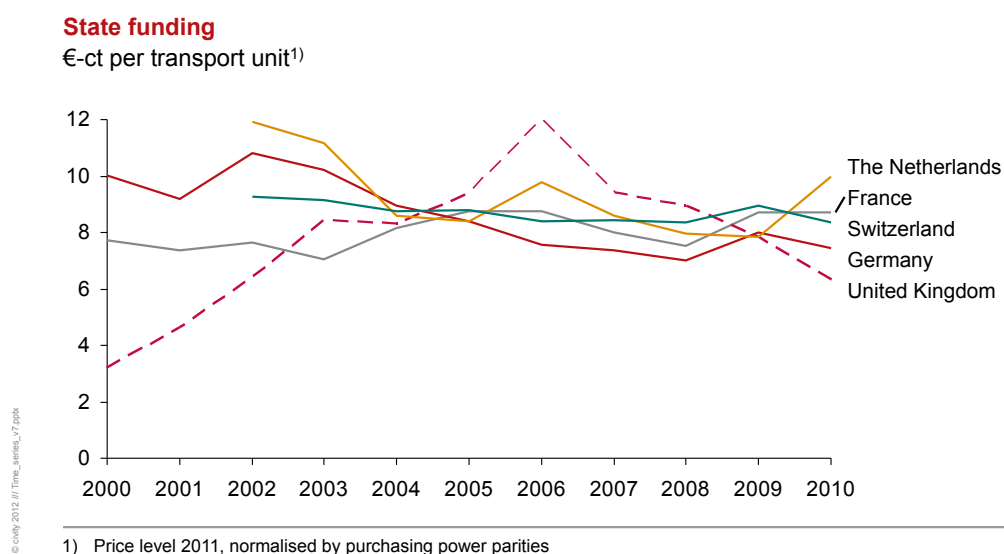


FIGURE 7 DEVELOPMENT OF STATE FUNDING (TRANSPORT UNITS)

No clear overall trend is visible from this analysis. The funding in France seems to remain on a fairly constant level, the UK had a significant rise until 2006 and dropped again, in the Netherlands funding oscillates between 8 and 12 €ct/transport unit and Germany's numbers show a fairly constant downward trend, coming down from 10 €ct/transport unit in 2000 to 7.5 €ct/transport unit in 2010.

The interpretation of state funding needs to be properly caveated:

- Summing up passenger-km and tonne-km does not completely enable a fair comparison of funding needs when the relative shares of freight and passenger transport vary between the countries compared. In some countries rail freight has a more dominant position than in others but most likely requires comparatively less funding. It would therefore be more appropriate to look at funding of passenger and freight services separately. However, this would require a very detailed analysis where, for example, the funding for infrastructure that is used by passenger and freight transport would be disentangled and related to passenger-km or tonne-km separately.
- It should also be noted that – although already comparing data over a ten-year period – lifetimes of infrastructure assets are much longer. Some of the benefits of large-scale investments which are funded in recent years will materialise in the future.

- Many networks are not in a steady state of renewal, funding levels depend on availability, national transportation policies and other extraordinary effects such as major accidents (e.g. the Hatfield accident in the UK). All these reasons can impact financial flows and lead to a distortion of the picture.
- The analysis does not take into account that the countries compared operate under different conditions and provide a different blend of services. Switzerland and the Netherlands provide a densely used and complex network, which is driving cost. The types of services vary, e.g. France offering extensive high speed services as well as conventional and suburban services. Furthermore, geographic and spatial conditions are different, e.g. UK as an island versus countries with high international and transit traffic. All these parameters impact cost structures as well as the potential to generate passenger and freight revenues, finally leading to different needs of funding.

When discussing funding levels, revenues from passenger and freight services need to be taken into consideration as well. In this sample ticket sale revenues per passenger-kilometre vary by a factor of two (see Figure 8). This is due to different political decisions and pricing policies, fare levels, the type and quality of transport services offered etc. The largest difference between annual state funding and passenger revenues is visible for the UK, which is more user-financed than other systems. Funding is at the lower end and revenues per passenger-kilometre are clearly at the higher end. However, the picture is incomplete and for a better juxtaposition of state funding and revenues it would need a consideration of other revenue sources as well.

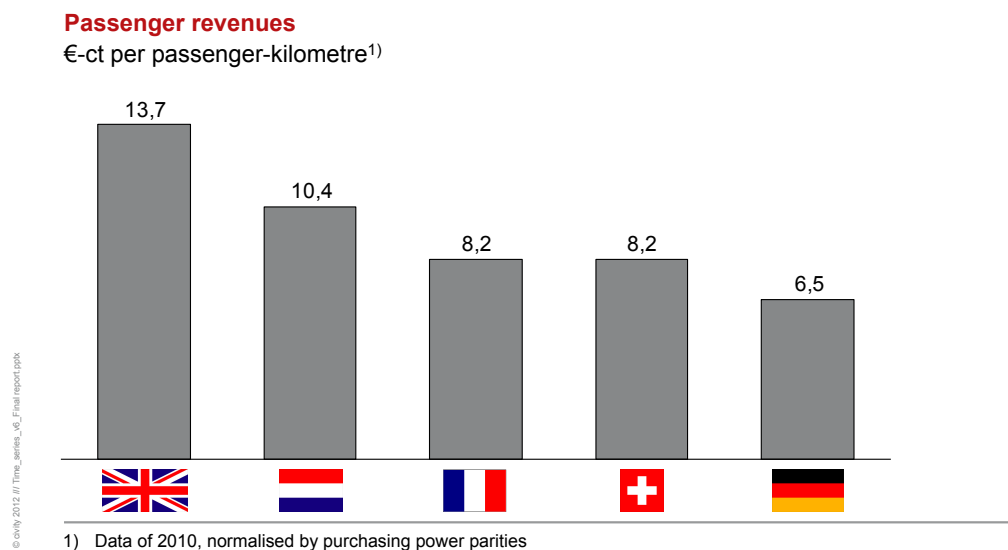


FIGURE 8 PASSENGER REVENUES PER PASSENGER-KILOMETRE

For all the reasons given above, it is not possible to draw firm conclusions about alternative structures from this analysis. However, it may be noted that there is no clear pattern of worse value for money from more vertically integrated countries emerging here.

Sources:

France:

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UK:

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The Netherlands:

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Switzerland:

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Part 2: Qualitative research findings

SUMMARY

In this part of the report we seek to understand, from a structural viewpoint, why certain reforms yield or fail to yield certain effects. The central research effort consists in the development of a deeper understanding of the rail sector's value chain, how incentives may be aligned or misaligned within the value chain, and how different structural models can ensure non-discriminatory access to the network.

The literature points to the importance of the analysis of transaction costs in unbundled regimes and to the relatively larger importance of the misalignment costs that may result from an inadequate institutional setup. Existing studies draw different conclusions concerning the desirability of vertical separation, but seem to agree that there does not seem to be a 'one-size-fits-all' solution.

The rail sector model defines four main planning time horizons, and corresponding coordination circles: long term planning, medium term service planning, the timetable cycle (usually one year), and real-time adjustments at the realisation phase. Several issues of misalignment of incentives between infrastructure managers and operators are discussed within each of the planning horizons, e.g. infrastructure investment and upgrades, infrastructure maintenance priorities, traffic control and disruption management. The pivotal point is that situations may arise where one actor bears the costs whilst the other one gains all or at least a noteworthy share of the benefits.

Unbundling is a potential source of detrimental misalignments. Track-access charging regimes and national performance regimes can play an important role but do not appear to be adequate to solve all misalignment issues. Additional re-alignment mechanisms are being developed in various countries, and it is noteworthy to mention that these tend to move towards hybrid, cooperative arrangements, rather than simple contractual market mechanisms.

Whether the combination of vertical separation with additional realignment mechanisms will lead to a similar level of performance to what can in principle be achieved in bundled regimes is doubtful, even though bundled regimes, as an alternative to unbundling, are not in themselves a guarantee for optimal performances. Additional performance incentives may be helpful here too and various options exist.

Seen from the point of view of actual market entry by new entrants, it seems clear from empirical data that substantial entry can occur under any of the reviewed institutional structures, and that one structure does not seem more favourable than the others on grounds of promoting entry. One important condition is the presence of a rail regulator, independent from the Ministry, and with adequate resources to enforce its decisions.

5 Review of the literature

In this chapter, we review non-academic literature on the impacts of alternative railway structures. This literature is very diverse, consisting mainly of government reports realised by teams of consultants. The studies that we briefly review here all focus on the functioning of the railway sector in one country, though most do also attempt to benchmark the performances of a national railway system with those of peers. Although most studies attempt to list the positive and negative consequences of various unbundling options, few existing studies do – to our regret – attempt to quantify precisely the consequences of unbundling, perhaps also underscoring the difficulty linked to the gathering of facts and the construction of useful counterfactual scenarios in this sector.

The most influential recent study on the consequences of unbundling is undoubtedly the McNulty (2011) study (see appendix A for more details). It is also the most revolutionary recent study in terms of its findings. It showed that, despite the improvements reached with past reforms in the British rail sector and compared to other European railways, the UK rail industry shows a significant efficiency gap, with rail costs that should be 20-30% lower than currently. The study views the current market organisation with its high level of fragmentation as an important reason for inefficiencies. A lack of an effective supply chain that starts with the customer (passenger and freight) and taxpayer, and focuses the efforts of all concerned on meeting needs in a cost-effective manner has been identified. Train operating companies were criticised for taking very short-term views in an industry that requires long-term planning, mainly as a consequence of relatively short franchises. McNulty characterised this system as ineffective and misaligned and the industry's legal and contractual framework as complex, with adverse effects and engendering additional costs. The resulting interfaces issue meant that whole-system approaches are currently difficult to apply in an industry that often needs them. McNulty states that there are few effective incentives across the wheel/rail interface, despite the complex track access charging system and performance regime in place.

From a general perspective, the study recommends a stronger leadership from the top but also a more devolved decision making in the system. It recommends changes to structures and interfaces, notably by devolution and decentralisation of Network Rail and the introduction of diverse ownership of some infrastructure management concessions. Moreover, a closer alignment of route-level infrastructure management with TOCs, either by cost and revenue sharing (and joint targets), joint ventures or alliances or full vertical integration through a concession of infrastructure management and train operations combined is suggested. The study also recommends that incentives for TOCs to reduce costs and co-operate more effectively with Network Rail should be strengthened. At operational levels, the study recommends a stronger focus on partnership with a wide adoption of best-practise frameworks to encourage whole-system, whole-life approaches, considering of trade-offs between infrastructure, rolling stock and operations in order to better select the optimum maintenance approaches and earlier involvement of suppliers and contractors as well as much wider use of partnering approaches.

McNulty's conclusions stress that "one size will not fit all", especially with different solutions being seen as optimal in areas where a single franchisee dominates train operations compared to where this is not the case.

Various studies realised in the context of the McNulty study looked in more depth at various aspects of the current British organisation. LEK (2011) argues that vertical integration would reduce transaction costs and improve incentives, but that it could reduce competition, not just because of fear of discrimination but also because there may be fewer bidders for franchises if infrastructure is included. Another study (First Class Partnerships, 2011) sought to quantify the benefits of vertical integration for a particular case study where a long franchise with responsibility for operating, maintaining and upgrading the infrastructure exists. It concluded that vertical integration would reduce overhead and support services costs whilst leading to more cost effective maintenance, renewals and enhancements.

From case studies undertaken for McNulty (2011) for the Chiltern and Anglia franchise areas, it seems that the Merkert (2010) estimate that reduced transaction costs would be modest was accepted. The principal benefits of vertical integration were seen to come from better alignment of incentives, such as: more efficient planning and implementation of renewals and enhancements because of the improved local knowledge of the state of assets and of the cost/revenue implications of alternative courses of action (including delaying renewals), better incentives to get work done in the most cost effective way, better planning of work to optimise the trade off between cost and impact on train services, and removal of duplication of effort for instance in performance management. Estimates were based on bottom-up assessment of potential savings in consultation with key stakeholders. First Class Partnership (2011) estimates these savings as 15-20% of infrastructure costs for Chiltern. However, some of these savings could also be achieved by restructuring Network Rail without increased vertical integration. LEK (2011) seems to take more like 2-7% as the range of net savings for Anglia. The LEK report on Alternative Railway Structures lists costs and benefits of vertical integration. Under benefits it places reduced interface costs, improved incentives to minimise disruption to services (incentives based on actual costs/revenues rather than penalties based on formulae), better-aligned incentives regarding infrastructure renewals and enhancements and a more commercial approach. Under costs it places transition risks, reduced TOC focus on train operations, possible damage to competitors and freight operators, fewer bids for franchises, less frequent franchise competitions if vertical integration led to longer franchise contracts, franchise lengths compromise between what is appropriate for infrastructure and what for train operations (may need 'periodic review' of train operations as well as infrastructure costs to rebase payments in the light of external events).

McNulty recommended experimenting with complete integration for the duration of the franchises where one passenger operator is dominant (Anglia franchise) but elsewhere he recommended joint ventures to undertake particular activities (e.g. station maintenance, track maintenance) and sharing of revenue and costs above or below projected levels. Although there is currently no sign of anyone moving towards a fully vertically integrated franchise, various alliances of different depths are being negotiated. The deepest alliance is that for South West Trains, currently in place under the name "Wessex", and where the infrastructure manager and the operator have a joint management team, reporting to a single managing director.

An earlier German study undertaken by the Technical University of Berlin (Brenck et al., 2004) attempted to assess different institutional configurations for the German railway sector. The study applied a transaction cost based approach to assess the synergies between the infrastructure manager and the railway undertaking. This so-called "Synetra"

report (Synergies between the railway network and transportation), which was considerably less comprehensive than the McNulty study, considered the most important interfaces between the two actors and four criteria to evaluate which organisational solution creates the lowest transaction cost. Following the approach of transaction cost economics, the criteria chosen are the specificity of an asset, the uncertainty, the frequency and the measurability of process within the interfaces.

The study identified 40 transactions that take place in five major interfaces: investment and financing, timetable coordination and slot allocation, operations management, research & development and safety. The study evaluated each process at the interfaces between infrastructure and rail operations using the above-mentioned transaction cost drivers. The authors then recommended a hierarchical solution, such as a holding, when the summarized "values" of the characteristics of processes at one interface is high. The authors recommended a hybrid solution, which can be a partnership or a joint venture, when transaction costs are medium high. In the case of low transaction costs, a market mechanism is recommended, consisting of contractual arrangements with different terms.

Contrary to the McNulty findings, the Synetra study concluded that for most interfaces and to fully benefit from synergies an integration of network and transportation is not needed. There is no general recommendation or one-size-fits-all solution either as the study concludes that for investments, especially in dedicated lines such as high-speed, a stronger need for coordination has been found, which could be resolved by using hybrid solutions. Other core interfaces such as timetable coordination, slot allocation and operations management should, according to the study, be coordinated through market mechanisms.

Later another German study attempted to examine various structural privatisation models for the German railways (Booz Allen Hamilton, 2006) and assessed the financial consequences of separating infrastructure and transport. This study (titled "PRIMON"), commissioned by the German Federal Ministry for Transport, Building and Urban Affairs and the Federal Ministry of Finance is the most comprehensive and quantitative piece of evidence encountered in the course of this study, attempting to estimate the once-and-for-all and recurring costs of moving from the holding company model to complete vertical separation. The PRIMON study suggested that it would be likely that a completely separated model would be less favourable than a holding company one in its impact on the government budget. In a long term view (2006-2020) the negative budgetary effect was estimated to range between €6.4 to 9.4 billion. Yet, this estimate is based on several drivers, some of which should not be regarded as a cost in our cost benefit analysis, e.g. the assumption that separation would increase competition, and thus reduce the profitability of the assets the government would either sell, or retain and receive dividends on. In the narrow sense, the costs of complete separation identified were a loss of synergies of €1.1 billion for 2006-9 and transition costs of €1.5 billion over the same period, although it states that DB estimated these costs as higher. For the longer run, PRIMON estimated a sustainable cost of complete separation of €0.488 billion per annum. As against these, the study assumed that competition would be higher and that this would lead to savings of €3.3 billion in present value terms in regional passenger services for 2006-2020, i.e. €0.22 billion per annum. Thus even if the latter estimate was accurate (and there are certainly doubts as to the degree to which complete separation would have led to more competition in the competitively tendered market, where there has generally been intense competition in any case), these benefits would have been outweighed by the estimated costs.

A large share of these costs was expected to be caused by less favourable labour conditions (as renegotiations with unions would have become necessary) and the loss of the corporate internal labour market that is needed to restructure the organisation. Further synergies would be lost by misallocating investments and by separating procurement and other central services. Another large contributor to these costs would be the abandoning of the single wagon load traffic, which – according to DB – was at that time (2006) only sensible to be operated under an integrated company (the marginal costs for infrastructure are very low in that case and this business is then able to achieve further cost coverage).

Few other published studies are directly aimed at analysing and quantifying the consequences of misalignments in the railway sector. However, a recent Dutch parliament enquiry on maintenance and innovation in the rail sector provides interesting insights (Tweede Kamer, 2011). Although the level of disruptions and delays on the Dutch railway network are low by international standards, repeated cases of major disruptions drew a high level of political attention which led to an extensive parliamentary inquiry on the organisation and financing of track maintenance in the Netherlands, based on interviews with responsible railway executives and specialized studies. One of the background studies realised an international benchmark on the organisation, utilization and maintenance in the Dutch railway sector (Hansen et al., 2011). The study is based on a comparison between six countries, which have been selected by the criteria scale, vertically separated or integrated, introduction of new signalling and safety systems and degree of excellence: Belgium, Denmark, The Netherlands, Sweden, Switzerland and JR East (Japan). According to the main conclusion of this study, vertically integrated companies like SBB and JR East, combined with other regionally, vertically integrated railway undertakings and networks for passenger services achieve the highest performances while freight operators do get open access to these networks. The study also includes a comparative analysis of highly utilised lines in the countries studied. The remarkable performances of the Japanese railways, exemplified here by JR East, is put forward and the study questions whether these high performances would have been possible if JR East had been in a separated setting.

On the basis of the successes of the mentioned integrated companies, the major study behind the Dutch parliamentary enquiry (Hansen et al., 2011) recommends an inquiry regarding synergy and welfare effects of (re)integration of operations and infrastructure management. According to this study, integration of the main RU and the IM would, for the Dutch situation, create opportunities for a more effective governance, system wide innovation and higher efficiency by optimizing investments and management. This could avoid the disadvantages of vertical separation that the study observes, such as suboptimal decisions driven by individual financial (operational) interests of the IM and the RUs. The examples mentioned by the study include the current separated (and double) information streams to passengers during disruptions, the underutilisation of existing capacities during major disruptions, the consequences of track possessions for maintenance on passenger and freight traffic, badly coordinated investment decisions on infrastructure extensions and new rolling stock and substantial transaction costs.

Finally, it is also important to mention the national debate launched by the French government (the so-called ‘Assises du ferroviaire’ involving all stakeholders) to evaluate the current French railway model and prepare its future. These debates led to several reports published at the end of 2011 (Assises du ferroviaire, 2011). One of these reports focused on the governance of the railway sector, and in particular on the functioning of

the current separation between the IM (RFF) and the main incumbent RU (SNCF). The report observes that the current governance regime of RFF and SNCF has much trouble to respond to the expectations of the various actors. Numerous actors, national and regional authorities are involved and the current model is hampered by its fragmentation and lack of clarity. The report concludes that the current regime is a source of inefficiency, and that a further grouping of all infrastructure management competencies under one management is desirable. The report also mentions that the current regime has led to a misallocation of public resources, away from priority investments needs. The report suggests two main options for the future of the French railway governance. One is based upon a stricter separation between IM and RU, the other based upon a stronger coordination of the RU and IM tasks within a common group company (groupe 'pivot'), but with a clear separation of essential functions. The report mentions that the first option could lead to sub-optimisation as identified by the McNulty study in Great Britain, and also to a loss expertise and professionalism due to an exaggerated separation. The second model is seen by the report as favouring system-wide optimisation but at the expense of a potential lack of neutrality versus potential entrants and of a monopolisation of railway expertise by the incumbent operator. Nevertheless, the report considers that the potential risks of a holding model (groupe-pivot) can be controlled and that the benefits of this model in terms of efficiency, staff mobilisation and industry development outweigh the risks. Therefore, in conclusion, the report recommends to the government to explore the option of a holding model.

In conclusion it can be said that the studies question the optimality of full vertical separation in the specific circumstances of the railway sector. The studies do not all come to identical conclusions, except perhaps for the finding that there does not seem to be a 'one-size-fits-all' solution in term of unbundling. A few elements seem to be determinant in the debate on the optimality of various arrangements. These include the discussions on fragmentation versus leadership, short-termism versus the need for long-term planning, sub-optimization and misalignment versus whole-system approaches and incentive re-alignment, and transaction costs versus induced system costs.

6 A generic model of the rail sector

We have seen evidence in the econometric analysis that the structure of the industry may have an effect on costs and that the effect may vary with the density of traffic on the rail network. However, econometric analysis alone cannot show why these differences occur. We have also seen that transaction costs and misalignments appear to be the main additional costs caused by vertical separation.

The generic ‘rail sector model’ developed in this chapter lays down the conceptual framework needed for the analysis of potential misalignments that will be conducted in chapter 7. It helps understanding where specific coordination mechanisms may be needed to ensure a proper functioning of the sector, distinguishing between the short, the medium and the longer term. It does also help in understanding whether and why these needs might be different from what can be observed in other sectors.

6.1 General presentation of the approach

A transaction-based approach

The model describes the main production processes and transactions present in the railway sector, irrespective of the institutional configuration chosen.

This is based upon a decomposition of the industry into ‘transformation processes’ and ‘transactions’ that explicitly or implicitly take place within the sector and that constitute elementary parts of the rail sector value chain. Distinguishing between typical stages such as build, own, maintain or operate, the model depicts a chain of input-output relations that are either internal or external to one company, i.e. ‘make-or-buy’ or ‘bundled- unbundled’.

This approach then allows superimposing various institutional configurations to illustrate and better understand the localisation of and boundaries between the actors created by various unbundling options.

This decomposition allows for a better understanding of related transaction costs, coordination needs and regulatory needs. This helps gathering a deeper understanding of the economics of the railway system as a whole, of its value-chain, and understanding the interdependences that exist between institutional configuration decisions and their consequences on sub-system *and* system-wide efficiency.

The rail sector model, as presented in this report, takes the shape of a generic chart, refraining from entering into every single detail of railway planning and production in order to provide useful insights while remaining tractable. It is based upon earlier work (see, e.g., van de Velde, 1999; 2009), enriched with additional rail sector expertise gathered throughout this study and further insights (e.g. Pfuhl et al., 2010).

Coordination mechanisms

Various coordination mechanisms can be envisaged. One obvious candidate is the market mechanism, where elements of the value chain are connected to one another by the rule of supply and demand and by a price mechanism. In some cases, a specific regulation (and regulator) may be needed to ensure the proper functioning of such markets. Alternatively, one may also come to the conclusion that in a number of cases internal coordination (i.e.

bundling) is a superior solution in terms of the overall economic performance of the sector. Hierarchy (internal coordination) should then be preferred to the market. But in some cases hybrid arrangements (joint-ventures, long-term cooperation, etc.) may also be contemplated where necessary, as alternatives to a pure market mechanism or to internal coordination.

The choice of the most appropriate mechanism depends on to the characteristics of the elements of the value chain at stake, the economic circumstances (economic development, economic perspectives, market conditions, characteristics of the networks and demand, etc.) and the institutional environment of the country or region. It is therefore also important to realise that the various elements of the value chain and boundaries between actors may require the implementation of different coordination mechanisms throughout the chain, all depending upon the varying characteristics of the transactions at stake.

The approach used in this report is inspired by the Transaction Cost Economics theory, as developed by Nobel Prize winner Williamson (1975; 2000), which pays explicit attention to transaction costs besides the actual production costs of a good or service. Transaction costs are the costs incurred in making an economic exchange, such as the search costs needed to determine whether the service or good required is available on the market and at what price, the costs of reaching an agreement with the selling party (contracting costs) and the costs related to enforcing the realisation of the transaction, making sure the seller sticks to the contract terms and – if needed – the costs of legal action to enforce the contract.

We distinguish in our approach between ‘pure’ transaction costs (as defined above) created by structural reforms and the wider costs generated by incentive misalignment between actors created by structural reforms. The latter are additional costs throughout the value chain such as additional capacity investment needs, additional operational costs or lost revenue opportunity resulting from a lack of coordination between IM and RU (see also definition section).

Applied to the railway world, this theory allows developing a deeper understanding of the factors that may indicate which form of organisation is more suited to minimise (transaction) costs. A main focus in this approach is the understanding of the reasons for which firms decide, in a free market, to organise some transactions on the market (i.e. unbundling of parts of the value chain across several economic actors) and sometimes decide to organise transactions internally (i.e. bundling under one chain of command within the firm). A main reason to move away from simple market transactions arises when the parties to the transactions are highly dependent upon one another due to the nature of the transaction at stake. This can e.g. be the case due to asset specificity, a situation where investments made by one of the parties to the transaction have less or no alternative use outside of the transaction. The theory states that internal firm hierarchy may in this case be more suited to resolve or prevent conflicts between the parties to the transaction; transaction costs are economised but this may come at the price of additional costs of internal bureaucracy. The theory also suggests that hybrid contracting – combining elements of market and hierarchy – can in some cases constitute an adequate intermediate solution. Hybrid contracting covers a wide range of arrangements characterised by a longer term relationship between distinct parties where changes and adaptations in the terms of the relationship may take place as a result of progressive learning. Strategic alliances, joint ventures and the like are examples of such arrangements. In this approach, the more cooperative adaptation between the parties to the transaction is needed, the less a simple market transaction will be suited and the more

a hybrid or – ultimately – internal hierarchy will be suited, all depending upon the balance of production, transaction and bureaucratic costs.

6.2 Generic rail sector model

For clarity's sake, this section will introduce step-by-step the graphical tool used to describe the rail sector model.

The decomposition of the rail sector value chain as presented here uses several horizontal 'layers', representing (1) the production of train services, (2) the associated sales and customer information activities, and for the production of infrastructure services, being both (3) the stations and (4) the tracks. The appropriate combinations of these various layers then lead to the delivery of a transport service to customers (see Figure 9).

Each of these layers covers a chain of input-output relations. These are represented by a flow-chart of activities covering all key production processes of the railway sector, arranged in columns from initiate, to build, own, maintain and operate (see Figure 10). The underlying chain of input-output activities is represented here greyed-out to illustrate the concept used. The details of this chain will be presented in more detail in the next section and in Figure 11.

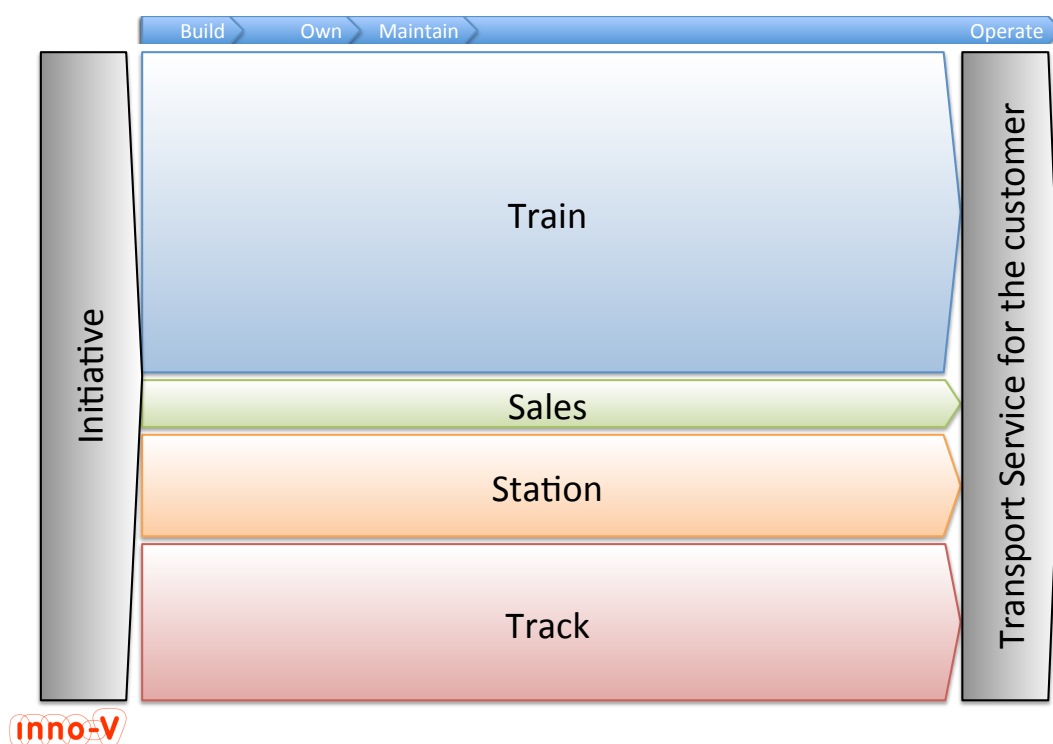


FIGURE 9 RAIL SECTOR MODEL: MAIN LAYERS (SOURCE: INNO-V)

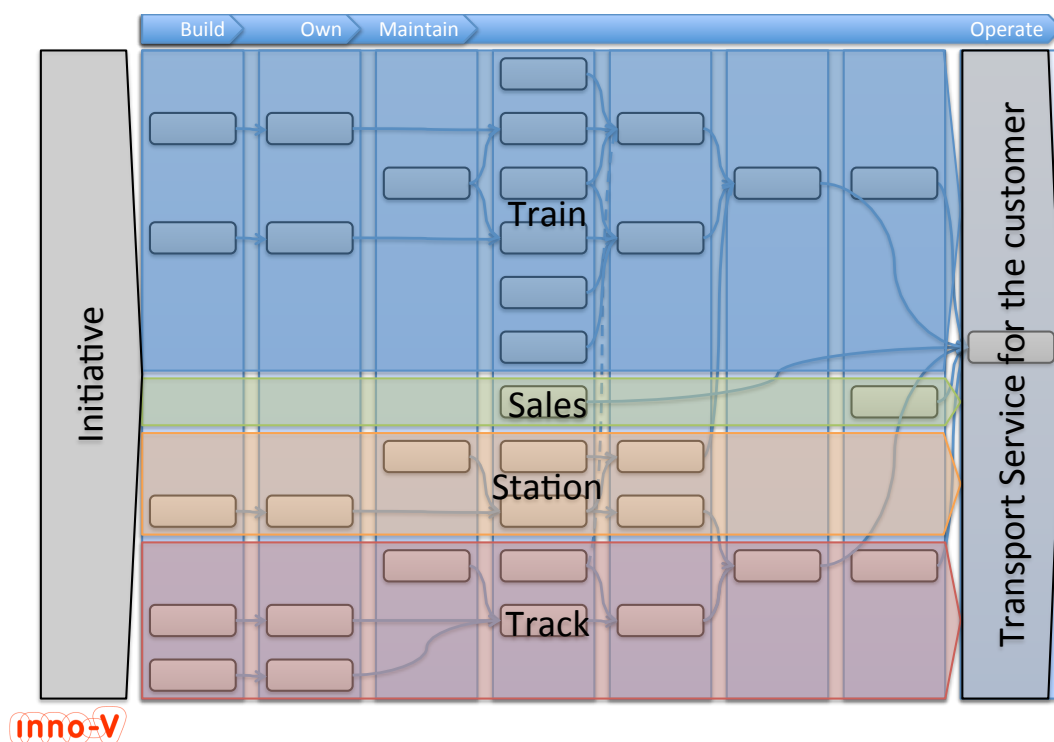


FIGURE 10 RAIL SECTOR MODEL: GROUPING CHAINS OF INPUT-OUTPUT RELATIONS INTO THE MAIN LAYERS (SOURCE: INNO-V)

Figure 11 zooms in on the transaction elements of the underlying rail sector model. From top to bottom and from left to right in the figure, one can see how various moving assets (carriages and locomotives) are first build and acquired, owned, maintained, combined with operational staff (drivers, conductors, catering...) to allow the delivery of a train service (a planned train run according to a specified timetable). A transport service to the passenger can then be delivered when this is combined with a similar combination of various fixed assets (stations and tracks), assembled to provide an infrastructure service (a planned path in a railway diagram). The actual delivery of the service then requires the transformation of a plan into reality, which entails various real-time production services present in the second column from the right in the graph: traffic control, transport control and customer information.

A few remarks need to be made. Firstly, a distinction is made between carriage and locomotive in the input-output chains in the upper part of the graph. While this is the usual way of producing for freight transport, passenger transport can also be characterised by the 'merger' of the carriage and locomotive into (inseparable) multiple-units (EMUs and DMUs). In graphical terms, two rows in the graph are then merged into one for that part of the rail operations. Secondly, station buildings lead to two essential outputs, one is a station service for the railway undertaking relating to the infrastructure and the 'path' it uses (a stop at a platform), the other output of the station relates to the services for the customers when boarding and alighting; this relates to the train service.

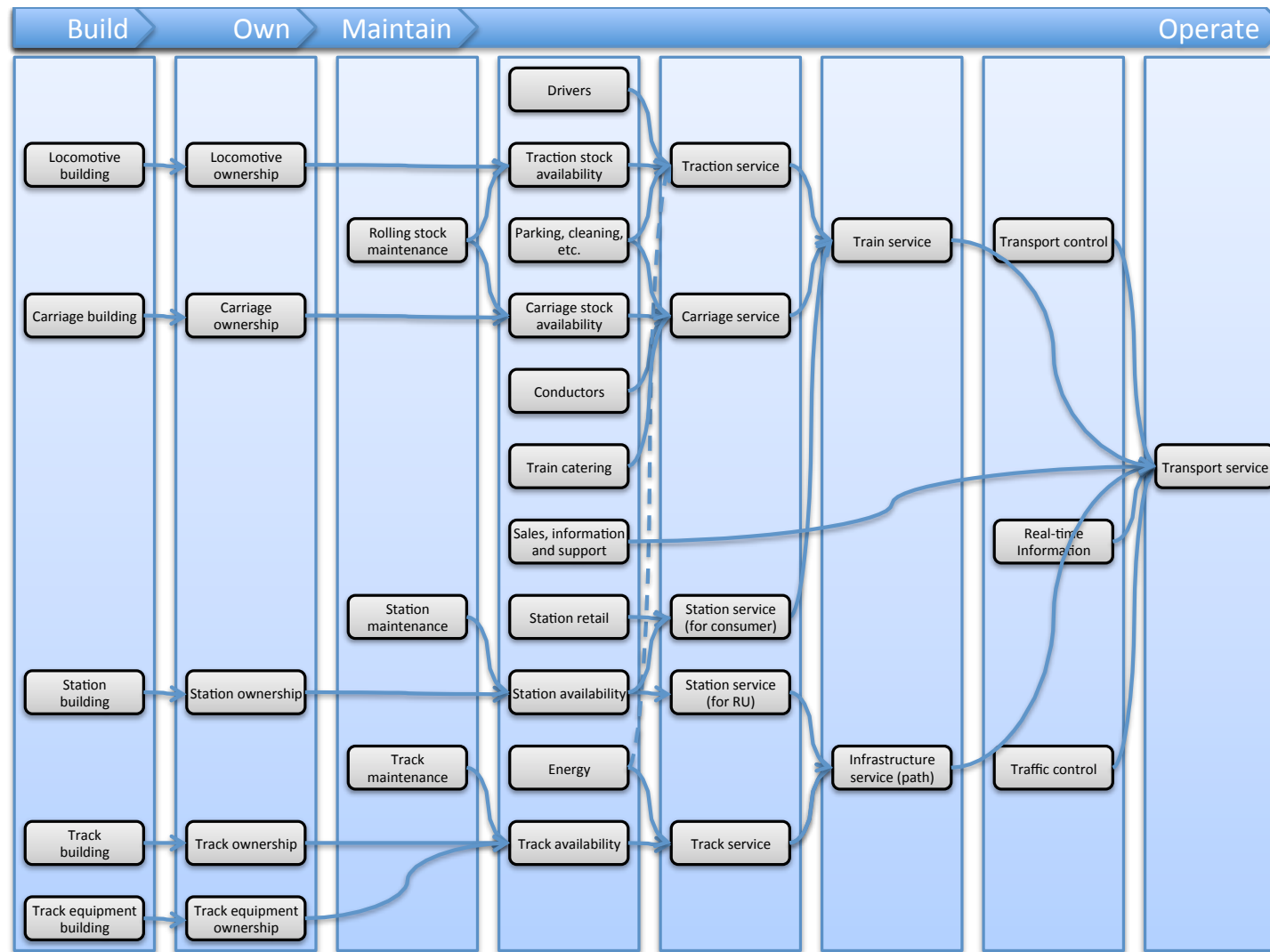


FIGURE 11 RAIL SECTOR MODEL (SOURCE: INNO-V, BASED ON VAN DE VELDE, 1999; 2009)

6.3 Chain coordination and regulation

Various elements can be superimposed upon this generic rail sector model to illustrate various coordination issues that arise in the rail sector. The following subsections will exemplify these, with the help of a number of graphical representations.

Planning horizons

Several planning horizons can be distinguished in the rail sector. Firstly, long term planning is concerned with investments in assets that are characterised by lengthy amortisation periods, both for the moving assets, and even more so for the fixed assets. Their configuration determines largely the general service concepts that will be feasible for the years to come (speed, comfort, connectivity, capacity). Secondly, medium term service planning is concerned with the development of concrete service concepts and staffing (incl. training). Thirdly, the rail sector is characterised by a timetable cycle, usually one year, representing the shorter term, often complemented by even shorter term planning (not represented here for the sake of clarity). Finally, real-time adjustments to the plans are often needed at the realisation phase to cope for unforeseen events, disruptions, etc. The green arrows in Figure 12 broadly illustrate the scope of these planning horizons.

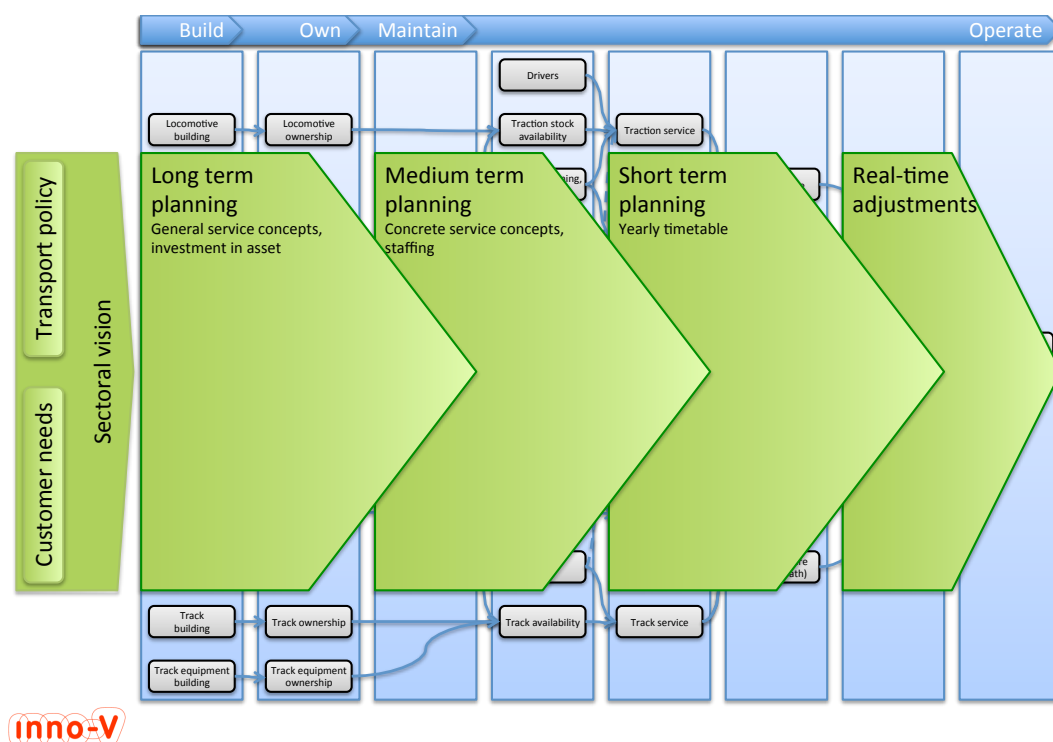


FIGURE 12 RAIL SECTOR MODEL: PLANNING HORIZONS (SOURCE: INNO-V)

Railway infrastructure- and transport service-provision usually fulfils customer needs as well as transport policy and other policy goals. A pure private investor planning leadership of this system would in many cases yield service levels which are below what is seen as socially and politically desirable. Public transport infrastructure planning based on social cost-benefit analysis and policy aims is therefore a common feature in Europe. Public sector (co-)funding is then used to reconcile public and private interests. Note, however, that US freight railways and to a large extent the Japanese railways (both vertically integrated) are lead by pure profitability principles even at the long-term

planning stage. This is unusual in Europe, with the Baltic railways as noteworthy exceptions. Public sector co-funding is therefore usual for various policy reasons, resulting in the need for a broad sectoral vision including both customer needs and policy aims.

Coordination circles

Coordination across the various branches of the rail sector model is needed at every single term of the planning process, as illustrated in the previous figure. These can be represented by a number of circles superimposed upon the generic rail sector model (see Figure 13).

The first circle on investment coordination relates to the longer term, to asset development, to the dimensioning of the railway system and the coordination in the ownership of the various assets needed. This relates, amongst other, to the issue of compatibility between the various assets (track and train, platform and train, locomotive and carriage), but also to the important issue of the optimisation of the total investment needs in the industry, across the infrastructure-train borderline. One example that can be given at this point is the choice for additional investments in the track (straightening) in order to allow the circulation of higher-speed trains, or the investment in (faster) tilting trains where this is on the whole (i.e. from a system-wide perspective) more economical than rebuilding or straightening an existing railway line. Such a trade-off can be seen in the investment decisions in the Swiss trains and infrastructures on the context of the Bahn2000 improvement program that was aimed at doubling the train frequency and shortening travel times.

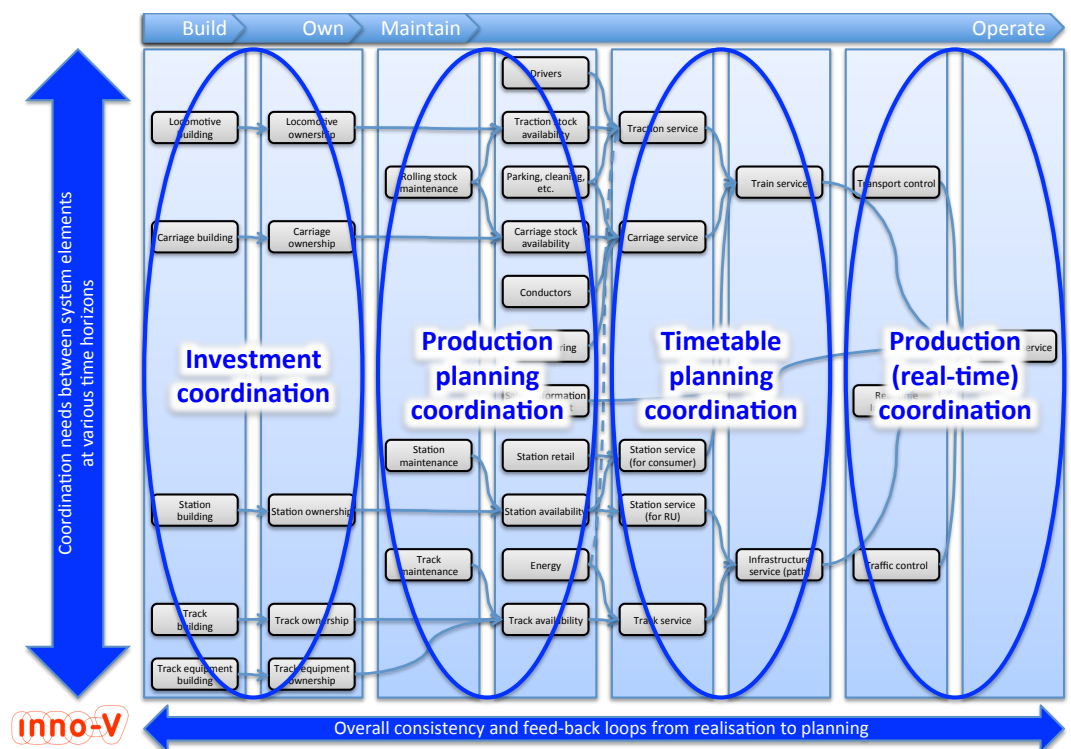


FIGURE 13 RAIL SECTOR MODEL: COORDINATION (SOURCE: INNO-V)

The second circle relates to the medium term and the coordination of the concrete means of production (especially staff), including the concrete maintenance and transport service concepts that have to be realised with the chosen assets and staffing. Various economies

of scope can be identified here between the staffing of stations, such as information, sales, traffic control and smaller infrastructural tasks (especially in cases of disruptions, such as snow problems, etc.) Several important trade-offs have to be struck at this level, especially when seen in balance with the former (investment) and next (timetabling) planning aspect. These are the trade-offs between preventive maintenance and corrective maintenance to the rolling stock and to the infrastructure. These choices on each side of the train-infrastructure divide have substantial consequences on the need for inputs (space, staff...) on the one and the other side of the divide. Infrastructure unreliability immediately creates additional costs on the transport side. Unreliability of the rolling stock or of the personnel is immediately a source of capacity conflicts on the infrastructure side, especially in densely used networks.

The third circle relates to the shorter term, essentially a timetable period and shorter timetable planning horizons. The coordination between train service concepts (passenger local, passenger long-distance) and between path requests for various markets (passengers, freight, maintenance, etc.) has to take place at this level. Timetabling norms, from the side of the infrastructure have to be coordinated with what is realisable from the rolling stock's side. System-wide savings can be achieved by adapting the planning norms to technological evolutions on the rolling stock's side and by implementing a feedback loop to (smaller) reconfigurations of the track and its equipment (in particular the signalling).

The fourth circles relates to real-time coordination of the operations of the railway. This covers traffic control (signals, switches...), transport control (dispatching of rolling stock and personnel) and real-time customer information. These functions require a high degree of responsiveness, as speedy reactions to disruptions are needed to avoid chaos. This is a particularity of the rail sector where, contrary to the air or road sector, broken-down vehicles cannot easily be put aside or overtaken by the rest of the traffic. A high degree of coordination with an instantaneous possibility for reaction is needed between traffic control, transport control and passenger information, especially in densely used networks. Analysis of disruptions and dispunctualities should also be made at this level and usefully fed back into the timetabling planning (both path planning norms and demands for services) and also – further left in the chain – into advices for marginal reconfigurations of the infrastructure such as to realise system-wide economies. The Japanese railways provide numerous excellent examples of such practices. Repeatedly applied over the years in a system-wide (train-infrastructure) and continuous improvement approach, they illustrate that performance analyses, tracking of the causes and feedback loops with marginal reconfigurations allow for substantial performance improvements and contribute to enhanced system profitability. The superior performances of the Japanese railways compared to the European railways in terms of track utilisation, reliability and punctuality are partly due to these feedback loops.

The horizontal blue arrow in Figure 13 illustrates the need for horizontal coordination between the various planning steps, in order to ensure consistency of the system. The presentation of the circles above has already pointed to various feedback loops from one step to the other. It is important to note that these are also a main input for more general Research & Development activities that are needed to guarantee a future for the sector, covering both the technical side (especially safety) and the commercial side (demand and service concepts).

Regulatory interventions

State interventions in the rail sector can be divided into several domains. We can, e.g., distinguish between regulation related to the recognition of an actor’s professionalism in order to be granted access to the profession and the market. This covers various items in the rail sector, such as safety regulations, driver’s licences, creditworthiness, etc. Licensing authorities and safety inspectorates, located towards the left in Figure 14, form illustrations of this type of intervention.

A second domain of regulation is that related to the behaviour of the actors in the market. This is located in the right hand part of Figure 14. General competition authorities can be found to intervene in the railway markets, e.g. in relation to market power, unfair behaviour, etc. A feature of the railway sector is the existence of specific rail regulators, with – mainly – an important role related to the regulation of the infrastructure manager. Main items here are the granting of fair access to the infrastructure and the calculation of fair track access charges. Chapter 8 reviews a number of options.

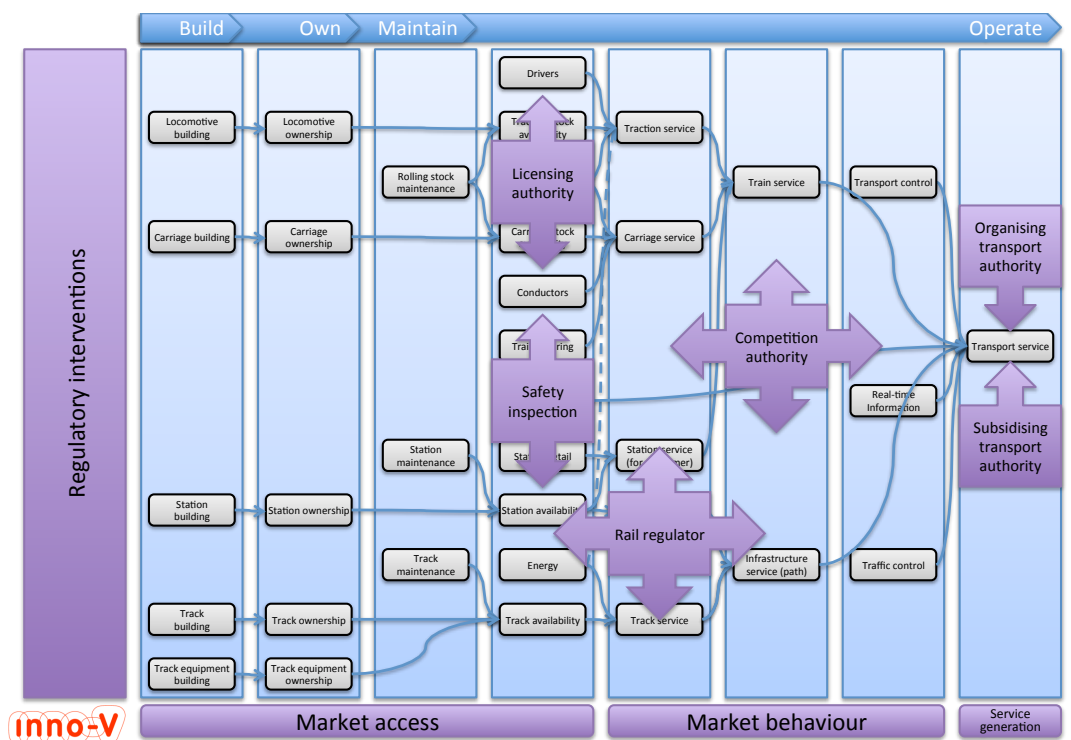


FIGURE 14 RAIL SECTOR MODEL: REGULATORY INTERVENTIONS (SOURCE: INNO-V)

A third domain of authority intervention in the rail sector is that of the service ordering authority (the transport or organising authority) who takes the initiative to order transport services from a railway undertaking (right in the figure). This can include in varying levels of specifications of the services to be provided (up to a detailed timetable) and of the vehicles to be used (up to authorities making trains available to the winning operator of a railway competitive tendering procedure). Alternatively, authorities can also create various forms of incentives meant to generate more rail transport than would otherwise be the case. This can cover various forms of interventions, varying from specific contractual payments to more generic forms of ‘subsidies’ available on equal grounds to all potential market players.

International coordination issues and actors

Railways do not operate in isolation from one another. And a lot of the involvement of the European Union with railways has to do with fostering a better international development of the railway by stimulating interconnection and interoperability. Figure 15 illustrates a number of issues present at this level. Note that these items are present wherever several railway undertakings and/or infrastructure managers operate in a same or neighbouring territory. In other words, these issues can be found in Europe when talking about international railway cooperation, but also nationally when several railways co-exist. This is particularly visible in Switzerland and Japan.

The leftmost coordination issue in Figure 15 is that related to the standards (such as those traditionally devised by the UIC, and more recently the TSI's developed by the EU and ERA) meant to ensure interoperability across borders. This includes discussion on signalling and safety systems (ERTMS, ETCS, etc.) This level also relates to interconnection and coherent development of wider networks (such as TEN-T by the EU).

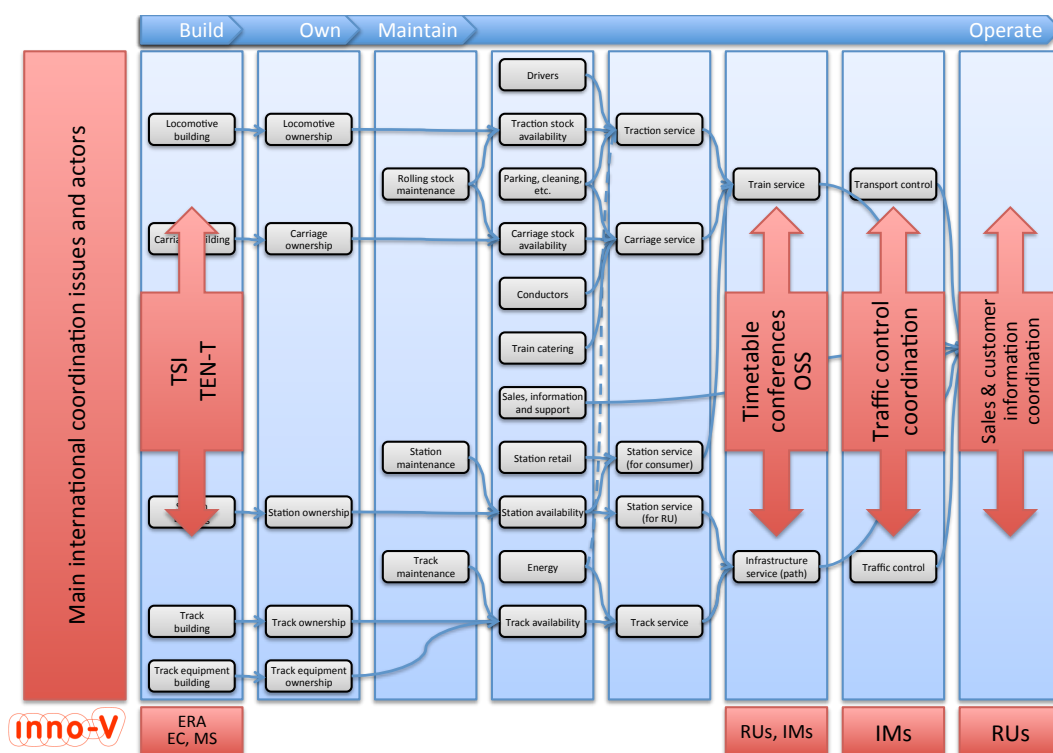


FIGURE 15 RAIL SECTOR MODEL: INTERNATIONAL COORDINATION AND ACTORS (SOURCE: INNO-V)

Towards the right in the figure, coordination issues related to concrete train services can be found. This covers the coordination of timetables across system borders (national and international timetable conference), but also the organisation of one-stop-shops to buy 'paths' across various systems. This is followed by traffic and transport control coordination and real-time customer information coordination at the operational level. The coordination of ticket sales and the access to pre-travel information are other major items at the level of the cooperation between railway undertakings. This can be organised via regulatory intervention, as can be seen in Switzerland or Great-Britain in terms of through ticketing, but market-based organisations also exist, as can be seen in the Japanese case.

6.4 Representation of current institutional configurations

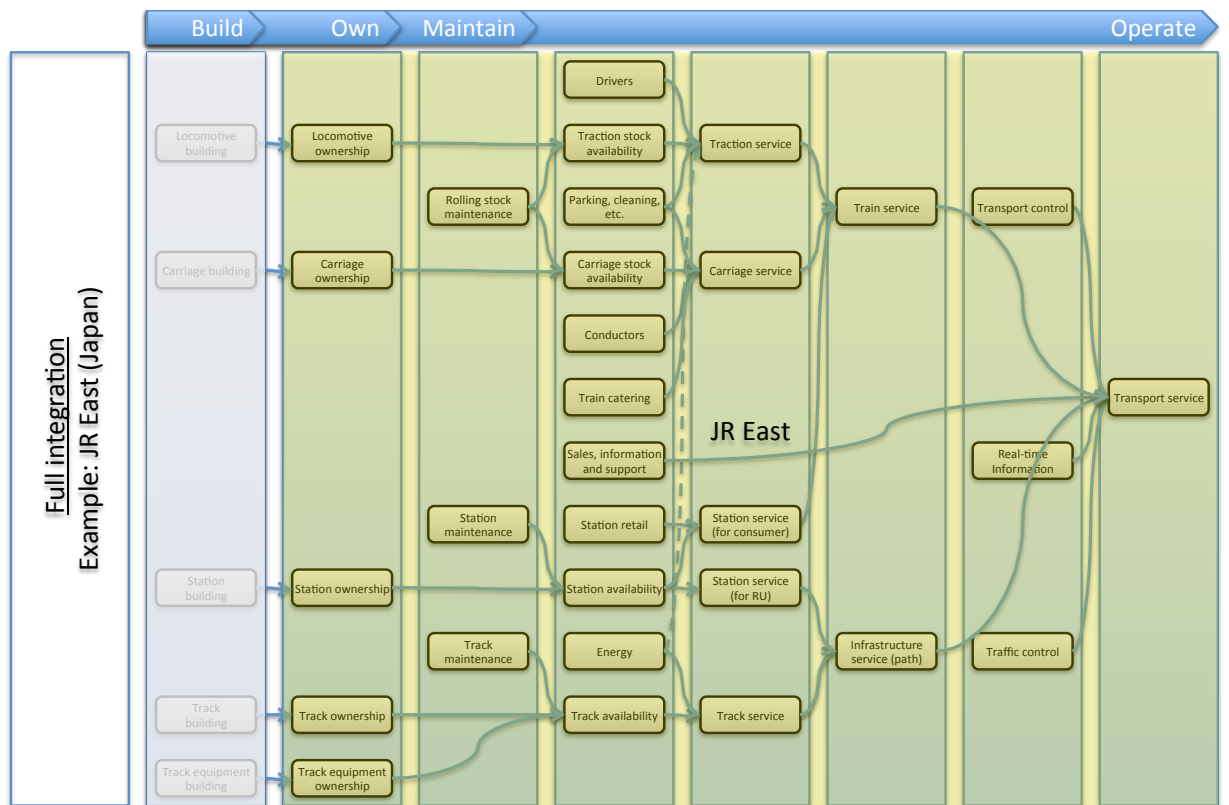
The structural options for the rail sector represent different institutional configurations of this decomposed value chain, where different actors combine different elements of the value chain within one or several organisations.

The graphs in the following figures illustrate this for several structural options, illustrating how the main incumbent operator has been reorganised into separate entities. This is done for several existing cases and one hypothetical case.

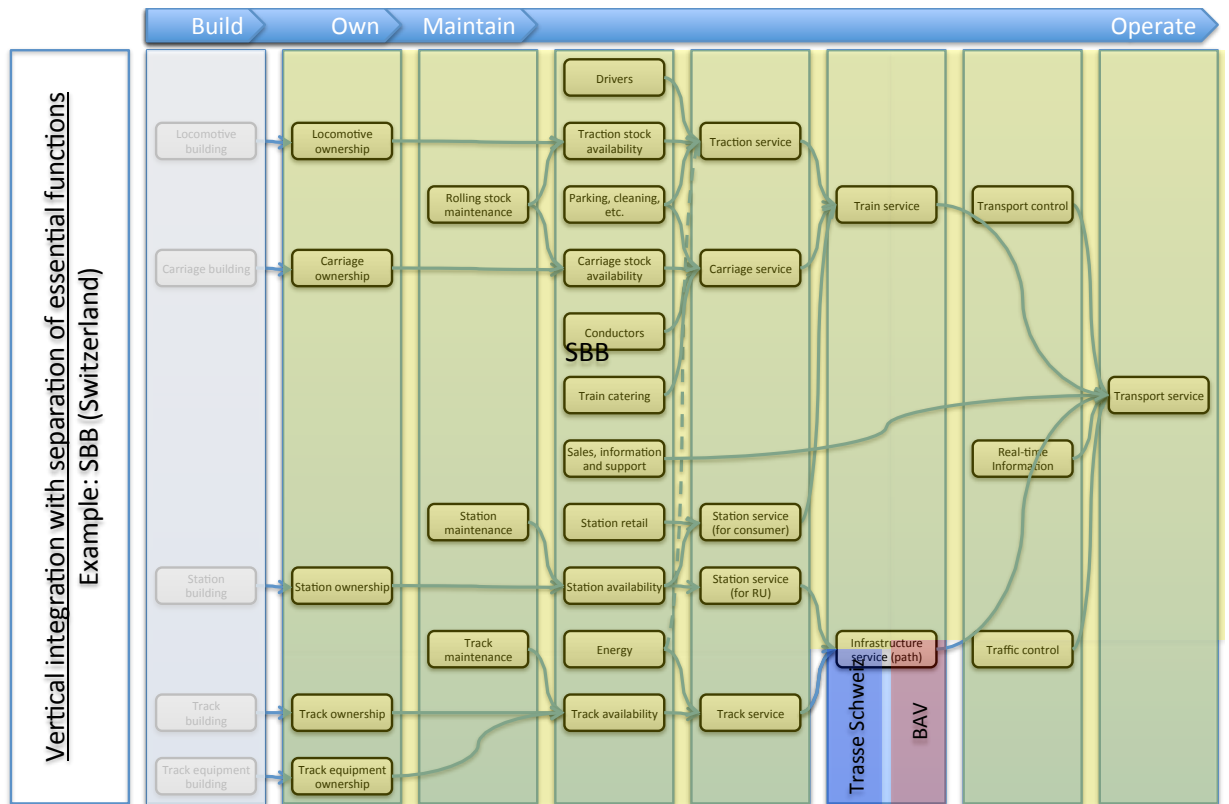
IMPORTANT NOTES concerning the following figures:

- *The colours in the graphs indicate only the main actors and their main boundaries.*
- *These figures are meant to present the essentials of various institutional configurations. They are simplified representations of a complex world. The graphs do not represent all details of each of the institutional configurations.*
- *Various arrangements exist for the asset building stage (leftmost stage in the figures). Rolling stock is usually bought on the market from rolling stock manufacturers. Arrangements are more diverse for construction works, combining market options with in-house production, or at least coordination of the realisation by the body responsible for infrastructure management. This part of the railway value chain is not located at the core of this study. It is therefore represented greyed-out and left out of considerations for the sake of simplicity.*
- *Many sub-contracting elements are left out of the figures for the sake of clarity. These include catering, cleaning, some maintenance activities, etc.*

More details about the basic structural characteristics of the national rail sectors in a selected number of countries are included in the country fiches in Annex F. These fiches are meant to allow for a snapshot view of national characteristics in no more than 2 pages per country.



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Figure 16 Rail sector model: Examples of vertical integration (JR, SBB) (Source: inno-V)

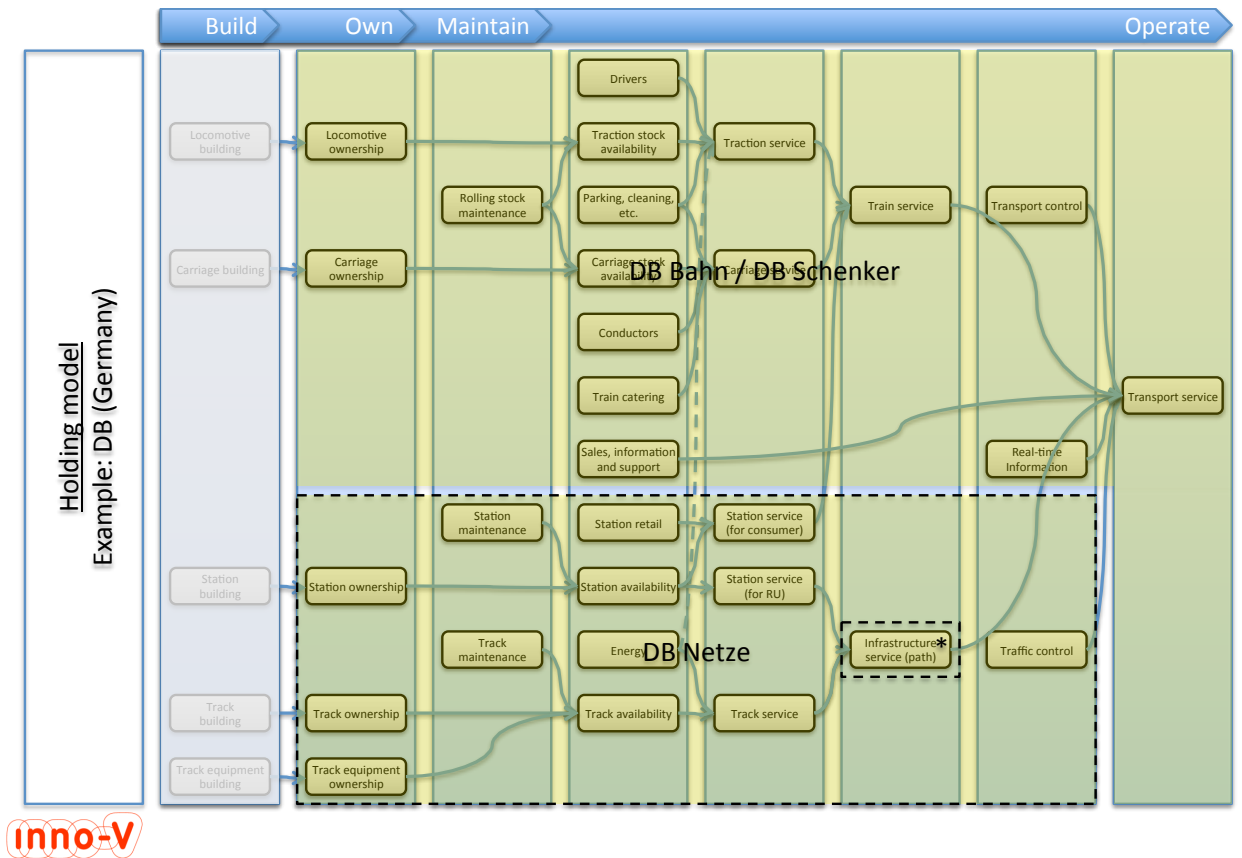
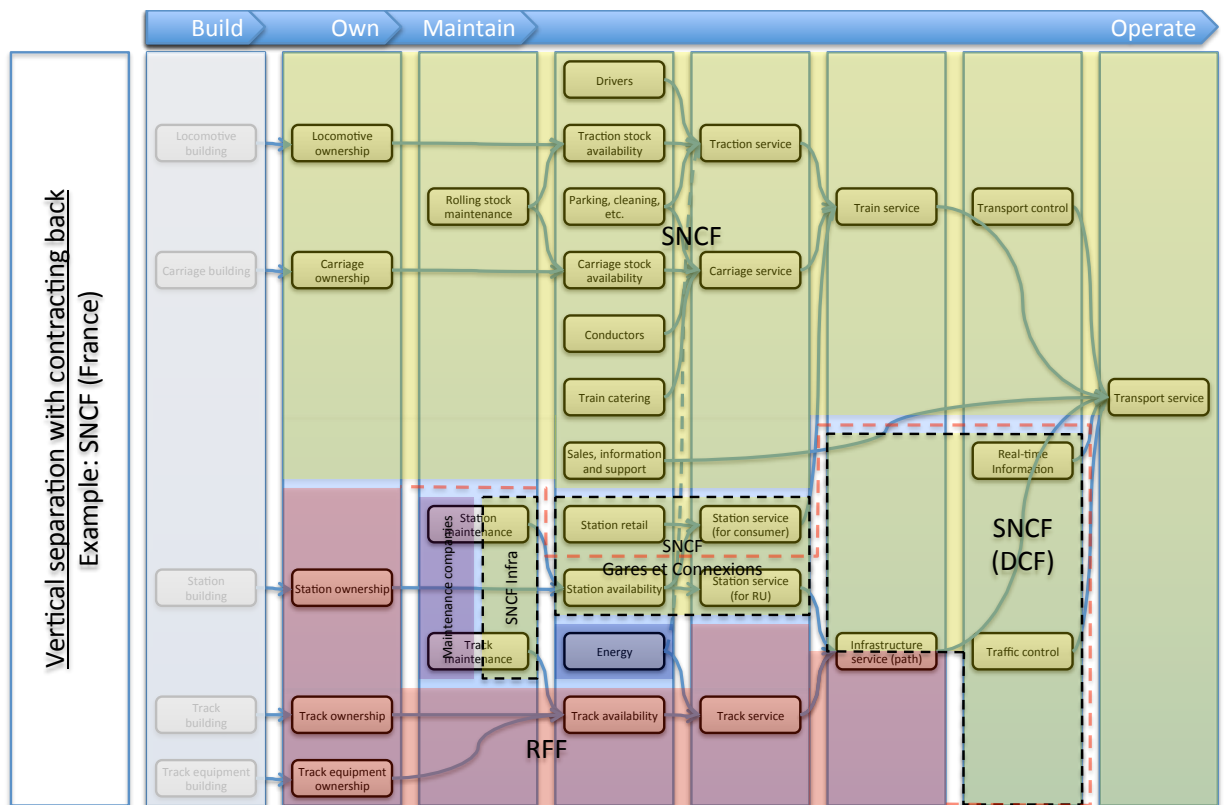
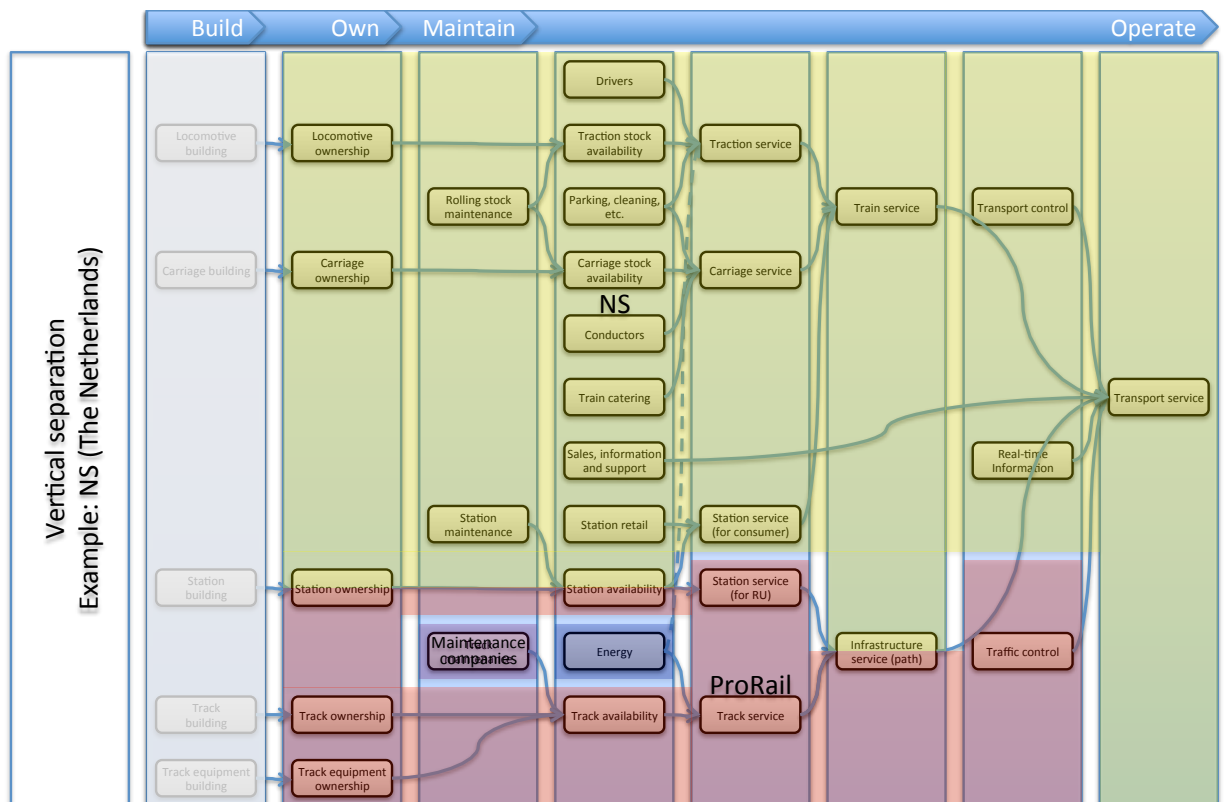


FIGURE 17 RAIL SECTOR MODEL: EXAMPLES OF HOLDING MODEL (DB) (SOURCE: INNO-V)

NOTE: * FUNCTIONALLY UNBUNDLED (CHINESE WALLS)

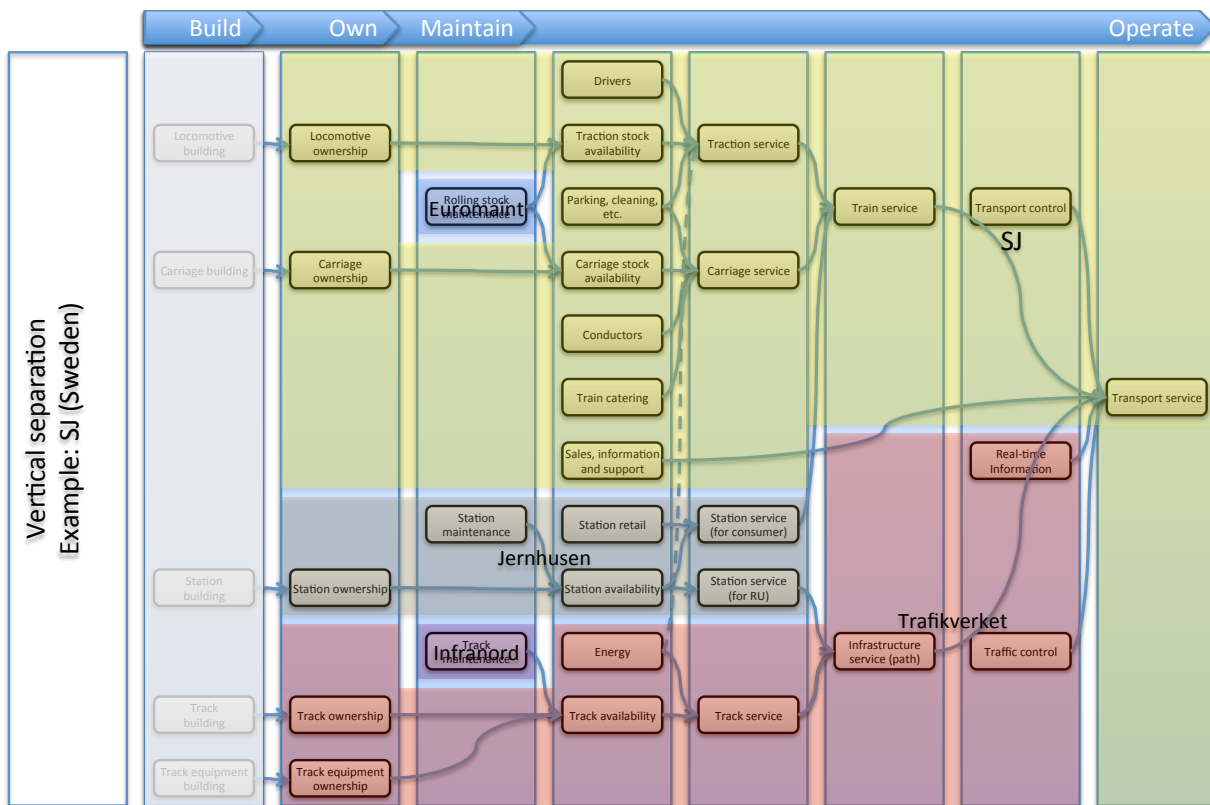


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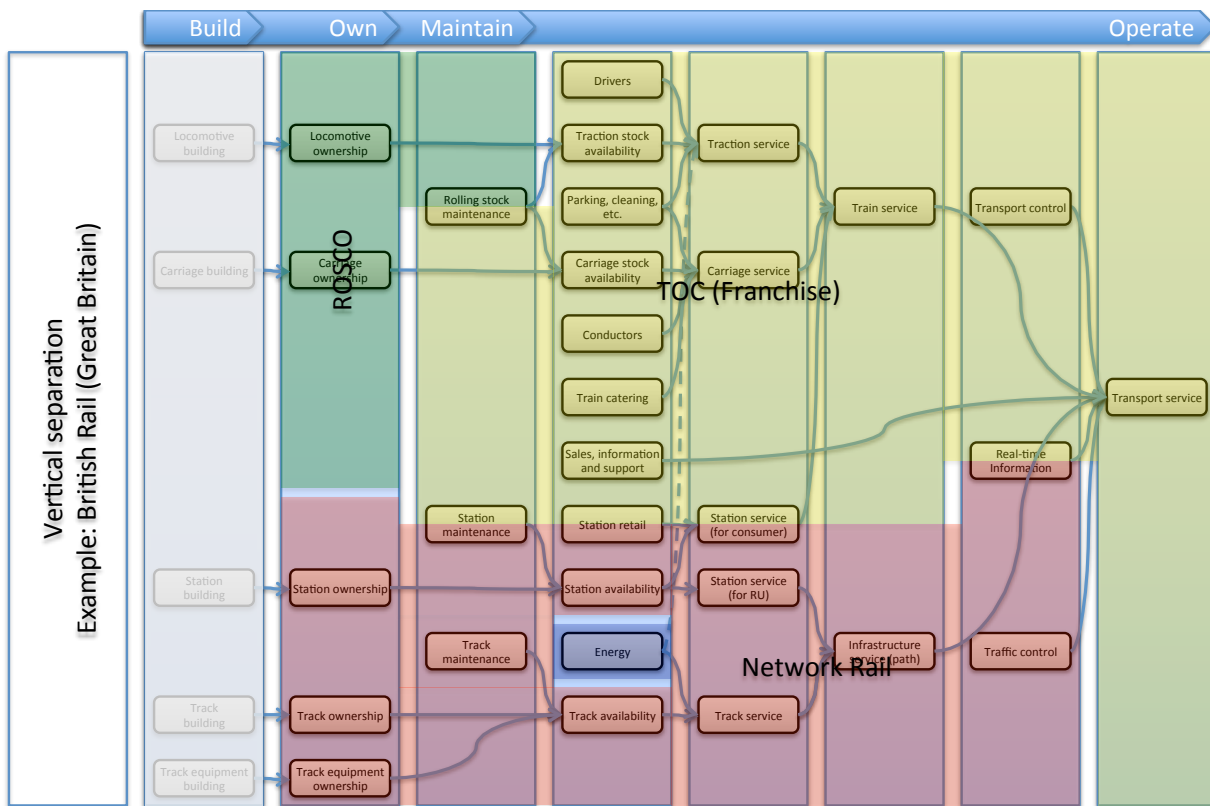


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FIGURE 18 RAIL SECTOR MODEL: EXAMPLES OF VERTICAL SEPARATION (SNCF, NS) (SOURCE: INNO-V)
(NOTE: RED DOTTED LINE FOR SNCF INDICATES THE FIELD OF INFLUENCE OF RFF).



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FIGURE 19 RAIL SECTOR MODEL: EXAMPLES OF VERTICAL SEPARATION (S, GB RAIL) (SOURCE: INNO-V)

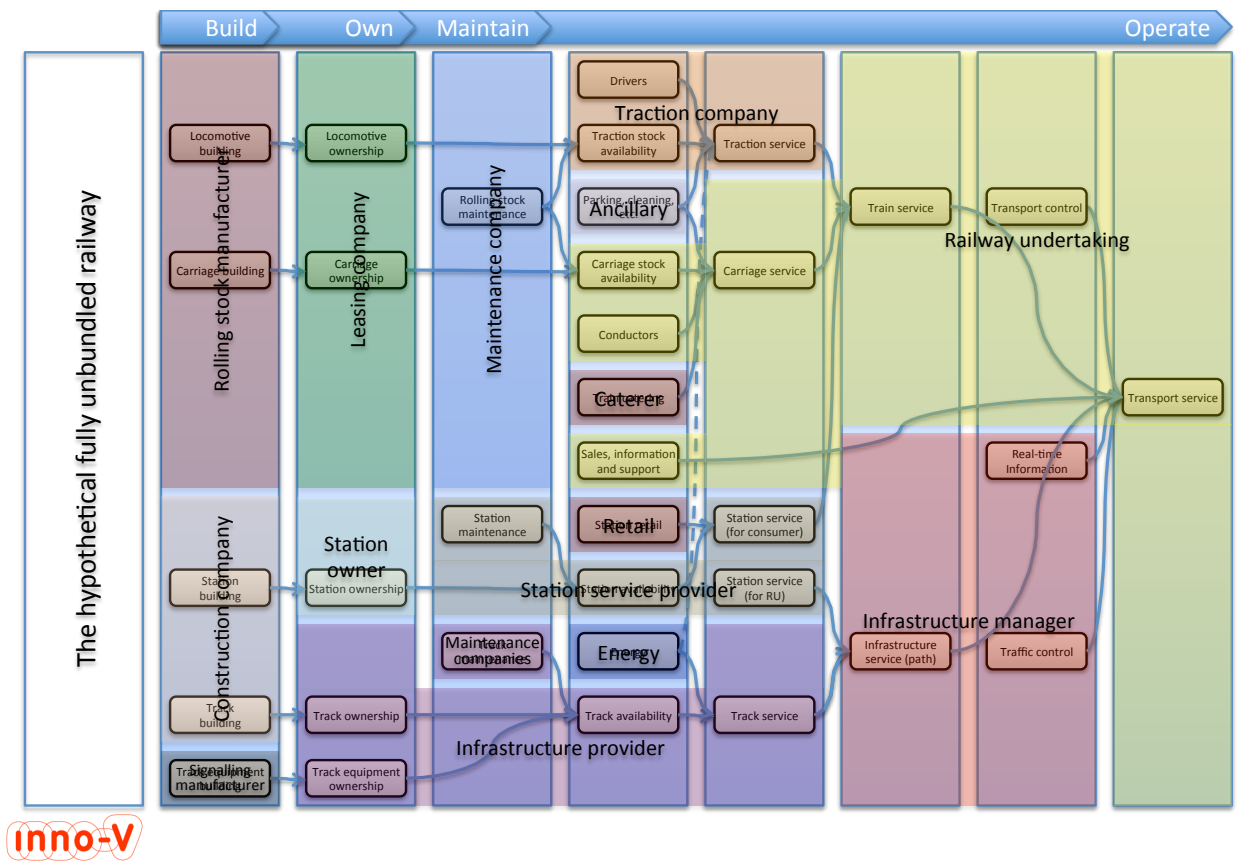


FIGURE 20 RAIL SECTOR MODEL: EXAMPLES OF VERTICAL SEPARATION (HYPOTHETICAL) (SOURCE: INNO-V)

7 Analysis of alignment of incentives between infrastructure manager and railway undertakings

This chapter inventories some potential misalignments between infrastructure manager and railway undertaking, following the lines set out in the Rail Sector Model presented in Chapter 6. The main focus of the chapter lies on the re-alignment mechanisms that could be devised to overcome potential misalignment issues and coordinate the different system elements across the various actors, branches of the input-output chain and time horizons. Specific examples implemented in several countries are cited. At the end, concluding observations are made.

7.1 Target functions of IM and RUs in various institutional settings

The analysis to be conducted in this chapter is best started by a discussion of the target functions of the main actors of the railway system under various institutional settings. Starting by vertical integration, we move to unbundled regimes, discussing the role of track access charges and the resulting investment incentives.

Integration

In a vertically integrated regime, all decisions pertaining to both the infrastructure and the operations of trains can be taken within one company by one line of command. Decisions can be taken comparing service revenues with integral production costs, including both infrastructure costs and train operations costs. Each service modification can be assessed in view of its additional costs and revenues and effect on pre-existing services. In other words, a business-case is developed for each 'new idea', from small to large investments, from small services changes to new concepts, etc. and each is evaluated in terms of its total contribution to the company targets (typically, profitability and survival).

This approach is at the centre of the management decisions of the Japanese vertically integrated railway companies (6 large regional companies issued from the horizontal separation and privatization of the former Japanese National Railways, and 15 pre-existing major regional private railways, besides about 100 other smaller and branch-line railways). This results in a tailor-made infrastructure that meets infrastructural needs while maximising passenger revenues. These for-profit companies are long-term profit-maximizers, subject to strong intermodal competition with airlines and intercity coaches, and to various regulatory constraints such as yardstick competition with their peers to prevent excessive customer prices. Sometimes, when their networks partially overlap, competition between train routes also add to the competitive pressure. Importantly, most of the railway companies have also extensively developed real estate, retail and public transport services around their lines to ensure a long-term passenger orientation towards the railways. This regime results in a powerful competitive and regulatory mix generating various strong competitive incentives on various time horizons.

Separation

The European railway sector is submitted to an obligation of accounting separation between infrastructure management and train operations and several Member States have also implemented various forms of organisational and institutional separation.

Ultimately, the two main actors are the Infrastructure Manager (IM) and the Railway Undertakings (RUs) in the vertical separation case.

In the absence of public financing and under shareholder control, the IM and RUs could be defined as private profit-maximizers submitted to monopoly regulation (IM) and competition (RUs). The RUs would attempt to maximise their profit subject to competition, and so would the IM subject to regulation. The description of these actors would be sufficient if only commercial services operated on the network. However, when contracted services also exist, a further main institution needs to be taken into consideration. The Transport Authority (TA), as contractor of public service obligations, then becomes a relevant player at various interface points. To a large extent, the first set-up of the British railway reform in 1994 was based upon this scheme, with as major difference that free competition between RUs was severely restricted and mainly replaced by competitive tendering for monopoly ‘franchises’ for the market rather than *in* the market, while the private infrastructure manager was submitted to monopoly regulation.

Track access charging

One major re-alignment mechanism can be implemented in such vertically separated regimes to replace the internal trade-offs made by vertically integrated companies. This is the track access charging regime. Ideally, the track access charging regime should induce productive, allocative and dynamic efficiency:

- Send the right signals to the infrastructure manager concerning the need for investments, renewals and enhancements to the infrastructure to provide a fit-for-purpose demand-oriented network;
- Influence the railway undertakings to make best use of the network, taking into account aspects such as route capacity and congestion, wear and tear caused by rolling stock and emissions from trains;
- Assure that both the infrastructure manager and the railway undertakings provide assets and services at a market-oriented level of performance (e.g. reliability, punctuality) and
- Induce both the infrastructure manager and the railway undertakings to constantly optimize their production to what is both technically and economically feasible.

Such a pricing regime would then – ideally – lead to system-wide optimisation, covering all activities in all coordination circles and leading to an optimal allocation of resources. In such a world, the coordination between infrastructure managers and railway undertakings would thus be the result of continuous competition, negotiation and contracting. Direct intervention by third parties, such as state intervention, would not be needed, other than regular regulatory oversight of markets.

Investment incentives

Mainly user-funded IMs

In the case of an infrastructure manager fully recovering costs through track access charges, incentives to invest will have to come from these charges and the performance regime. However, due to the long-term nature of infrastructure investments, the IM will in such a regime be faced with substantial risks concerning its future cash flows due to the specificity of the assets (irreversible investments with no alternative usage and strong interdependence between IM and RU).

While asset specificity issues can be mitigated within an integrated or holding situation with credible long-term commitments from both ‘sides’ (IM and RU), this situation is more difficult to resolve under a separated regime. This can even result in a decline of infrastructure investments following separation in the rail sector (OECD, 2012, p. 110). One can then speculate on the sort of arrangements that might emerge in such a market to overcome such problems. The fear of assets being stranded as a result of investment by one party depending on the decisions of the other would lead to long term contracts covering both the capacity and quality of service to be made available to the RUs and the charges to be levied. This would take the shape of a two-part tariff (Nash, 2005):

- The fixed charge would cover costs that depended on the capacity and quality of the system rather than its use;
- The variable charge would cover short run marginal cost and give the correct incentives for the RU regarding the services to run.
- It is likely that a performance regime would also be included, with penalties imposed on either party for costs it imposed on the other as a result of unreliability.

This was indeed the relationship intended between RUs and IM in Britain in the original privatisation, even though passenger RUs were themselves subject to franchise agreements with the government involving service obligations and payments.

In practice a number of problems were found, leading to sub-optimality at the level of the whole of the railway system:

- Firstly, repeated negotiations as requirements changed led to delays and uncertainty; a freight RU bidding for a contract could not know what capacity and quality of service it would receive to execute that contract, or what it would be charged, until the negotiation was complete.
- Secondly, the task of the regulator in preventing discrimination and monopolistic pricing for the use of infrastructure was rendered extremely difficult. For instance, the main freight operator was able to use its market power to negotiate a favourable two-part tariff which was thought to disadvantage other operators, but it was difficult to establish whether this was discriminatory.
- Thirdly, passenger operators on relatively short franchises could not sign up to long run contracts involving investment; only the government was able to say what its long run requirements would be.

Note that, except in the case of a monopoly franchise (as in Britain, where whoever wins the franchise pays the same charges), a two-part tariff would be seen as discriminatory under EU legislation. Therefore, it may be impossible to design a track access charging system that simultaneously provides for non-discrimination, appropriate incentives for efficient development of the network and appropriate incentives for its use. European legislation aims at having track access charges supposedly based on short run marginal cost plus mark-ups based on market conditions where needed for financial reasons.

Mainly publicly-funded IMs

In practice, most European IMs are publicly owned, may have various objectives and are partly funded by the state. This is now also in effect the position in Britain even though Network Rail is legally a not-for-dividend private company with no shareholders.

The incentives to invest will in this case, to a large extent, come from the financing from multi-annual contracts with the government and further regulation (such as the licence

condition for Network Rail in Great Britain to 'meet the reasonable needs of its customers').

A critical issue is that this might not lead to an efficient identification of what RUs need compared to a direct commercial relationship. The IM, and even more RUs, might not under such arrangements look for the more efficient solutions and prefer the IM to invest in 'gold plated' facilities, involving excessive spending for the functionalities required, or excessive functionalities compared to what is strictly needed under a more efficient business-like approach. This comes through the fact that even if the IM is under pressure from the regulator, the RUs are under pressure from no one in terms of contributing their efforts to minimising the necessary investment costs by the IM. This situation was identified by the McNulty study in Britain but also arises in other countries.

In Britain, the solution to this problem was seen by McNulty as being closer arrangements between Network Rail zones and franchised train operating companies, taking the form of alliances, joint ventures or even the leasing of infrastructure to the franchisee. Different solutions were seen as appropriate for different circumstances; for instance, the latter was only seen as appropriate where there was a single dominant train operator, as there are in some parts of Britain given the comprehensive franchising system and the dominance of passenger services.

Another issue arises where track access charges are chosen to be low. The majority of the budget of the IM will in such countries come from government, which becomes de facto the IM's main customer. Such situation bears the risk of a reduced focus on the needs of the RUs as customers of the IM and of a disproportioned focus on political preferences in terms of infrastructure investments that may not be in line with true market needs. A correction of this problem will depend upon the existence and adequacy of the monopoly regulation regime imposed upon the IM. However, a fundamental problem is likely to remain: that of the information deficit of the regulator about the real needs of the RUs.

An additional problem appears in countries where the necessary state financing is not systematically available. A randomness of public payments can obviously have serious detrimental effects on the functioning of the sector, especially when combined with low track access charges.

7.2 Interfaces, misalignment and coordination circles

Clearly, various institutional configurations can be envisaged for the railway sector. These will generate different interfaces and coordination issues between the actors created by those unbundling options (a few examples of the variety of institutional configurations are given in Figure 17 to Figure 20). This chapter cannot review in detail each single option.

Our focus in the rest of this chapter will be on the potential misalignments caused by various unbundling options, compared to the integrated situation that is used as a point of reference for the analysis. The following analysis is therefore meant to provide an insight into the issues that are likely to play a major role at each of the four stages distinguished in chapter 6.

The market mechanism is the main re-alignment mechanism implemented throughout Europe. This takes the shape of track access charges and performance regimes. This was done not so much as a free choice but more as part of the European legal obligations to do so. The countries have done this with largely varying levels of refinement, with several of

them not using all possibilities offered by the European legislation, by lack of knowledge, due to the complexity of the issue or for various political reasons. Yet, as noted above, a track access charging regime cannot simultaneously achieve alignment of incentives on both investment and operations, whilst obeying European rules on non-discrimination. Even where one of the most refined track access charging regime was devised, i.e. Britain, the McNulty report concluded that further coordination and more collaboration was needed to move to a higher efficiency level in the unbundled railway sector (see also section 7.1).

For that reason, and while the *market mechanism* (track access charging) can remain an essential feature, a growing number of examples show that one may also come to the conclusion that in a number of cases *hybrid arrangements* (joint-ventures, long-term cooperation, etc.) may also be needed as a complement to a pure market mechanism. Some also advocate that *hierarchy* (internal coordination, i.e. bundling) is in some cases superior in terms of the overall economic performance of the sector.

To review these issues, let us look in more detail at the four main planning horizons identified in the rail sector model and at the associated potential coordination needs between the various branches of the underlying chain of input-output relations that together lead to the delivery of transport services to the customers (see chapter 6).

This section presents potential incentive misalignment issues within each of the four main planning horizons identified. This analysis has been informed by a number of examples of poor and good alignment, drawn from research, interviews with railways undertakings²³ and the study team's own expertise. Where possible, references to concrete cases are given.

IMPORTANT NOTES:

- *The cases presented in the next sections are just a few illustrations of the type of misalignment issues that can arise within each coordination circle, and of the coordination (re-alignment) mechanisms that have been developed in various countries.*
- *When the text refers to the 'system level', this refers to the total of the railway system, summing both the IM and the RUs.*

7.2.1 Investment coordination

The *first planning stage* relates to long-run investments that determine the strategic scope of the rail system. The core responsibility of the IM is to provide a railway infrastructure to RUs, enabling them to draw on these resources and produce transportation services. Asset development, dimensioning and ownership coordination are the most important activities needed to undertake the necessary investments. The level of investments is driven by both railway undertakings and regional or national transport authorities (where relevant), expressing their demand for capacity and service levels. Investments require large funding while planning and building them, whereas the return on investment through revenues comes later. Lifecycles in rail and in particular in

²³ Interviews were carried out with representatives of SNCF, DB, FS, NS, SBB, Trasse Schweiz, MÁV, GySEV, VPE and PKP.

infrastructure are particularly long (about 30 to 40 years and more). As a consequence the investor bears a substantial risk if the users are not committed to a sufficiently long period of utilisation or if the number of potential users is too small. Note that recent theoretical literature also points in the direction of underinvestment as a possible result from vertical separation (see, e.g., OECD, 2012; Ehrmann et al, 2009; Pakula and Götz, 2011).

Key issues with a potential for misalignment that can appear at this stage are those related to a mismatch between market needs and infrastructure investment, and between infrastructure and rolling stock investments, both in sizing and in specification of technical standards (compatibility and performances). These issues become visible when considering extension or decommissioning of sections of the network, or for the upgrading or downgrading of sections of the network. Conceptually, they are the following:

- Extension or decommissioning of sections of the network:
 - The RU intends to increase its service offer and requests additional capacity (a new line, an additional track or an additional station). The IM might not want to build the additional track if the long-term income streams from track access charges do not cover these investments or are at risk if the RU decides to stop using the new track. The IM's decision will depend on the specificity of the investment (for example a dedicated track which can only be used for a certain type of service) and the possibility that other RUs will continue to use it. Given the variety of track access charging regimes and of funding mechanisms, transport authorities (TAs) are also likely to be involved as these investments may require substantial state funding over and above what the track access charging might deliver.
 - The track access charging system (TAC) will not be able to generate optimal investments (see also section 7.1). Coordination between IM, RUs and TAs will be required to assure that the interests of all parties are taken into consideration. Whether a system-wide optimisation of resource allocations can be reached will depend heavily upon the way in which the costs and benefits of various investment options accrue to the various actors. The IM will, e.g., have no incentive to invest in measures that raise the profitability of the RUs, even if the total system-wide effect is positive.
 - The IM may also want to reduce its costs by optimising the network and decommission underutilised tracks and sidings. A reduction of the asset base would lead to reduced maintenance costs, above the access charge revenues foregone. As a consequence the RU could have, e.g., to stable trains in other locations, increasing operational costs due to empty rides. These additional costs for the railway undertaking could be higher than the savings made by the IM. However, the IM will not be affected by these disadvantages, as he will only face the loss of track access charges.
- Upgrading/Downgrading of the network:
 - The IM may intend to upgrade the system, which could create benefits such as better services through higher line speed, increased capacity, or a reduction in life-cycle costs based on better maintainability and reliability. However, this may require investments from RUs in their rolling stock to assure full technical compatibility and benefit. The coordination processes can be very lengthy and not all RUs might see the benefits and be willing to invest. Examples could be seen in upgrading signalling systems or electrifying lines.

- From a system-wide perspective, some regional branch lines could usefully be downgraded to simplified operations with lighter trains in order to reduce total cost of operations. However, neither the IM nor the RU may have sufficient incentive to initiate such reconfiguration as the balance of costs and benefits is not likely to be evenly divided between them and/or as it will require complex negotiations.

Misalignments at this stage may lead to higher system costs through a waste of resources in excessive (partially useless) investments or lack of decommissioning in infrastructure, or investment according to a technical standard that is not used or required by the RUs. Misalignments here may also lead to lower system capacity per unit of investment than technically feasible due to a lack of appropriate fine-tuning between track and train configurations. And misalignments can lead to the non-development of potentially attractive markets.

The examples given in Table 9 illustrate the issues presented conceptually above.

TABLE 9 EXAMPLES IN INVESTMENT COORDINATION

Investment coordination examples	
The Swiss Rail2000 service improvement programme	<ul style="list-style-type: none"> • The Swiss case of the Rail2000 service improvement programme is probably one of the best examples of how large-scale investments can be coordinated within an integrated railway structure. The Swiss Federal railways (SBB), with infrastructure management working together with passenger service, developed an optimal solution to reduce total investment need at the system-wide level, i.e. both track and train investments. The consensus-based nature of the Swiss system was an additional success factor. • The Project Rail2000 stands for the introduction of a new concept, aiming at an increase in quality and capacity. One of the main goals was to double the frequencies and reduce travel times between hubs to less than one hour. Investments were necessary both in track and rolling stock. • In order to reduce the investment budget for the project, a number of integrated system-wide trade-offs could be struck and integral decisions could be taken due to the bundled railway structure: infrastructure investments have, where possible, been cut by using tilting trains instead of investing in more costly line upgrades, and double-deck coaches have been introduced to increase capacity instead of having to extend the length of station platforms on some lines. These trade-offs were made on a case-by-case basis, analysing the specific trade-offs of each section improvement.
The “High Frequency Rail” programme in the Netherlands	<ul style="list-style-type: none"> • Some alignment of long term investments can, however, also be realised in an unbundled regime. That this is likely to require an intensive cooperation between the IM and the main RU is exemplified in the Netherlands where ProRail and NS jointly developed a Vision 2020 resulting in a programme named “High Frequency Rail” to improve the performance on the busiest lines in the network. • The expertise of both parties was brought together and interaction towards the ministry and political parties led to agreements on the additional public funding required. While cooperation made things move ahead, it did not include overall system-wide trade-offs and balancing of costs and benefits, as in the Swiss case, as this would have crossed the institutional divide between train and track across which direct payments would not be allowed.

Investment coordination examples

The British experience

- In Britain, investment planning is coordinated by Route Utilisation Strategies by Network Rail and the High Level Output Specification by the government, yet we can observe that the McNulty Study in the UK has led to the conclusion that the fragmented industry needs more coherent and coordinated structures to improve value for money.
- A cross-sectional group has been set up, overseen by the Planning Oversight Group, which involved representatives of Network Rail, passenger and freight train operators and suppliers. The "Initial Industry Plan" (IIP) produced by the group sets out the industry's view of how the railway could develop in the next 5 year planning period and beyond to deliver a more efficient and affordable railway. The group's views on network strategy, plans and strategic choices inform the Governments specification of outputs and determination of funds available (HLOS and SoFA).
- The government stepping in with funding to ensure the IM is adequately financed to undertake investments is obviously facilitating investment coordination in vertically separated systems. However, this tends to generate new problems. Governments will not always have the information on what the RUs need. Investment needs may remain unseen if the RUs themselves or the IM do not have the overview at the system level. Alternatively, when the RUs realise the investment needs, government funding combined with information asymmetry due to the separated lines of command may actually remove the incentive for RUs to assist the IM in finding the most cost-effective solution and they may have an incentive to argue for 'gold plated' solutions (excessive investments). The Chiltern case study from the McNulty report gives an example of track renewals being undertaken earlier than was economically optimal.

Investment prioritization issues

- A different danger stems from direct government funding of the IM, loose from an 'ordering' of infrastructure via the RUs. This can create a tendency to favour projects with a high political profile, at the expense of less visible investments aimed at maintaining the quality of the existing network in the longer run.
- It is argued that this has happened in Sweden, where new lines to low population areas have been built whilst renewal of the core system has been neglected.
- A similar problem has arisen in France, as mentioned by a recent report by the French Cour des Comptes (Sénat (France), 2012). Here the infrastructure maintenance costs of the French rail network seems to have grown exaggeratedly in the past years, while the IM RFF is seen to have a tendency to favour re-investments on secondary line at the expense of main lines, as it is easier to conduct works on those lines due to the lower traffic levels. Furthermore, the co-funding from regional authorities for renewal of rail infrastructure played also a key role in incentivising the IM to invest its scarce funds into parts of the network with the lowest level of train density while neglecting major lines.

Coordination of investment needs: rolling stock and power supply

- An interesting example of both a lack of coordination and of misalignment of incentives occurred in Britain regarding the replacement of London suburban rolling stock. British track access charges distinguish between types of rolling stock in terms of their impact on wear-and-tear costs and operators are charged for electric current for traction. However, when several London commuter operators simultaneously ordered large fleets of new rolling stock with higher performance and higher electricity consumption, heavy costs of strengthening the power supply were imposed (House of Commons, 2003, Hansard 28 January).
- There was no incentive for RUs to take this cost into account, or indeed for the IM to undertake the necessary work. The result was a period when the new rolling stock could not be fully utilised, until the government funded the necessary work. This case shows the lack of coordination of investment planning, and the inadequacy of track access charges to deal with the problem of incentives as it concerned a non-marginal change.

Investment coordination examples

ERTMS/ETCS

- The introduction of new technologies across the train-track interface is another issue where coordination and proper alignment of incentives is crucial in the railway environment. The ERTMS/ETCS standard can serve as one example. It is based on the uniformity of messages and tools used for the exchange of signalling information between trackside and trains, only ERTMS equipped trains can run on equipped lines, unless a double signalling system (legacy and ERTMS) is maintained in existence. It is therefore necessary that all the actors (IM and RU) coordinate their deployment strategy.
- The potential misalignment issue linked to ERTMS results mainly from the complexity of the equipment and the asymmetry in the cost consequences for the parties involved. The stakes differ for the IM and the RUs. The IM may strive towards interoperability of its tracks and also want to minimise the period where the old and the new (ERTMS-based) signalling systems co-exist, in order to reduce its maintenance costs. The RUs from their side must bear substantial costs to convert their fleet to an ERTMS-based signalling system, which is not necessarily in balance with the potential gains that the new system could generate in term of additional interoperability and thus accessibility to European lines.
- The experience from Sweden regarding the implementation of ERTMS illustrates some of the problems that can appear in an unbundled regime. At the system level, ERTMS will (at least in the long run) have a positive impact in terms of interoperability and capacity and also lead to financial savings. However, the costs and savings are unevenly affecting the actors that need to work together in a synchronized way for this technical shift to happen. This was recently highlighted in a new ERTMS status report from the Swedish IM (Trafikverket). It appeared that, while the IM will get the savings, the RUs are facing substantial costs for new on-board equipment, in particular for conversion of the current fleet. Moreover, at least in the short term, they get no direct benefits or additional revenues from this, and they cannot simply pass on the costs to their customers. This has led to a stalemate situation where several actors, and in particular the RUs, are better off waiting, at least until someone else takes the risks and costs associated with on-board installation in the first vehicle of each type. In addition, there are many technical problems still to be solved that call for coordinated action, for example when it comes to testing compatibility between on-board and track-side equipment. These problems are well-known and have been discussed for several years in Sweden, but this has not resulted in any viable solution, for example on a different financing model or a redistribution of costs and savings between actors. Most recently there seems to be a new consensus that for this type of major technical development project, there is a clear need for one actor to be responsible at the system-level. The government may therefore give Trafikverket a further mandate in this direction, although this will not necessarily solve the financing problem.
- Another case can be observed in the Netherlands where the ‘Hanzelijn’, a brand new railway line, was built with both the conventional safety system and ERTMS, because the necessary on-board equipment is not available on the side of the operator due to its cost and the lack of an integral approach for ERTMS implementation across the network. As a consequence, the maximum speed will be lower than it would be with the ERTMS equipment and only a part of the expected reduction of journey time calculated in the infrastructure investment decision will be reached. Note that a higher speed could also have been reached by allowing adaptation of the conventional signalling system, but such an adaptation would have been contrary to the policy of introducing ERTMS on new lines.
- The case of the Italian Railways (Ferrovie dello Stato Italiane) on the other hand illustrates how a closer collaboration between IM and RU within a holding company model and the availability of funding for both trackside and on-board equipment managed to realize the first and most extensive application in Europe of the new signalling and control system

Investment coordination examples

ERTMS/ETCS Level 2 at 300 km/h, accompanied by the introduction of other new technologies, either recently implemented or to be progressively extended on Italian lines. The wide application of the standard in Italy (in only 5 years) is seen to result from the synergies that the holding group could guarantee.

- In France, a different case can be mentioned to illustrate the difficulties that may appear. Here a modification of the signalling system of a high-speed line (LGV Sud-Est) was needed in order to increase the capacity of the line. Two options were considered. One was to invest in ERTMS, which would necessitate a substantial investment in on-board equipment for the trains. The other was to further develop the existing TVM signalling system, which would necessitate important investments along the tracks. In 2005 a national advisory council to the Ministry recommended they adopt ERTMS but also to devise mechanisms to compensate the RU (SNCF) adequately in the shape of track access charges rebate or by having the IM (RFF) pay part of the train equipment. These ideas were not implemented but the question reappeared with the next high-speed line investment. Here the suggested solution was to leave the operator to bear the train investments and also to increase the track access charges; this results in double-penalisation of railway undertakings and as a consequence makes them less competitive vis-à-vis road transport and short-haul aviation.
- To summarise, ERTMS, by its nature, transfers signalling equipment from the track to the train, leading to increased costs for the on-board equipment (which is structurally more expensive than trackside equipment due to the more difficult environment in which they have to be fitted (electromagnetic problems, vibrations, shocks...). Its implementation requires a long period of time during which double on-board equipment remains necessary to allow the trains to communicate both with the legacy national as well as with ERTMS/ETCS trackside signalling systems. There is therefore a strong need for coordination/alignment of implementation schedules for trackside and on-board ERTMS equipment to eliminate unnecessary costs and wasted investment; this is only achievable when the IM works closely with major train operating companies in the country and if the funding is secured for both trackside and on-board equipment.

A synergy between real-estate investments and railway development in Japan

- Finally, it is interesting to mention the case of the real-estate investments of the Japanese railways. Although outside the common approaches developed in Europe in the past decades, their approach is similar to what could be seen in large cities in Europe around the beginning of the 20th century. Major private vertically integrated operators in the Japanese conurbations have for decades had a long-term vision on the development of the railway system in close synergy with the development of neighbouring real-estate at and around their stations and along their lines.
- This strategy of housing and retail development ensures, in the longer run, that urbanisation grows towards and around the railway system, generating a long-term customer base for the railways and a high rail modal share. It managed to generate a profitable railway system, including infrastructure costs.
- This strategy is only possible if long-term real-estate development and medium-term retail re-development within those areas are undertaken in close coordination with the planning of passenger transport services (both train and buses) within those areas. Numerous examples of such strategies can be seen across Japan and they have served as source of inspiration for the reform of the former Japanese National Railways in 1987.

7.2.2 Production planning coordination

The coordination of production planning is the *second planning stage* of the rail industry, where infrastructure and operations find a system wide optimum around three main items:

- The first is the quality of the resources provided, which includes all issues related to wear-and-tear at the wheel-infrastructure interface and the need for appropriate reliability in infrastructure, rolling stock and personnel to be able to cope with disruptions of various sources. Note that these items are closely linked. Note also that there can be economies of scope at the level, e.g. in terms of staffing.
- The second item is the issue of the ‘minor’ reconfigurations and ‘small scale’ investments in infrastructure, rolling stock and personnel training. This issue, whose ultimate impact on total system costs and performances is often underestimated, includes various measures that marginally modify the assets and their performances but that can have substantial effects on total system performances. Various examples can be given, such as the addition of a signal, a switch or a platform, and other marginal reconfigurations of existing assets.
- A third major issue in this context is the maintenance of fixed assets and fleet where a lot of interaction occurs (including the rail-wheel interface). Maintenance concepts that are assuring a life cycle cost optimum on a system level need just as much coordination as the question of resources made available to manage the next fall and winter problems.

Conflicts that might arise as parties optimise their own business without looking at costs and benefits from a system perspective that – consequently – remains at a sub-optimal level. Conceptually, the main issues can be presented as follows:

- Quality of resources and reliability:
 - The IM, submitted to cost pressure, may try to minimize expenditures on investments and maintenance. As a consequence activity levels (e.g. the frequency of important maintenance activities such as tamping, grinding, replacement of wires) could be reduced, leading to a lower level of asset quality, which in the longer run will be measurable as a deteriorating condition of rail, overhead lines etc. As a consequence, RUs can experience increased wear and tear of wheel sets and pantographs. Typically neither track access charges nor performance regimes will reflect these costs back to the IM.
 - Furthermore, in a separated model, the IM has no opportunity to draw on the RUs’ staff (and conversely) to solve problems with joint resources as is commonly the case in integrated railways where train or station staff can help to solve infrastructure problems and conversely. As a consequence reaction time is increased and costs are increased by loss of economies of scope.
- Small to medium scale investments:
 - Limited investments in the existing network (compared to comprehensive enhancements and upgrade programmes) can unlock significant positive operations effects in terms of capacity and reliability. Examples of relatively minor investments are: marginal changes to line design and layout, removing a switch, moving or adding a signal, adding a passing track, lengthening a platform, etc. Conversely, the IM might want to decrease cost by marginally reducing the complexity of the network. For example by removing points that are cost intensive in maintenance and prone to failures. While each removed

- point improves the IM's cost position, RUs may lose flexibility and require engaging into other cost increasing activities to enhance their reliability.
- RUs may see other opportunities to amend the infrastructure but may have no incentive to motivate the IM to address these issues, e.g. due to the near completion of a franchise term, or due to the regulatory regime of the IM which does not allow for the necessary contracting with the RU or (regional) TA. Alternatively, it may be easier or more attractive for the RU to convince the IM or the TA to invest in excessive facilities ('gold plating' of capacity) especially when the realisation of such larger facilities requires less coordination or fewer amendments to the operating practices of the RU.
 - The IM might, from its side, see some improvement potentials but may not be motivated to invest if a corresponding return cannot be expected (similar point for larger scale investments and track access charges) or if implementation requires substantial coordination with RUs in terms of modified practices (tighter operational punctuality management, increased rolling-stock reliability, etc.)
 - A lack of interaction between IM and RU due to regulatory barriers may lead to a situation where the RU cannot see which potentials exist on the IM's side (and conversely), keeping the system at a sub-optimal level or at a higher (infrastructural) costs than feasible.
 - These issues are further worsened when mutual gains between IM and RU are difficult to realise such as when costs and benefits of marginal investments fall on different sides of the fence.

These issues taken together co-determine the medium-term performance possibilities of the existing rail system. A misalignment at this stage will lead to a lower capacity of the existing railway system, and – in turn – to higher total system costs.

The examples given in Table 10 illustrate the issues presented conceptually above.

TABLE 10 EXAMPLES IN PRODUCTION PLANNING COORDINATION

Production planning coordination examples	
Coordinated small scale investments with high efficiency impact in Japan	<ul style="list-style-type: none"> • The best examples of a well-balanced approach to medium/small scale investments and reconfigurations can be found in Japan where railways routinely search for and implement marginal reconfigurations to existing railway lines in order to continuously improve their performances in terms of capacity or integral costs and results. • Numerous examples can be observed where the desire of the RU to accommodate growing passenger demand by even only one additional train per hour on an already heavily used route will trigger a search for a set of measures, both on the infrastructure and on the train side to realise the capacity enhancement at the lowest possible integral cost (infrastructure and train) or the highest possible total return. • This can include the addition or displacement of a few signals, the reconfiguration of a few switches or a minor section of track, the addition or lengthening of a platform, or the introduction of a new type of rolling stock with wider doors or higher acceleration. Such measures are then taken jointly, after calculation of the integral business case for the vertically integrated railway company. The aim is then, e.g., to reach a balance in saving just enough seconds on the other train runs to allow accommodating one or several additional trains, while the resulting additional passenger return allows covering all reconfiguration costs in the long run.

Production planning coordination examples

McNulty and incentive misalignment in Great Britain	<ul style="list-style-type: none"> • The integral Japanese approach to improvements, as presented above, is difficult to realise in unbundled regimes, even those that have developed sophisticated track access charging systems and performance regimes as the British one. • Several misalignments issues have been identified in Great Britain when RU and IM deal with (medium-scale) enhancements issues. In the analysis conducted within the McNulty study (see also the references made to the McNulty study in chapter 5) it was found that Network Rail's detailed specification of enhancements drives significant costs without creating commensurate benefits for TOCs. • Giving TOCs a direct involvement in specifying and delivering enhancements through a joint venture could address this issue (L.E.K. and Frontier Economics, 2011, Vol. 2, p. 109). A case study on Chiltern Railways comes to the conclusion that Network Rail does not have sufficient knowledge about RU's needs to specify investments in the most cost-effective way possible, and that they are also not sufficiently inviting operators to provide their requirements and thus are receiving insufficient input and guidance about their actual needs. (First Class Partnerships, 2011, p. 6). • Furthermore, the McNulty study comes to the conclusion that enhancements are seen as a free good. Incentives are lacking for both TOCs and Network Rail to ensure that enhancements delivered achieve desired outputs at the lowest cost. This is a key issue, and no-one incentivises the TOCs to help in this process. This happens, although the ORR monitors efficiency of enhancements on a scheme-by-scheme basis. (L.E.K. and Frontier Economics, 2011, Vol. 2, p. 110). • The Chiltern case study comes to the conclusion that a joint responsibility for operating, maintaining and upgrading the infrastructure through a vertical alignment of an infrastructure manager with a train operating company would lead to cost savings of 16% to 19%. This could be achieved through reduced overhead and support services, lower maintenance and renewals cost through better timing and re-use of displaced components on more minor lines.
Towards more cooperation between IM and RU in the Netherlands	<ul style="list-style-type: none"> • An example from the Netherlands shows that the unbundled regime was leading to antagonistic preferences for the IM and the RU in terms of infrastructure functionality. This was in particular due to the budget constraints imposed by government upon the IM, combined with relatively low track access charges. • A partial solution to this was found in the development of joint approaches between the ProRail and NS as main RU, where joint screening of all cost-reducing options (such as the reduction of the number of switches) are undertaken in a culturally more traditional 'cooperation' approach rather than a stricter and more distant supply/demand approach.
Misalignment between IM and RU in France	<ul style="list-style-type: none"> • Problems are also reported in France where integral system-wide trade-offs that could be done before vertical separation are apparently not done anymore. • SNCF observes that infrastructural reconfigurations or renewals undertaken since the creation of RFF as a vertically separated IM have led to a reduced functionality of some of these installations. The implications of some costs reductions on the functionality of the installations for the RU are seemingly insufficiently or not taken into account by the IM. • SNCF points to the fact that this has had an impact both on the stability of train operations (punctuality) and on the available capacity. Interestingly, it appears that some renewals have even inadvertently led to capacity reductions or made future upgrading prohibitively expensive, due to a lack of consideration for the integral system-wide impacts of the decisions made.

Production planning coordination examples

Important trade-offs in track maintenance and total system costs and revenues

- Further examples can be given that pertain to the reliability trade-offs that appear at this level. A main issue is that of the quality of the maintenance of the various assets versus the punctuality/reliability that can be realised later on in the value chain. Again Japan is a good benchmark here, where an integral approach to this issue allows the railways to decide which level of preventive maintenance is needed (both in infrastructure and rolling stock) to lead to an optimum result for the whole of the railway, bearing in mind the related costs and the consequences at the operational level.
- Essentially: more preventive maintenance allows for a reduced loss of capacity at the operational level due to less train and track break-downs, which leads to a higher reliability and indirectly to higher customer revenues.

Economies of scope between RU and IM

- Economies of scope between train operations and infrastructure management tasks are another field of action at this level.
- The usage of regular passenger trains during normal timetabled operations to monitor the condition of the track geometry is one way to reduce costs and unnecessary capacity usage by monitoring trains. On the staff side, the usage of operator staff and mechanics to remove snow at the stations or switches disappeared with the unbundling (e.g. in the Netherlands, contrary to Switzerland), leading to additional costs and delays.
- These and further examples of integration can be observed in vertically integrated cases, e.g. Japan, but are difficult to realise under an unbundled structure. Note also that these economies of scope issues in staff or in asset utilization gain in importance with lower densities of operation.

7.2.3 Timetable planning coordination

The *third planning stage* relates to the actual timetable planning. Aligning the interests of efficient infrastructure provision and efficient train operations requires the coordination and resolution of conflicts stemming from capacity requests by several train operators as well as fitting in the capacity needs of the infrastructure manager for renewal and maintenance.

Timetabling in general can be seen as a formalised and well-structured process. The challenge occurs when conflicts arise from requests competing for the same track capacity. These conflicts do not only stem from railway undertakings but also from the infrastructure manager who on one side might find himself required to deliver a "24/7"-railway, and on the other side needs to embed possessions into the timetable to allow him to carry out efficient maintenance and renewal activities. A potential risk at this stage is that of discrimination in access to tracks and facilities. Conceptually, the main issues can be presented as follows:

- Need for maintenance and renewal slots:
 - The IM might wish to reserve paths that are optimal to undertake maintenance and renewal activities (like a 48 hour week-end shift, or daytime maintenance under full line closure rather than shorter and more expansive night shifts), the RUs will prefer little interruption of services and the works to be carried out in shorter shifts, at night or under the rolling wheel and not to have to make compromises leading to reduced services, lower speed and longer travel times due to track possessions by the IM. Coordination between IM and RUs is needed for renewals of assets to be undertaken while operation continues. This requires

- modifications to the timetable, deviations, test drives and other irregular operations including extensive information to the customers.
- The conflict is based on the IM's objective to minimise maintenance and renewals costs and thus choosing the best time window for these activities, while the RUs intend to run trains as regularly as possible and want to avoid any traffic hindrance, leading to timetable deviations, bus replacements, additional customer information and management, other cost-driving activities and, ultimately, loss of customer revenues.
 - A misalignment is likely to occur, as a track access charging system is not able to provide a solution for this and it is difficult to specify a performance regime that will adequately reflect the cost and induced market effects for the RUs of possessions in all circumstances. This is because the necessary activities need to be assessed on a case-by-case basis to determine the solution that is best to achieve a total optimum, including the cost and benefits of both parties for different scenarios.
 - Robust timetables:
 - The RU aims at customer satisfaction, hence demanding from the IM paths that enable attractive services. The RU requests a frequency and travel time, the IM calculates the exact paths and is in charge of coordinating demands and solving conflicts according to specific procedures.
 - Where track access charges are based on short run marginal cost and a performance regime is in place, the IM may tend to leave spare capacity to ensure a robust plan, reducing potential operational conflicts, delays, etc.
 - Excessive cautiousness of the IM may even engender excessive spare capacity in order to guarantee robustness/stability of the timetable and avoid penalty payments.
 - A misalignment may occur if no mechanism exists to investigate which amendments to the timetable and corresponding operating practices might help to optimise capacity utilisation, costs and revenues at a system-wide level. The implementation of specific measures can further be hampered by the lack of one line of command that could make a trade-off and balance risks across infrastructural issues and issues related to operational practices of trains.

Misalignments at this stage would lead to a waste of capacity, reducing the performance of the railway as a whole, increasing total system costs and missed market opportunities for the RUs (as a consequence of tracks closed for maintenance at periods that could generate good traffic), which can be harmful for the economy as a whole.

Table 11 presents various examples to illustrate the issues presented conceptually above.

TABLE 11 EXAMPLES IN TIMETABLE PLANNING COORDINATION

Timetable planning coordination examples

Timetabling and path allocation

- The timetabling process can be organised in various ways, all according to the type of unbundling put in place. Fundamental choices are those of the allocation of the timetable calculation function and that of the path allocation function. The second one is in the current regulatory context in Europe considered to be an 'essential function' submitted to strict regulatory oversight such as to guarantee non-discrimination. The first one can be located at the IM, although the major RU often retains a major role. In some cases, the major RU is even in charge of the calculation of the whole timetable, whereas the manager of the essential functions remains in charge of controlling its non-discriminatory character.

Timetable planning coordination examples

- This situation exists in Switzerland. The main RU, which in this case is integrated with the IM, develops the whole of the timetable and takes responsibility for its realisation and for its stability. This is based upon the conviction that this is the most efficient arrangement, due to the high level of capacity utilisation. This also includes a clear system choice for integrated control centres (see also section 7.2.4). Behind this lies the view that a separation of these processes would lead the IM to building in more margins in the timetable, as the IM would want to cover risks related to a lack of precision in operational procedures by the RUs over which he has no direct control. This would then eventually lead to a reduced available capacity and therefore to increased costs.
- In the British case, the IM is responsible for timetable calculation and path allocation. Experiences here tend to show that the regulation of the IM does not necessarily incentivise the IM to generate more traffic and more revenues through track access charges. In some cases, the IM even preferred running less trains in order to meet regulatory targets.
- Problems are also encountered in the Netherlands where the cost minimisation targets of the IM in relation to maintenance activities lead to project clustering and maintenance times at times that are not preferred by the RU who prefers to minimize customer impact. A partial solution was found, after a complaint from the RU to the competition authority, by having RU and IM solving the problem as much as possible in mutual discussions. While this allowed solving problems for the short term using common sense, it could not, however, address major or longer-term issues as this immediately impacts upon the finances of the IM and the unbundling does not allow for system-wide trade-offs.
- Similar issues have appeared in France, with in this case the RU also complaining that the information on planned infrastructure works comes so late from the IM that this impinges upon the period in which trains are supposed to be open for seat reservations by passengers. According to SNCF, 69% of all night trains in 2011 were not open for reservations (i.e. customers could not buy tickets) 60 days before the trains were scheduled to run. This lack of timely commercial visibility of the trains led, according to SNCF, to significant losses of commercial revenues.

Track possession planning and commercial consequences

- The planning of track possessions for maintenance is another potential source of long-term effects as exemplified by the following case observed in France. The ambitious maintenance programme engaged by RFF, following a main infrastructure maintenance audit (“Rivier” report) and the construction of new high speed lines (in particular the Tours-Bordeaux route), has had a strong impact on rail traffic and in particular on the long-term viability of the rail freight market.
- The issue at stake here is the lack of commercial knowledge and commercial interest of the IM in what the consequences of its actions may mean for the customers of the RU(s) impacted by track possessions. In this case the IM planned long-term track possessions which induced freight customers to set up alternative transport solutions which, once set up, led to a permanent loss of traffic for rail to the benefit of the road.

7.2.4 Production (real-time) coordination

Day-to-day coordination of the transport services to the customer is realised in real time in the *fourth planning stage*. This is mainly about ensuring reliability and punctuality of operations and minimising disruptions within the established plan. It also includes all activities that are needed to return to normal operations when disruptions happen. The transport control activities (allocation of crews to trains and of trains to planned services), traffic control activities (controlling signals and points) and real-time passenger

information need to be coordinated at this stage. They highly impact train services as they happen at the interface with the customer (passengers and freight clients) and have a major impact on punctuality and customer satisfaction.

A major challenge at this stage lies in the speed of interaction between the transport controllers, the traffic controllers and the passenger information systems and their ability to solve problems quickly in order to prevent snowballing.

This stage is also a major source of information for continuous improvement analyses although its importance is often underestimated. These can be decisive for the improvement of railway performances when they lead to effective feedback loops to the third planning stage (e.g. adjustments to the timetable), to the second planning stage (e.g. review of maintenance standards and minor reconfiguration of the infrastructure or signalling) and the first planning stage (e.g. development of new systems and markets).

Conceptually, the main issue can be presented as follows:

- Disruption handling:
 - Contrary to most other transport sectors, the railway system is usually characterised by a major difficulty or even impossibility to ‘park away’ dysfunctional vehicles, resulting in stringent operational constraints. A single dysfunction can easily generate huge disruptions through snowballing and this effect increases with the density of the operations, the number of operators and the diversity of their needs, resulting in a very complex operational environment, especially when the railway operates close to capacity.
 - Traffic control centres need to make numerous decisions in a complex operational environment. Especially when it comes to disruption handling, decisions often need to be taken very quickly (i.e. within a few minutes), this is even crucial in high-density (high-frequency) railway systems.
 - One of the difficulties is to balance these decisions between a system and an individual operator's perspective. Achieving system optimum requires a holistic view. But doing this requires detailed knowledge of train loadings and implications of delays for later services, etc. This knowledge resides in the transport controller and at the RUs, not at the IM.
 - The performance regime should give the IM the correct incentives but it will always be crude. The RU will know the consequences of delaying one train rather than another better (e.g. sometimes it may be absolutely crucial to later performance that an empty train should run on time) but again may try to exaggerate the case for giving priority to his own services. The performance regime will also not give an incentive to the party not responsible for the delay to cooperate in trying to minimise its effects.
 - Depending on its exact regulatory regime, the IM may focus on reducing its own costs, rather than be incentivised to focus on reliability and availability. This can then lead to additional delays and reduced punctuality from which the RUs will suffer in terms of lost revenues and/or increased operational cost for trains, drivers and customer management.
- Feed-back loops:
 - Analysis of the causes and consequences of delays across all involved actors is an essential element in improving railway performance. This can lead, via feed-back loops to the three earlier stages, to the development of more robust timetables, while identifying and addressing asset reliability issues in an

economic way and engaging into reconfigurations of assets (small investments) where needed and economically sensible.

- Such analysis requires full co-operation in sharing data on disruptions and it requires co-operation in devising improvements. To the extent that data disclosure may affect payments under the performance regime, there may be an incentive to both parties to withhold information.
- To the extent that the improvements envisaged have different cost and benefit balances for the parties involved, there is likely to be a lack of incentive to cooperate for those parties bearing most of the costs.

The consequences of misalignments at this stage are important, even though they are less visible in the short term. They can result in losses in reliability and punctuality, and ultimately of patronage via the reputational effect this will have on passengers; and failing to properly and consistently analyse operations, disruptions and their root-causes are a major source of missed opportunities in the railway sector in terms of economic optimization at all stages.

Table 12 gives examples illustrating the issues presented above.

TABLE 12 EXAMPLES IN PRODUCTION (REAL-TIME) COORDINATION

Production (real-time) coordination examples	
Disruption handling, separation and traffic control centres	<ul style="list-style-type: none"> • In the UK the existing performance regime gives incentives to the IM and the RUs regarding delays. But where one party causes the delays, the other has no incentive to work to minimise its effects, e.g. if the RU is fully compensated for revenue losses then they have no incentive to contribute to minimise disruptions caused by track maintenance work, although the customer performance regime does give some incentive to minimise disruption. Moreover, the existence of a performance regime does not itself give the IM sufficient knowledge to take the optimal decision. Solutions are needed to create a well-functioning interface in daily operations, especially in separated institutional set-ups or where several railway undertakings operate on the network. • In the Netherlands a national Operation Control Centre Rail (OCCR) was set up in 2010, following major operational disruptions in the rail sector in 2005. An analysis showed that in the separated organisations of RU and IM too few people had an overview of the whole of the operational railway system, and that the management of vital operational railway processes was hampered by the physical separation between representatives of the RU and the IM. The initial aim of the OCCR is the optimisation of transport operations by improving incident management. The main idea is to join existing organisations together, not organizationally, but physically. As a result a control room, staffed 24/7, now joins representatives of the IM (ProRail), NS and NedTrain. Other RUs are partners, without being represented permanently and further RUs are given access to the cooperation. One of the results of this approach is an ability to isolate disruption from the rest of the network, preventing further spreading, and a shorter recovery time. • Comparisons with similar processes in Switzerland and Great Britain have shown that transparency of work processes, rather than secrecy and barriers, results in more trust and therefore better cooperation within and outside the Operation Control Centres. A survey came to the conclusion that communication and cooperation was better, where Network Rail and Train Operating Company staff were brought together in co-located and integrated control centres (Network Rail, 2006). Co-location thus provides clearer communication channels between key players, which accelerates the dissemination of critical information leading to greater awareness, better decision making, quicker response times, improved performance and

Production (real-time) coordination examples

a safer railway.

- Developments in France in 2009 have also led to the development of separated locations of transport and traffic control in the development of new control centres, notwithstanding the lessons that were already being drawn in Britain and in the Netherlands. While at the national level, the IM staff of the CNOF (Centre National des Opérations ferroviaires) and all RUs that wish to are able to share the same premises at the traffic control centre, on the contrary at the regional level and for specific lines of the Paris urban mass transit network (line C of the Paris RER for example), RU and IM staff are now located in separate rooms or buildings. This situation is particularly surprising as densely used passenger rail lines generally do not share their core infrastructure with other traffics.

The brittleness of unbundled train systems

- Several studies carried out at Delft University of Technology looked at the operational practices of unbundled railways, comparing the Dutch and British case. They focussed on how traffic and transport control have been reorganised and on the resulting trade-offs. Steenhuizen and de Bruijne (2009), in their study “The Brittleness of Unbundled Train Systems: Crumbling Operational Coping Strategies” report on the strategies traffic controllers display to cope with daily conflicts in behavioural responses by traffic and transport controllers in the Netherlands, at ProRail and NS.
- The authors conclude that while current reforms seem to have raised system performance, they also ignore the operational context of ‘coping’, making the train system more ‘brittle’ on the long term. They find that the restructured, unbundled settings tend to hamper the utilisation of the more sensitive coping strategies of system operators to deal with unfamiliar and unexpected events. As the visibility of cause-and-effect chains further decreases, the chances for unexpected events increase and unseen incidents may ripple into system failure more often and more easily. Steenhuizen (2012) in his later paper “Cutting dark matter: Professional capacity and organisation change” tries to understand the effects of the radical institutional reforms on the provision of services in rail infrastructure operations.
- That study attempts, perhaps for the first time, to describe how professional practices capacities in the railway sector, including judgment, tacit knowledge and tacit skills, work as a whole. He encourages both managers and scientists to pay more attention to such professional capacities in infrastructure operations, and to its radical instability.

Passenger information and customer focus

- Passenger information in cases of disruption is another crucial process. A contentious issue is whether this should be carried out by the IM or by the RU. Bad experiences in the Netherlands with major disruptions due to snow problems in the past winters have led Parliament to discuss the issue at length. The IM focussed mainly on punctuality, giving insufficient priority to passenger information.
- This led to a recent decision to transfer all passenger information tasks from the joint responsibility of NS and ProRail, to NS, with the approval of the competition authority.

Feed-back loops

- Cases of disruptions and bad punctuality are major sources of information for the improvement of railway performances if root-cause analyses are conducted properly and fed back into planning and procedures at the various stages.
- The Japanese railways have developed exemplary feedback methods, in line with a continuous improvement approach and this contributed to their record high levels of punctuality and reliability of infrastructure and rolling stock. Events of dis-punctuality are analysed statistically to identify systematic issues. These are then addressed by a thorough analysis of all elements that may be causing them. Such analysis is carried out integrating all relevant inputs from the track, the signalling, the rolling stock, the staff and the timetable to the related procedures.

Production (real-time) coordination examples

- This process generates suggestions for punctual improvements that are evaluated at system-level by the integrated railway operator to identify those that will provide the best cost-benefit ratio for the railway as a whole. This may then lead to modifications to the operational procedures (4th stage), to the timetable (3rd stage), or to the marginal reconfigurations of the infrastructure (2nd stage), and ultimately even to new types of rolling stock (1st stage).
- The realisation of such continuous improvement processes is much more difficult in an unbundled regime, as costs and benefits are unlikely to fall all on the same side of the fence.
- For example, the British performance regime does provide much of the information necessary for analysis of and feedback from delays, but Network Rail and the train operators have been implicitly obligated to work together to improve punctuality via Joint Performance Improvement Plans, even before the McNulty study, recognising that ultimately improvements in performance will benefit both. Also, the devolution of Network Rail in combination with alliancing between a route and a railway undertaking created new opportunities to discuss and finance new solutions (budgets are now more locally controlled). For example, drivers have been trained on diversionary routes in a programme partly funded by Network Rail, so diversions are easier to organise and also less costly in terms of compensation. Yet, while beneficial, these activities still fall short of what is achieved in the Japanese case.
- In the Netherlands, ProRail and NS both have set up organisational units outside the OCCR to analyse failures on a daily basis. The idea is to analyse delays, failures and causes and allocate them to responsible units (drivers – rolling stock – infrastructure). Here too useful suggestions for improvement resulted, but the absence of one line of command between IM and RU makes it difficult to make the balance of costs and benefits that may be unevenly distributed across both organisations. The recent discussions on the simplification of the infrastructure in the Netherlands is an example of useful trade-offs that may be difficult to make in unbundled regimes. In this case, ProRail suggested to simplify the infrastructure by reducing the number of switches, which would have various positive effects including reduced maintenance costs, increased line speed, increased capacity and higher reliability. It would also mean a reduction of flexibility in case of disruptions necessitating a rerouting of trains. For the operator, this change would imply a deterioration of the services for the passenger (fewer direct connections, more changes of trains). It would also require adapting to a reduced flexibility (less possibilities for solving disruptions), which would have to be offset by several changes to operational practices, an increasing rolling stock reliability and system punctuality. Savings are essentially located on the side of the IM, while the balance is less clear for the RU who benefits from savings (higher speed) and potentially more revenue (higher frequency) but is also submitted to likely cost increases (higher reliability).
- In a bundled regime, only the sum of all costs and benefits across IM and RU would count. Yet in this unbundled situation, the sum at the IM and the sum at the RU cannot simply be traded-off.

7.3 Analysis: Unbundling and realignment

The review of misalignment issues presented in the previous section illustrated some of the potential conflicts that can occur at the interface between infrastructure manager and railway undertaking. It shows that alignment issues exist in all four coordination circles when the actors follow their own objectives or priorities.

Potential consequences of misalignments are varied and include held-up investment opportunities in various technical assets, networks not developed in line with market requirements, sub-optimal combinations of assets (rolling stock, track and personnel)

leading to excessive costs of production, externalities in the sense of efficiency savings from one party's actions at the disadvantage of the other party's cost and performance and negative impacts on daily operations. The misalignment issues have important technical components and the pivotal point with all these issues is that costs and benefits of various actions can fall apart and that one actor bears the costs whilst the other one gains all or at least a noteworthy share of the benefits.

Costs of misalignment

The quantitative evidence available to assess the concrete cost consequences of misalignment is unfortunately very limited. While some studies have attempted to review the transaction costs (Merkert et al, forthcoming), much less is available about the induced costs of unbundling. The most extensively and recently analysed case obviously is the UK where attempts were made to quantify the consequences of a number of misalignments across various stages of the railway sector model and where the report demonstrated a need to establish better working coordination mechanisms between the actors and to improve incentives leading to a more market-oriented development of the network (see the McNulty study). But also cases from the Netherlands and France show that mechanisms are needed to achieve a stronger alignment, while earlier German studies made an attempt at quantifying some of the potential effects of unbundling (see, e.g., the PRIMON study (Booz, Allen, Hamilton, 2006)).

In the absence of clear quantifications of the consequences of specific misalignment issues, it could be interesting to be able to quantify at least the relative share of various types of misalignments in total potential misalignment costs. Figure 21 shows the average distribution of total system costs based on a number of Western European railways. The data used here represents the actual expenditures, some of which are financed by public funding, some by own financing of the IMs. Note that the renewals included in these figures cover a period of five years and can be fluctuating substantially as they depend on the availability of funding and the state of renewal. Whilst some countries in Europe are catching up on investment backlogs, resulting in spend above average renewal rates, others benefit from earlier investments and might have reduced their renewal spend. The range of renewals in the underlying sample is between 11 and 22%. Enhancements (e.g. line upgrades to increase speed/capacity) and extensions are not included in the distribution above. But of course they can significantly increase the level of infrastructure expenses.

A simple allocation of those costs to the four coordination circles used in the analysis is unfortunately not straightforward. A first observation is that infrastructural needs of the railways are proportionally much more important than, e.g., in the airline industry, underscoring the capital importance of a proper alignment of incentives around all items related to investments in such assets. The first circle (investments in infrastructure and rolling stock) is likely to represent the largest share of expenditures. Expenditures in the second circle seem similar to the first circle, driven by maintenance activities on infrastructure and rolling stock and including large numbers of staff. Life cycle costs and the performance of the railway system are mainly determined in these two stages. Hence a maximum of coordination is required here to avoid critical issues at the root such as misdirected or held-up investments. Important remarks should be made in order to avoid oversimplification. The magnitude of these budgets as part of the total railway system costs is difficult to grasp. Some Western European railways spend a third of their total budget on renewals that would mainly fall into these circles. If enhancements were to be

included the share could be even higher, but the enhancement budgets tend to be very volatile.

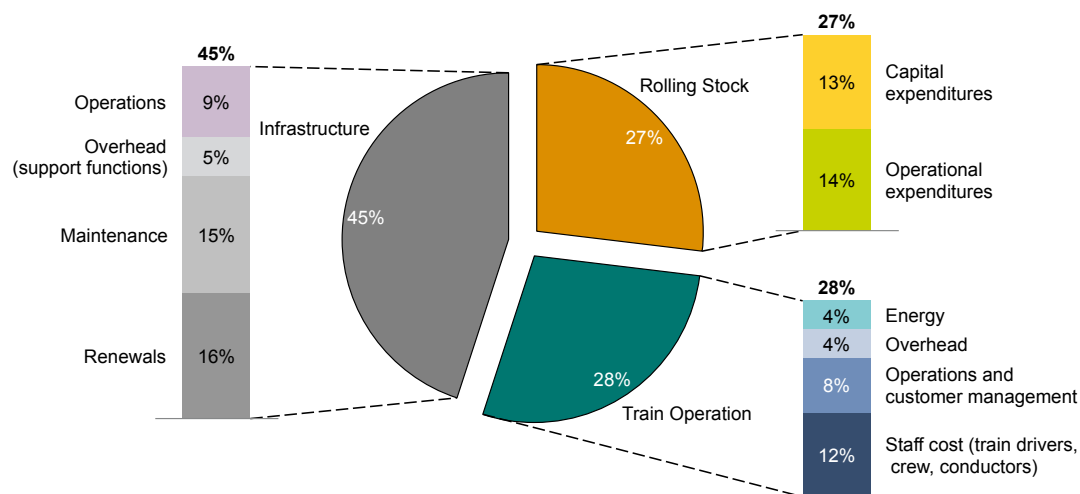


FIGURE 21 DISTRIBUTION OF SYSTEM COST (SOURCE: CIVITY MANAGEMENT CONSULTANTS)

The pure spending in the third and fourth circles is in comparison likely to be considerably lower, as they mainly concern administrative and support functions. Additional costs resulting from unbundling are likely to be present here in the shape of additional transaction costs, but these are not necessarily substantial. However, the induced costs of incentive misalignment resulting from unbundling are likely to be much more substantial, as discussed in the previous sections. These will mainly be additional infrastructural needs to accommodate the same traffic, and missed market opportunities, as explained at length in section 7.2.

Realignment mechanisms

As introduced in chapter 6, various coordination mechanisms can be envisaged and several are used to re-align the interests of the parties resulting from unbundling. In this chapter, we have seen that additional re-alignment mechanisms have been developed in various contexts besides the basic re-alignment mechanism formed by the track access charging system, which itself proves to be insufficient to solve all misalignment issues created by unbundling.

The re-alignment mechanisms put in place are hybrid solutions, combining market and hierarchy. Long term contracts, strategic partnerships and joint ventures are examples of this. They set out targets and partially apply bonus/penalty schemes to incentivise the actors over and across the train/infrastructure divide. In the UK different depths of alliances spanning from non-contractual agreements between the infrastructure manager and railway undertaking, to voluntary contractual agreements and sharing of staff have been developed. The establishment of joint control centres or setting up of interdisciplinary teams to resolve winter problems represent examples of this form of coordination, as can be seen in the Netherlands or the UK.

The examples mentioned reach from top management coordination circles such as the Rail Delivery Group and the Initial Industry Plan in the UK, to hybrid arrangements emphasizing a much stronger vertical alignment between IM and RUs, such as devolution and joint-ventures to share revenues and cost between IM and RUs. These are

fundamental measures that are meant, via contracting, to re-align the incentives of both parties, such as what is suggested by the McNulty study in the UK.

These solutions are scalable in scope, size and depth. The right of information and decision-making can be agreed according to the specific needs. Contractual arrangements can reinforce commitment and support risk mitigation. Implementing these solutions usually involves the development of partnerships over longer periods of time. The processes needed for this can sometimes be lengthy and involve a number of parties. This means that these arrangements also come at a cost, the transaction costs to design, negotiate, contract and manage them.

Note also that there is an interesting cultural element in the ways in which incentive alignment can be realised. The tradition of consensus in Switzerland, e.g., tends to generate a cooperative behaviour between market players (in this case between vertically integrated railway companies and other transport operators), stakeholders (such as transport authorities), the regulator, owners and funders. Combined with a long-term whole-system planning at the political, regulatory and industry levels, this has led to a successful railway system.

Optimality of re-aligned unbundled regimes

The analysis conducted and the examples given show that several options exist that attempt to overcome at least some of the potential misalignments induced by unbundling. It remains difficult, however, to identify to what extent and under which conditions these re-alignment mechanisms are sufficiently powerful to deliver the same level of optimisation as what is potentially achievable under coordination through bundling. In other words, the existence and implementation of ‘a’ re-alignment mechanism that delivers performance improvements does not prove that the misalignment issue has completely been solved.

Several problems complicate the drawing of a simple conclusion:

- The first is that the scarcity of points of comparisons in terms of best-practice realigned railway regimes and efficient bundled railways. However, the high performances of the 21 major (bundled) Japanese railway companies, in relation to the best performers in Europe, are a major source of evidence to indicate that there is room for further performance improvement.
- The second is the lack of thorough benchmarking of relevant production processes between those scarce relevant railway systems. Most studies, including this report, have to work with general, published company data. A more detailed – and much more time-consuming – comparison of sets of production processes would deliver useful additional insights for a further improvement of performances.
- Thirdly, the European railway sector and policy makers have not spent much time attempting to identify and quantify the potential misalignments resulting from unbundling or the beneficial consequences of the re-alignment mechanisms put in place. We found few such studies, and most of them were unfortunately not in the public domain. Additional research on incentive misalignment issues would be welcome.
- Finally, the drawing of clear conclusions on the effectiveness of the re-alignment mechanisms currently in place would in many cases require waiting a few more years due to their recent date of implementation, or indeed the fact that they have not yet all been implemented (see the McNulty recommendations in the UK).

Incentivised bundled regimes

The reasoning above may seem to assume that a bundled railway system is ‘by nature’ more efficient. Obviously, this is by no means all that simple. Rather, the reasoning above shows that a bundled regime *can* allow for integral decisions to be taken to the advantage of the system as a whole, leading to a higher performance at the system level than what would result from the juxtaposition of two optimal decisions at the sub-system level (RU and IM) that would be insufficiently re-aligned towards system-wide optimality. Whether a bundled regime *will* lead to optimal decisions at system-wide level and deliver better performances depends upon more factors. An essential one is whether sufficiently powerful external pressures for performance improvement exist. Clearly, many of the former European bundled regimes have in the 20th century been suffering from unclear, weak or contradictory sets of incentives, further blurred by various interventions (service obligations, investment policy, and employment policy) that have heavily burdened railway costs and performances. Many of the earlier European legislation has indeed been aimed at relieving the railways from those burdens (e.g. Regulation 1191/69 and Directive 91/400), but this was not necessarily sufficient to induce full efficiency and total customer orientation.

Competitive pressure is seen by many as an indispensable additional source of discipline for better performances. The European Union favours open access (on-the-track competition) and competitive tendering (off-the-track competition). But other options exist throughout the world and have proved to be very effective. The most relevant one is probably the Japanese railway re-regulation of 1987 that has managed to substantially improve the performances of the former Japanese National Railways by horizontal separation into 6 large regional companies that remained vertically integrated, were privatised and were de facto told to follow the example of the 15 pre-existing privately-owned vertically integrated regional railway companies that operated successfully and profitably around the major Japanese urban areas. Competition was introduced into this system not by tendering or open-access, but mainly by intermodal competition (coaches, airplanes), privatisation and competitive regulation (yardstick competition between classes of railways). It led to profitable railways (including the infrastructure) and substantial performance improvements (see, e.g., Mizutani and Nakamura, 1997 and later publications). We have referred on several occasions to the practices of the Japanese railways as a useful benchmark. Another interesting example is that of the American (freight) railways deregulation with the Staggers Act in 1980, although probably less relevant for most European states, except perhaps for the Baltic States. Here too, railways remained bundled and while a reduction of state involvement, closing down unprofitable operations and more competition between networks played an important disciplining role in bringing the railways back to success. A recent report (Roland Berger, 2012) reviews some of these and further experiences outside of Europe.

Separation under low quality infrastructure and the need for appropriate funding

Some railways suffer from a critical need of appropriate funding, leading to a quality of infrastructure that threatens the survival of the railway system as a whole. The Polish railways currently face tremendous challenges linked to the necessary upgrade of the infrastructure and the lack of public funding to undertake this task. As a result of this huge maintenance and investment backlog, massive speed restrictions are imposed for many years across the whole network. This situation leads to a destroyed viability of several long-distance services such as the main passenger lines, notably Warsaw-Gdansk

(the scheduled direct trains take from 4:40 to 6:30 hours for a distance of 370 km, at best 84 km/h average speed for what should be a major inter-city line). Intermodal competition by air and road (coaches) benefit from this situation at the expense of the railway. The bulk of the remaining passenger services are loss-making while freight transport manages to be viable.

A restructuring of the network – meaning a decommissioning of a number of low-use lines – seems overdue as well as further strategic decisions by the government, including spinning off the freight operator. Long-distance passenger services in Poland seem potentially as viable as in other countries, but this would require substantial infrastructure investments. Only relatively higher-speed services would be able to reverse the losses incurred to aviation and road. Current modernisation projects will certainly help the system once they have been completed.

The Polish railways have already been reorganised according to a holding company model but the main actors in the holding (PKP Intercity, PKP Cargo and PLK – the IM) behave essentially independently from one another. The IM is faced with a difficult situation as the operators are complaining about the quality of the network and the high level of track access charges. Furthermore, a very intensive catching-up has started to occur more recently, maintenance and renewal works are sometimes themselves becoming a problem for network access. The situation with track access charges is further worsened by the relatively simple charging system adopted in Poland. As a result the IM's entrepreneurial flexibility is limited. Additionally, the average level of charges aims at a coverage of 80% of the operational costs of the infrastructure, while the direct cost would represent only 45%. However, charging only direct cost would presumably precipitate the railway into deep financial problems due to the unpredictability of government funding. While the resulting growing deficits that the IM would experience would in principle lead to an infringement procedure from the EC against Poland, but this would take a long time before leading to a solution. This could be fatal for the whole system.

In this environment, while the option of horizontal separation (separation between passenger and freight) seems interesting, the question of further vertical separation seems of little relevance and, given the existing de facto level of separation, will probably not lead to any significant change. A clearer strategy for the future of the infrastructure and adequate financing for its development seem far more decisive in this context.

7.4 Conclusions

The considerations above lead us to conclude that there does not seem to be a single simple recipe for success:

- Unbundling is a potential source of detrimental misalignments, but re-alignment mechanisms can be devised.
- Complex track-access charging regimes and performance regimes are contractual market mechanisms that can play a role but that do not appear to be adequate to solve all misalignment issues.
- Additional re-alignment mechanisms are being developed in various countries, and it is noteworthy to mention that these tend to move towards hybrid, cooperative arrangements, rather than simple contractual market mechanisms.
- Whether the resulting set of mechanisms will lead to a similar level of performance to what can in principle be achieved in bundled regimes (see, e.g., Japan) is doubtful.

- But bundled regimes, as an alternative to unbundling, are not in themselves a guarantee for optimal performances. Additional performance incentives may be needed here too and various options exist.
- Ultimately the choice of the most appropriate re-alignment mechanisms to put in place will have to depend upon the characteristics of the elements of the value chain at stake, the economic circumstances (economic development, economic perspectives, market conditions, characteristics of the networks and demand, etc.) and the institutional environment of the country or region. It is therefore also important to realise that the various elements of the value chain and boundaries between actors may require the implementation of different coordination mechanisms throughout the chain, all depending upon the varying characteristics of the transactions at stake.

8 Competition and non-discrimination

Non-discriminatory access to the infrastructure is necessary to guarantee the proper functioning of regimes where several railway undertakings may get access to the same network. A non-discriminatory track access charging regime is a second condition to prevent distortions of competition. Path allocation and the setting of track access charges are also known as ‘essential functions’ in the context of the assessment of the independence of the infrastructure manager.

A potential problem where these activities take place within a company that is also a train operator, is that of the company controlling both the infrastructure and train operations would use the information received from its potential competitors in the context of infrastructure management (path requests and infrastructure charging) to its own competitive advantage in terms of market development, capacity allocation, charging setting or in the determination of its infrastructure investment strategy.

There are ways to address these potential problems, and regulatory oversight is part of the solution to prevent discrimination from happening. This chapter describes options for non-discriminatory access to the infrastructure in relation to various institutional configurations and presents some evidence concerning the actual market share of new entrants under various institutional arrangements.

8.1 Options for non-discrimination

Full unbundling is the most radical form of unbundling where essential functions are managed fully independently from railway undertakings. This institutional configuration is in place in Great Britain, the Netherlands, Sweden, Spain and several other countries.

Other Member States have opted for an institutional configuration where infrastructure manager and railway undertaking are not fully institutionally separated, keeping a vertically integrated company, or retaining an infrastructure manager and railway undertaking(s) under one holding company²⁴. In these cases we can observe various arrangements for the location of the essential functions of track access charging and path allocation within these institutional configurations.

The two main ones are:

- Institutional separation of the essential functions, in which these functions are located in one or several distinct institutions (this regime exists under various configurations in Switzerland, Hungary, Slovenia, Luxemburg and in the Baltic states); and
- Enhanced compliance and regulatory mechanisms where the essential functions remain within the holding, but are submitted to additional rules and checks to ensure their neutrality (such as in Germany and Italy).

²⁴ ‘Holding models’ cover a wide variety of arrangements in terms of ownership, management, etc. We use this term here to cover all intermediate arrangements between vertical integration and vertical separation.

The following table presents various cases aimed under different arrangements at guaranteeing a non-discriminatory allocation of capacity and charging of track access: full unbundling, separation of essential functions (Switzerland and Hungary) and holding model with enhanced compliance and regulatory mechanisms (Germany and Italy). We also present the European Commission’s views on this question (which are not shared by all Member States).

TABLE 13 OPTIONS FOR NON-DISCRIMINATION: VERTICAL SEPARATION (FULL UNBUNDLING)

Vertical separation (full unbundling)

- Full unbundling, by having an institutional separation between the activities of the infrastructure manager and railway undertaking, is the most extreme case. Here the essential functions are managed fully independently from railway undertakings and non-discrimination is in principle guaranteed.
- Yet, even in this case, regulatory oversight is needed to entitle entrants the right to complain and guarantee the true independence of the infrastructure manager from the interests of the incumbent railway undertaking. This is because, even in the presence of institutional separation, the infrastructure manager may still tend to favour the train operator who gives him most of its business. Moreover, in most countries, the infrastructure manager and the incumbent railway operator are still owned by the state and still responsible to the same Ministry. In this situation it is important that the regulator should be independent from day to day control by the Ministry and have adequate powers to enforce its decisions (i.e. not simply advise the Minister) in order to guarantee independence.
- This institutional configuration is in place in Great Britain, the Netherlands, Sweden, Spain and several other countries.

TABLE 14 OPTIONS FOR NON-DISCRIMINATION: SEPARATION OF ESSENTIAL FUNCTIONS

Separation of essential functions

The integrated Swiss railway system and its independent capacity allocation body

- The Swiss railway system is characterised by its high performance, high level of reliability and punctuality, and strong passenger growth over the past decades. Currently, the Swiss railway network is one of the most densely used rail networks in Europe. The average Swiss resident uses the train about 50 times/year, which is more than three times the EU average. Services are highly coordinated via a clock face timetable and through ticketing arrangements between all public transport operators. Several vertically integrated companies co-exist in the Swiss rail system. SBB, owned by the Swiss Federation, is the main vertically integrated operator. Regional operators vary in size and activity. BLS and SOB are larger operators operating on their normal gauge networks and on that of SBB to which they are interconnected. Numerous other regional railways, in majority owned by the public sector, operate on branch lines and mountain railways on narrow gauges and rack railways.
- Specific arrangements have been made to guarantee fair competition and non-discriminatory access to freight operators to the standard gauge network, despite the vertical integration of the railway companies. Trasse Schweiz was created for this purpose in 2006 as an independent capacity allocation body. It is currently organised in the shape of a non-profit company held equally by the Swiss public transport association and the three main standard gauge railway companies of Switzerland (SBB, BLS and SOB). Representatives of the shareholders cannot be member of traffic operations departments or of the management board of the shareholders. Furthermore, there is a contractual prohibition for the shareholders to issue instructions to the

Separation of essential functions

board members of Trasse Schweiz. The determination of the track access charging system since 1999 is a competence of the Swiss ministry of transport, which is carried out via legislation, while the Swiss railways arbitration commission (RACO) is the investigation body in case of suspected discrimination. Beside one complaint concerning a local tramway network, for which the RACO is not responsible, the RACO received only two complaints in the time period 2003 to 2004. Both came from the incumbent freight railway undertaking and were related to access to the network of third infrastructure managers. In both cases the parties involved reached a mutual agreement before the RACO finished its investigations and the complaints were withdrawn. The RACO has never had to judge on complaints up to now.

- Since 2006 Trasse Schweiz is responsible for timetabling, being in charge of handling and allocating path requests. It mandates SBB to elaborate a draft timetable. As BLS and SOB have mandated SBB to execute the timetabling on their network, the mandate of Trasse Schweiz also covers the networks of BLS and SOB. Trasse Schweiz checks and remains responsible for the non-discriminatory compilation of the timetable and is actionable at the RACO if a railway undertaking or third applicant feels discriminated by the elaboration of the timetable. This is carried out in a spirit of consensus, which is typical for the railway system in Switzerland. In the case of conflicting path applications Trasse Schweiz looks for alternatives that allow for the realization of both applications under conditions that are commercially satisfactory for the parties involved. In practice Trasse Schweiz was able to solve more than 99% of the path conflicts, which was only possible due to the integrated planning process involving both the timetable planners and those planning service concepts at the railway undertakings. Trasse Schweiz carries out the whole of its tasks with limited costs, making use of only 10 FTE's.
- An important feature of the Swiss railway network is the need for a quick response in case of disruptions without finger pointing, due to the extremely high level of capacity utilisation. The traffic control centres are therefore part of the vertically integrated railways. Their behaviour is characterised by a high level of operational cooperation with the other railways that may be operating on their tracks, favouring in case of disruption the taking of swift ad-hoc decisions at a local level to allow a quick return to normality and a high level of reliability and punctuality. This is further enhanced by full transparency on the decisions taken by having the infrastructure managers concerned publicising information on the disruptions and their handling, and allowing for scrutiny by the railway undertakings concerned.

Separation of essential functions in Hungary

- The Hungarian railway network is mainly composed of the networks of the stated owned MÁV (94% of the tracks) and the smaller GySEV (a vertically-integrated mixed shareholding company owned by the Hungarian state, the Austrian state and a private Austrian shareholder) (5% of the tracks). The Hungarian railway network is rather dense, but a substantial part of the network is single track (86%) or currently submitted to speed restrictions, especially outside of the main railway corridors radiating from the capital city Budapest. The passenger operators on these networks are MÁV (via its subsidiary Start) and GySEV. 24 freight operators provide services on the network, out of which Rail Cargo Hungary Hungária (formerly part of MÁV and now owned by Rail Cargo Austria, part of ÖBB) is the main one, together with GySEV as second and other freight operators. The other operators have less than 20% in freight.
- VPE (Hungarian Rail Capacity Allocation Office) is an independent body responsible for capacity allocation and timetabling, access charging, and performance regime. VPE is also responsible for the network statement in close cooperation with MÁV Co. It was established in 2004 as a company owned by the Hungarian state and reorganised in 2008 in line with the European Directives. VPE is responsible for capacity allocation, both for train operators and also for the capacity needed for infrastructure maintenance by the infrastructure manager.

Separation of essential functions

Currently, MÁV in its role as infrastructure manager provides the data for the determination of the track access charges, VPE then sets the charges and the infrastructure manager takes care of the invoicing.

- Until 2008 VPE was in charge of capacity allocation, while the actual calculation of the timetable was done by MÁV and GySEV for their own networks. However, this activity was transferred to VPE in 2008. With a total staff of 33, 17 people work in the timetabling and One-Stop-Shop (ad-hoc path requests). The capacity allocation process itself is paperless as a new computerized system 'Kapella' was introduced in 2008. The regulatory body can review allocation decisions. Due to the characteristics of the freight market in Hungary, and the availability of excess capacity, capacity allocation for freight path is more ad-hoc in Hungary than, e.g., in Switzerland where freight paths are to a larger extent determined in the yearly timetable.

TABLE 15 OPTIONS FOR NON-DISCRIMINATION: HOLDING MODEL WITH ENHANCED COMPLIANCE AND REGULATORY MECHANISMS

Holding model with enhanced compliance and regulatory mechanisms

Enhanced compliance and regulatory mechanisms in Germany

- The German railway network is the largest in Europe. Around 400 railway undertakings are licensed to access the network. Out of the total of 1 billion train path-km (which corresponds to the output of the French and British network together) 20% are produced by DB's competitors. Inevitably, parts of the network are heavily used, creating bottlenecks and conflicting interests between operators.
- In Germany, DB Netz AG – part of the DB AG holding – is in charge of path allocation. Since 2006, the Federal Network Agency is responsible that the accesses to the network and service facilities as well as access charges are not discriminating. The process of timetabling commences 17 months before introducing a new timetable. The increasing need for time and paths for maintenance and renewal (178 construction activities in 2008 vs. 752 in 2012) has made early and integrated planning necessary. Railway undertakings have to submit their slot requests to DB in compliance to a standardized process that is laid down in the Network Statement. If conflicting requests cannot be resolved within certain tolerances, DB Netz AG initiates a coordination process ("Koordinierungsverfahren") that in the first instance aims at a cooperative solution between infrastructure manager and operator. If unsuccessful, DB Netz AG starts the decision making process ("Entscheidungsverfahren") with up to three steps of escalation. If the issue cannot be resolved by applying a number of standard prioritization rules (taken from the General Railway Law (AEG) and thus legally binding), the train path is allocated to the operator who is expected to pay the highest track access charges. If this procedure fails too, the path is auctioned to the highest bidder. The Federal Network Agency is involved in this process and is also to be notified by DB Netz AG if the allocation of a train path is denied. The agency is entitled to evaluate DB Netz AG's decision and to finally decide about the allocation.
- DB Netz AG has seen a significant increase in paths requests. Since 2007 the number of requests increased from 45,630 to almost 60,000 requests for the annual timetable in 2012, plus 950,000 requests for short-term paths outside the timetable in 2012 (most of these are freight path requests). Third party operators have submitted approximately a quarter of these requests. The number of conflicts has, however, remained rather constant: according to DB, a quarter of the requests led to conflicts. However, only nine conflicts had to pass through the

Holding model with enhanced compliance and regulatory mechanisms

decision making process described above. There has been no need to apply the pricing or auctioning mechanisms so far.

- Since 2007 the Federal Network Agency is conducting a market survey, interviewing railway undertakings about their satisfaction with the railway network, including questions about the access to the network. On the German scale going from 1 (best) to 5 (worst), the quality of track access has been graded as good (2.5). The quality of the network itself has received the worst grades (3.5). The survey also states that in general charging practices are seen as more critical than access itself. Among the decisions that the Federal Network Agency announced within the last years were modifications to the pricing of DB's stations, the abolition of the "regional factors" as a pricing element of the charging regime as well as lowering charges in case of DB performing poorly.
- The German Railway Act also requires the adoption of measures to ensure the independence of the infrastructure manager within a holding regarding track access decisions. The law specifies that railways with a holding structure providing both infrastructure and operations need to create separate legal entities so that the infrastructure manager is able to take independent decisions about the timetable and access to the network. Further requirements are made with regard to the organization. Employees taking decisions in these essential functions may not be involved in functions of the railway undertaking. In the case of DB, this means that the members of the supervisory board of the infrastructure manager DB Netz AG may not be acting as members of other supervisory boards within the holding. Furthermore, the holding's legal department may not provide advice concerning track access and charging to DB Netz AG. Finally, a code of conduct has also been established, consisting of internal directives and a training programme to ensure that employees being involved in decisions about timetabling, access to the track and access charging follow these principles of independence. All these requirements fall under the supervision of a Commissioner of Independence who is obliged to monitor compliance with these rules, handle all complaints, take appropriate countermeasures and inform the Federal Railway Authority (Eisenbahnbundesamt) in an annual report.
- In addition to the German and European legal obligations, in 2011 DB also introduced a Competition Officer in order to demonstrate that it supports a level playing field for all railway undertakings. The "Joint Resolution by the Chairmen of European Railways on the opening of European Railway Markets and European Standards of Regulation", signed in 2009 by 30 representatives from railway undertakings, infrastructure managers and associations was a further commitment to fair competition and effective regulation. According to this resolution, every railway company joining the resolution nominates a contact person who is responsible for issues of competition and regulation within the organization. DB's Competition Officer is in charge of guaranteeing this consistent and legally compliant regulation management within DB and all subsidiaries, both nationally and internationally since 2001. The officer provides information to and receives complaints from internal and external market actors concerning all issues with regards to competition and regulation. DB also publishes its annual competition report as part of this function.

Italian Railways: Open-access competition within a Holding model

- The Italian market was one of the first European markets to be fully liberalized (since 2001). The opening to competition in Italy is occurring fairly rapidly, as witnessed by the increasing number of operators active on the market, especially in freight. The increasing competition necessitated the introduction of an appropriate Regulatory Authority, competent for all transport modes and with strengthened independence.
- The new Italian Transport Authority, which is to be operational by the end of 2012, will establish tender schemes to award public service contracts, establish minimum quality

Holding model with enhanced compliance and regulatory mechanisms

- standards for national and local services and define the criteria for infrastructure charge and allocation of infrastructure capacity.
- Similarly to Germany, the Italian IM (RFI) is a separate legal entity in charge of network capacity allocation according to the rules and deadlines set in the Network Statement, and in compliance with EU principles of transparency, fairness and non-discrimination. Members of the board of RFI cannot act as members of other boards within the Holding. Moreover employees of RFI in charge of essential functions are located in separated premises and access to information systems is protected to ensure independence.
 - The Network Statement is published by RFI, based on consultations with the parties concerned and submitted to the prior approval of the Regulatory Body. It contains a detailed description of (i) the rights and duties of the IM and the Applicants, in relation to the capacity allocations, (ii) the use of the rail infrastructure and the delivery of the relevant services, and (iii) the charges due.
 - The Infrastructure Manager tries to process all the conflicting train path requests and if necessary it provides alternative solutions to RUs to ensure compatibility. In case of saturation of the infrastructure, a coordination process is activated in an attempt to resolve problems. Otherwise, priority criteria are applied. In any case the Regulatory authority is entitled to evaluate the IM's decision and to finally decide about the allocation.
 - This regulatory framework led to a significant development of competition. However, the level of competition is not extending throughout the network homogeneously: new-entrants choose to operate services only on profitable rail routes. As regards to freight transport, the market shares of competitors (including foreign RUs) are growing significantly, but only along some international transport corridors (along the north-south trans-frontier axis, they control 40% of traffic). In passenger transport, competition in High Speed Rail was quickly achieved successfully.
 - The entry of NTV on the HS market is an Italian first in terms of opening: no other EU country has so far witnessed open-access on this segment of the market to competitors. Interestingly, competition in the HS passenger market seems to create new demand in terms of passenger traffic, without a decrease in the incumbent's market volume. Ultimately, an important feature of the Italian case is that the opening of the HS market improved the quality of the service, introduced a strong competition in pricing, and increased the overall attractiveness of the train as a means of transport.

TABLE 16 OPTIONS FOR NON-DISCRIMINATION: THE EUROPEAN COMMISSION'S VIEW

The European Commission's view

- There is a common understanding both at the Commission and within the rail sector that infrastructure managers must be impartial in how they grant access to their networks. The reasoning is that there is a risk of competitive advantage and collusion when the party that controls access to the infrastructure is part of a group that is managed in a unified fashion and that includes one or more railway undertakings. Such a structure could, in principle, tempt the infrastructure manager to restrict access to the network for railway undertakings that are not part of the group. For these reasons the existing legislation, Directive 2001/14/EC, requires legal, organisational and decision-making independence for the infrastructure manager, and it requires in particular a separation of the 'essential functions', namely capacity allocation and charging, when independence is not guaranteed by means of institutional separation (full

The European Commission's view

- separation) of the infrastructure manager.
- However, the Directive does not specify in much detail how the separation of essential functions should be implemented. Quite naturally, different Member States implemented this requirement in different ways.
 - In 2006 the European Commission decided to publish its own opinion about how the requirement should be implemented (European Commission, 2006, Annex 5). The Annex contains the following criteria:
 - Monitoring of the independence requirements by an independent authority or third party (e.g. an independent rail regulatory body) and possibility for competitors to complain about breaches in independence requirements;
 - Statutory and/or contractual independence provisions in the relationship between the entity entrusted with essential functions and both the holding and other companies of the group;
 - The board members of the entity entrusted with essential functions may not simultaneously be board members of the holding or other companies of the holding;
 - The board members of the entity entrusted with essential functions and senior staff members dealing with essential functions should, for a reasonable number of years, be barred from accepting any senior position with the holding or with other entities under its control after they leave the essential functions entity;
 - The management board of the entity entrusted with essential functions must be appointed under clear conditions and legal commitments to ensure the full independence of its decision making, and it should be appointed and dismissed under the control of an independent public authority (such as a rail regulatory body);
 - The entity entrusted with essential functions should have its own staff and be located in separate premises or with protected access, access to the information systems has to be protected to ensure independence, and the contacts with the holding and other group companies should, by internal rule or contract, be limited to the official communications connected with the exercise of the essential functions.
 - It is important to note that these criteria result from the Commission's interpretation of the current directives and that this interpretation is not part of EU rail sector legislation. In spite of this, the Commission decided to launch infringement procedures against some Member States because they had not implemented the separation of essential functions according to the Annex 5 criteria. Legal proceedings are currently underway at the European Court of Justice in order to clarify this situation. Whatever the outcome of those proceedings, it remains the case that the Commission views these criteria with favour.

This section illustrated that countries have developed different ways to achieve non-discriminatory access. The regimes encountered vary from vertical separation, to the separation of essential functions or the addition of enhanced compliance and regulatory mechanisms in holding regimes. Furthermore, the European Commission has also developed its own views on this issue.

What is most relevant, across this variety of institutional configurations, is to look at the actual empirical outcome in terms of market shares gained by entrants to the industry. This is done in the next section.

8.2 Evidence on shares of new entrants under various regimes

It can be interesting to review the facts in terms of the market shares of new entrants under various regimes in order to evaluate the relative merits of various institutional

configurations. As already noted in the literature review, Drew and Nash (2011), using the 2009 Rail Market Monitoring Survey (RMMS), found no evidence that vertical separation led to more intra-modal competition than the holding company model. This section updates that evidence using the latest published version of the RMMS.

Comparison of market shares by new entrants

Figure 22 shows the market share of *new entrants*²⁵ in the freight transport sector, based on the most recent Rail Market Monitoring Survey (European Commission, 2012). The figure distinguishes between vertically separated regimes and vertically integrated or holding company regimes. The figure shows that the average shares of new entrants for these two subsets of countries do not significantly differ; suggesting that market entry and intra-modal competition can exist under various institutional options. Nor is there any clear pattern that countries with separated essential functions or enhanced compliance mechanisms have a different level of competition than other VI/HC countries, although obviously the sample is very small for this to emerge. Atomistic market shares (numerous small operators without any single larger operator) do not seem to be typical for these markets.

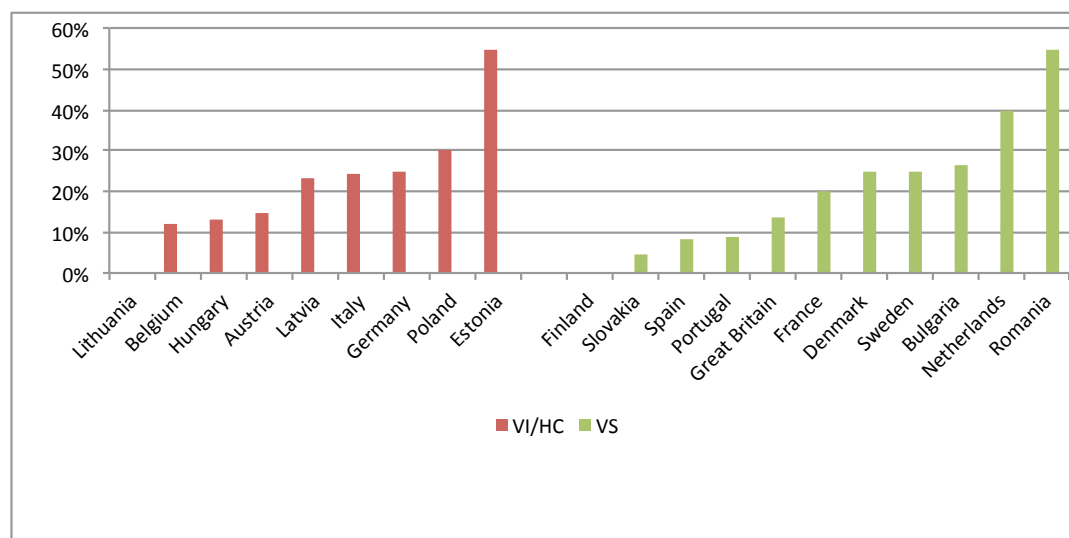


FIGURE 22 MARKET SHARE OF NEW ENTRANTS IN THE FREIGHT MARKET, SELECTED COUNTRIES, 2010 (SOURCE: RMMS, 2012)²⁶

The rail freight market was open to competition EU-wide from 2007. Some Member States already had competition on their rail freight markets before that date. Moreover in a few Member States the incumbent freight operator was sold off *en bloc* (e.g. Hungary, Denmark, and Netherlands) or split up and sold off (Great Britain).

However in many Member States the incumbent operator still has a freight operator that is furthermore the largest market player. These very different starting conditions mean

²⁵ New entrants are defined here as operators that were private when their activities first started. De facto successors of historical incumbents are not considered to be 'new entrants' in this definition, e.g. DB Schenker Rail (UK, NL, DK), Freightliner (UK), Rail Cargo Hungaria Zrt. (HU).

²⁶ The lack of full or comparable data did not allow us to include all Member States in this overview.

that it is difficult to make meaningful direct comparisons concerning the share of new entrants on a cross-country basis.

Growth of market shares of new entrants

A promising additional approach is therefore to look at the *change* in market concentration over time by taking the market share of all but the largest operator. In every case the largest operator is either the national incumbent's freight company or a successor company of it. Since EU-wide market opening was imposed only from 2007, we look at the RMMS data for the year 2008 and compare it to the latest publically available data which is for 2010, as published in European Commission (2012). Table 17 shows the market shares in those Member States for which data is available for both years from the RMMS publications. This leaves us with 17 Member States.

TABLE 17 MARKET SHARES IN RAIL FREIGHT IN 2008 AND IN 2010

Country	Market share of all but the largest (2008)	Market share of all but the largest (2010)	Change in market share (2008-2010)	Full separation	Fully separated capacity allocation (including full separation cases)
AT	14.0	14.6	0.6	0	0
BE	6.1	11.8	5.7	0	0
BG	14.3	21.6	7.3	1	1
DE	22.0	25.0	3.0	0	0
EE	49.0	45.0	-4.0	0	1
ES	5.0	8.1	3.1	1	1
FI	0.0	0.0	0.0	1	1
FR	10.0	20.0	10.0	0	1
GB	44.2	51.4	7.2	1	1
HU	14.4	19.5	5.1	0	1
LT	0.0	0.0	0.0	0	1
LV	9.6	23.3	13.7	0	0
NL	25.0	40.0	15.0	1	1
PL	24.0	35.8	11.9	0	0
RO	41.0	54.7	13.7	1	1
SI	0.0	7.5	7.5	0	1
SK	3.9	4.3	0.3	1	1

The two last columns indicate whether the Member State has a fully separated infrastructure manager (1 if yes, 0 if not), and whether the Member State has fully separated capacity allocation, i.e. either a holding model with a fully separate body for capacity allocation, or full separation, or the French model (RFF is a fully separated infrastructure manager and is in charge of capacity allocation, but the Commission considers that it is not a proper case of full separation).

The first question is whether countries with full separation have seen stronger growth in the share of all but the largest freight operator as compared to countries that do not have full separation. The second question is similar, but for the case of countries that have implemented a full separation of capacity allocation or full separation, as compared to

those countries that have implemented neither reform. This question can be assessed by computing the average for each group of countries. This is shown in Table 18.

TABLE 18 AVERAGE CHANGE IN MARKET SHARE (2008-2010) OF ALL BUT THE LARGEST OPERATOR BY INSTITUTIONAL TYPE (PERCENTAGE POINTS)

	Countries with full separation	Countries without full separation	Countries with fully separated capacity allocation (including full separation cases)	Countries without fully separated capacity allocation
Average change in market share	6.7	5.4	5.8	7.0
(Min. – Max.)	(0.0 – 15.0)	(-4.0 – 13.7)	(-4.0 – 15.0)	(0.6 – 13.7)

The data suggests that neither full separation nor full separation of capacity allocation lead to stronger growth in the market share of operators other than the largest operator. Having separation, in other words, does not seem to support rail freight market entry more than not having separation, as measured by the market shares of the smaller players and by the range (min. – max.) of market shares in the respective set of countries. Besides the average results there is also no clear pattern at the extremes of the distribution. The changes in market shares range from below one percentage point in five countries (Finland and Slovakia with full separation, Lithuania and Estonia with full separation of capacity allocation, and Austria with neither) to ten percentage points or more in five countries (Romania and the Netherlands with full separation, France with full separation of capacity allocation, Poland and Latvia with neither).

Of course the high variability between Member States suggests that neither of the group comparisons shown might be statistically significant. A first consideration is that the standard deviation of the change in market share is 5.6, several times more than either of the differences between group averages. But besides differences in group averages, a more comprehensive statistical test, particularly well-suited for small samples, would be the non-parametric Mann-Whitney U test. This test is used to determine whether one of two groups of observations tends to have larger values than the other. After applying this test, it is clearly found that the groups are not significantly different from each other²⁷, neither for full separation (versus not having full separation), nor for full separation of capacity allocation (versus not having full separation of capacity allocation).

Entry in the passenger market in the period of our data comprises almost entirely the outcome of competitive tendering. Competitive tendering is not used in many countries, but it occurs both under vertical separation and holding company models. Its outcome does not appear to depend on the degree of separation.

²⁷ Full separation (versus not): n1=10, n2=7, U=38.5 (two-tailed p-value 0.74); fully separated capacity allocation (versus not): n1=12, n2=5, U=35.0 (two-tailed p-value 0.65).

Open access in passenger transport is currently very limited, and took off essentially in the last one or two years. For this reason it could not be included in this study, although recent national experiences will be interesting to follow (e.g. Italy, Austria, Czech Republic).

8.3 Conclusions

We have seen in this chapter that a number of mechanisms may be used to ensure non-discrimination in dealing with entrants in the rail industry, regardless of overall industry structure. One important condition is the presence of a rail regulator, independent from the Ministry and with adequate resources to enforce its decisions. Various arrangements were reviewed and a few concrete examples presented. This covered vertical separation, the separation of the so-called ‘essential functions’ into an institutionally separate organisation, the internal enforcement of an enhanced compliance regime within the holding company itself, and a presentation of the so-called Annex 5 provisions for independence between railway undertakings and infrastructure manager.

We have no clear evidence on the cost and relative effectiveness of these different measures, although clearly the bodies undertaking the essential functions in Switzerland and Hungary are lean organisations that do not cost much to operate.

What is clear from the empirical data is that substantial entry can occur under any of the reviewed institutional structures, and that one structure does not seem more favourable on grounds of promoting entry.

Part 3: Potential effects of reforms in view of the 4th Railway Package

SUMMARY

In this part we draw upon the findings from the quantitative and qualitative findings of the study in order to evaluate the potential effects of reforms that may be imposed in the context of the EU's 4th Railway Package.

Summarising previous findings, we find no evidence that vertical separation increases competition compared with a holding company model and likewise none that such increased competition would reduce costs. Nor do we find any evidence that vertical separation improves rail's modal share compared with a holding company model.

Vertical separation does not have much effect on costs at average train density levels, but at high levels of train density it increases costs and on less dense systems, vertical separation seems to have lower costs. Crucially, a decision to impose vertical separation throughout the EU would raise costs by at least €5.8 billion/year for no accompanying benefits. If rail traffic density rises, as would be a result of the European Commission's 2011 Transport White Paper goal to raise rail's modal share, then the costs of imposing complete vertical separation everywhere would rise dramatically.

Misalignment issues are important and need to be paid much more attention. The need for coordination differs according to the situation of the railway regarding issues such as density of traffic and the need for change. Where vertical separation is put in place, it is very clear that additional measures to align incentives should be considered. However holding models may also require additional efforts.

The transferability of alternative approaches to vertical separation that allow for a non-discriminatory network access (such as the separation of essential functions and enhanced compliance and regulatory mechanisms within a holding model) should be studied in more depth to allow adapting them to local circumstances.

Policy recommendations

Countries should be free to choose the structural option that best suits their circumstances – thus allowing competition between different organisational models – subject to providing for non-discriminatory access for competitors. This should include both the possibility of switching from a holding model to vertical separation, and the possibility of switching from vertical separation to a holding model.

Where vertical separation is adopted careful thought must be given to measures to ensure correct alignment of incentives. This includes, but must go beyond, efficient setting of track access charges and performance regime bonuses and penalties.

9 Cost-Benefit Analysis

This chapter develops a simplified Cost-Benefit Analysis of shifting from a structural option to various other structural options. To realise this, the chapter takes into account the findings of both the quantitative econometric work on costs and modal share and the qualitative analysis on misalignment issues and options for non-discrimination. The chapter aims at presenting the potential net effect of shifting from one structural model to another.

Return to complete vertical integration is not seen as a realistic option within the European Union. Therefore, the following options were retained for the analysis to be conducted in this chapter:

- Vertical separation model:
 - No additional provisions
 - Measures to achieve realignment
- Holding company model:
 - No additional provisions
 - Enhanced compliance mechanisms
 - Annex 5 provisions
 - Separation of essential functions

We first make an overall comparison of the holding company model with complete vertical separation before comparing the different sub-options within each model and drawing a general conclusion.

Comparing full institutional separation with the holding company model

In general, one would expect that the strongest argument for full institutional separation would be that it provides assurance to railway undertakings of non-discrimination, and therefore attracts the greatest degree of competition. This in turn might lead to an improvement in services (yielding benefits in the form of additional revenue, benefits to users) and reduction in costs. Other possible advantages of complete institutional separation are that it provides financial transparency and enables specialisation. Transparency may in itself be a way of increasing competition, but it may also have other advantages in terms of helping regulators and state authorities to make efficient decisions, for instance regarding investment. In a franchising system it may attract bids from more companies than those who would be willing to take responsibility for both the infrastructure and train operations in (regional) vertically integrated franchises.

On the other hand, as we have seen, complete institutional separation raises issues of transaction costs, duplication and misalignment of incentives. The literature review provides evidence of all of these, and suggests that problems arising from misalignment of incentives may be the most significant. We have considered these possible misalignments in detail in chapter 7 of the study. Such misalignments may affect investment planning production planning, timetabling and real time production coordination. For instance, infrastructure managers may have too little incentive to help train operating companies to increase revenue, by timely implementation of improvements in capacity and quality, and by failing to optimise timetables, slot allocation and day to day operations (for instance in terms of planning and undertaking track maintenance and renewals and recovery from delays).

TABLE 19 POSSIBLE COSTS AND BENEFITS OF FULL VERTICAL SEPARATION (COMPARED WITH A HOLDING COMPANY MODEL)

Possible costs	Possible benefits
<ul style="list-style-type: none"> • Increased transaction costs • Costs of duplication of staff • Misalignment of incentives leading to increased costs and poorer services in: <ul style="list-style-type: none"> • Investment coordination • Production planning efficiency • Timetabling optimality • Production coordination 	<ul style="list-style-type: none"> • Increased competition leading to lower costs and improved services • Increased specialisation also leading to lower costs and improved services • Increased transparency, improving efficiency of regulation and funding, leading to lower costs and improved services

Thus overall we find reasons to believe that depending on a number of circumstances vertical separation may raise or reduce costs, and may raise or reduce rail's modal share, compared with the holding company model. Any overall cost-benefit assessment must therefore depend on empirical quantification. Although our qualitative analysis provides many examples of such analysis, it does not permit overall quantification, so we must rely on the econometric analysis for that. However, we note already that we found no evidence that complete vertical separation typically leads to more competition than the holding company model, which already seems to undermine the strongest argument in favour of vertical separation.

We have found no evidence that structural reform in the freight market has benefitted rail's modal share. In the passenger market, it appears that the combination of permitting market entry and vertical separation is superior to vertical integration, but we are unable to conclude whether this is better than the combination of permitting market entry with a holding company.

Regarding costs, we have weak econometric evidence that the holding company model reduces costs compared with full integration, whilst the analysis strongly suggests that complete vertical separation reduces costs for lower density railways but raises it for high density railways. At typical density levels, the holding company model seems to have the lowest costs. At any density level, vertical separation is more costly where a high proportion of revenue comes from freight traffic.

We were prepared for the result in terms of higher density railways, as we believe that the transactions and misalignment costs that arise with vertical separation are to a considerable extent associated with timetabling and real time traffic control, which are more problematic where traffic is dense. We are less able to explain the result for lower density railways. Even if vertical separation increased competition, we find no evidence that increased competition reduces costs. Whilst we have noted that there are other arguments as to why vertical separation might reduce costs, we do not find these very convincing.

In any event, for many of the largest European railways, at current traffic levels, complete vertical separation does not appear to reduce costs, and imposition of a rule requiring it would impose substantial costs on the European rail system as a whole. If traffic grows in accordance with European Commission goals (2011 transport white paper), there will be even fewer railways for which costs are projected to be reduced by complete vertical separation.

The only publicly available study of the impact of moving from the holding company model to complete vertical separation of which we are aware is the PRIMON (2006) study undertaken for the German government. The PRIMON study suggested that it would be likely that a completely separated model would be less favourable than a holding company model in its impact on the government budget. In a long term view (2006-2020) the negative budgetary effect is estimated to range between €6.4 to 9.4 billion. Yet, this estimate is based on several drivers, some of which should not be regarded as a cost in our cost benefit analysis, e.g. the assumption that separation would increase competition, and thus reduce the profitability of the assets the government would either sell, or retain and receive dividends on. In the narrow sense, the costs of complete separation identified were a loss of synergies of €1.1 billion for 2006-9 and transition costs of €1.5 billion over the same period. For the longer run, PRIMON estimated sustainable costs of complete separation of €0.488 billion per annum. As against these, the study assumed that competition would be higher and that this would lead to savings of €3.3 billion in present value terms in regional passenger services for 2006-2020, i.e. €0.22 billion per annum. Thus even if the latter estimate was accurate, these benefits would have been outweighed by the estimated costs.

Thus whilst it is possible that in some circumstances vertical separation might be a sensible structure to adopt, it certainly cannot be advocated for all circumstances.

Variations on the holding company model

The main objection of the Commission to the Holding Company model is that it gives the infrastructure manager an incentive to discriminate in favour of its own sister companies, and thus makes market entry more difficult for other undertakings. To date, the main defence against that has been the appointment of a regulator, to consider and rule on alleged cases of discrimination. Moreover, complete vertical separation will not remove the incentive for the infrastructure manager to favour major customers over minor ones. It should be reiterated that we have found no systematic pattern whereby new entry, where permitted, is less likely with a holding company than complete separation, so it is not clear that further measures are needed. Nevertheless, alternative further solutions to the problem of potential discrimination have been suggested and were discussed in the previous chapter. We will comment on each in turn:

- Firstly there is the possibility of institutional separation of essential functions, namely setting access charges and allocating capacity. We have found interesting examples of such arrangements in Switzerland (combined with complete vertical integration of infrastructure and operations), Hungary, Luxemburg, Slovenia and the Baltic countries, and for certain years in the Netherlands. However, the extent of the data was not sufficient for us to obtain robust econometric results. It does not appear that such a body needs to be expensive. We have seen the examples of Switzerland and Hungary where a body with a very small staff fulfils this function (in Switzerland, infrastructure charges are the responsibility of the Ministry, and detailed timetabling is undertaken by SBB under the supervision of Trasse Schweiz, but in Hungary the body in question is completely responsible for capacity allocation, charging, and timetabling). Thus it is not in itself a costly reform, but it may introduce some of the misalignment problems that were discussed in chapter 7, where development of the most effective timetable is made more difficult by vertical separation of this function. In Switzerland, this risk is minimised by having the main operator prepare the actual timetable. Some would object that this

solution could introduce some possibility for discrimination, but this seems to work well in Switzerland. In Hungary, the problem is reduced by the existence of spare capacity in the infrastructure.

- The second possibility is the complete or partial implementation of the Annexe 5 requirements that the Commission presented in its working document of 2005. These range from cooling-off periods for IM staff, passing by the obligation to separate IT systems to the obligation to have separate buildings for IM and RU staff. These are not generally completely implemented at present, and it is the subject of current legal proceedings to determine whether their requirement is implied by existing legislation. According to the recent opinions expressed by the Advocate-General to the European Court of Justice, this is not the case. Clearly we have no real evidence on the impact of these requirements at present. The costs they imply are not money costs but those of not always being able to appoint the best, most experienced person to a particular post, and of not being able to share knowledge from the infrastructure manager and train operators as effectively as when these conditions are not imposed.
- The third possibility is the implementation of enhanced compliance mechanisms. The closest experience we have found of this is the provisions within DB and FS to ensure transparency and non-discrimination as described in the previous chapter. Our impression is that this is a useful way of reinforcing the commitment of senior management to non-discrimination throughout the organisation, but again we have no quantitative evidence on its effects beyond noting that DB and FS are the holding company facing the greatest degree of competition in our sample.

Quite apart from these three variants, we have found that the role of the holding company varies enormously from case to case and may also change over time. Whilst we see the Holding Company model as always involving a body that is responsible for separate subsidiaries dealing with infrastructure and operations, the role of that body varies. In Poland, for instance, the holding company plays little role in trying to integrate the activities of the different subsidiaries, whilst in Germany it plays a much more active role particularly in terms of non-essential functions such as longer term planning and investment. Nevertheless, in the quantitative analysis we have had to take the holding company model as a single option for comparison with complete vertical separation and with a separated realigned system. The variety of roles a holding company may play and their effectiveness remain issues worthy of more detailed research.

Comparing full institutional separation with a realigned separated system

Our main evidence on the comparison of a realigned separated system with complete vertical separation is that of Britain.

From the time of reform in 1994, Britain paid more attention to the alignment of incentives than did most countries. Thus a sophisticated system of track access charges differentiated to reflect the different wear and tear imposed by several hundred different types of vehicle was introduced. Later a congestion charge was added to reflect the greater potential for performance degradation (delays etc.) when lines are operated close to capacity. There are plans to increase the degree of differentiation of both charges as part of the current periodic review. There is a performance regime in which railway undertakings are compensated for delays attributed to the infrastructure manager or other operators, and in turn pay for the delays they cause. There is also a small payment to the infrastructure manager based on passenger-km to give them an incentive to

undertake small-scale investments to enhance quality or capacity. Larger investment projects generally arise out of the process under which the government decides on the quality and capacity of infrastructure it is willing to pay for as part of the periodic review (the High Level Output Specification and the Statement of Funds Available). This process is informed by the application of cost-benefit analysis and overseen by the regulator. The regulator also undertakes periodic reviews of the infrastructure manager's finances, determining its revenue requirements on the basis of benchmarking studies of efficient costs, and has imposed a licence condition that it should 'meet the reasonable needs of its customers', and the regulator may impose penalties if it fails to do so. It can impose fines where quality falls below required standards. To the extent that it is unclear to what extent Network Rail will respond to such penalties, as it has no shareholders to bear the pain, these are supplemented by a system of performance related bonuses for Network Rail senior managers, also requiring the approval of the regulator.

Nevertheless, it was still considered by the McNulty (2011) review that there were major failings in the correct alignment of incentives. In particular, it concluded that railway undertakings had no incentive to assist the infrastructure manager in reducing total costs, since only franchisees pay more than marginal costs and they are protected from changes in track access charges under the terms of the franchise agreement, whilst the infrastructure manager had inadequate incentives to assist railway undertakings to improve performance and revenue. Various forms of alliances are advocated to overcome these problems. For some years, the infrastructure manager and railway undertakings have operated joint control centres responsible for real time control, with the dominant operator always present and smaller operators allowed to be present if they wish. Other alliances may cover specific issues such as track or station maintenance. The deepest alliance so far implemented is that with South West Trains, where a joint management team is now responsible for both infrastructure and train operations. Alliances necessarily involve a degree of sharing of revenues and or costs. But the most effective alliance in terms of alignment of incentives is the formation of a joint venture. Each partner then looks at its share of the profits rather than having an incentive only to look at the share of costs it will bear and the share of revenue it will receive. Essentially this result is also achieved in the case of South West Trains without a formal joint venture, since base line costs and revenues were agreed for the duration of the alliance, and all changes in costs and revenues from the baseline are shared equally between the two parties. There is evidence in the McNulty case studies that a joint venture might achieve substantial cost savings (up to 20% in one case study). However, railway undertakings that are not part of the joint venture will at best not receive the main benefits, and the problem of ensuring that they are not discriminated against may be tougher than with complete vertical separation. Thus these solutions work best where there is a single dominant train operator in the area covered by the alliance with common boundaries with a region of the infrastructure manager; this is true of many areas of Britain because of the franchising system operated for passenger services and the low level of freight traffic.

Conclusions

In conclusion, then, the evidence does not suggest that vertical separation is necessarily best in cost-benefit terms. We find no evidence that vertical separation increases competition compared with a holding company model and likewise none that such increased competition would reduce costs. Nor do we find any evidence that vertical separation improves rail's modal share compared with a holding company model (although it does improve passenger market share when combined with market opening

compared with vertical integration). For freight, there is no evidence that if it did increase competition this would improve market share.

Regarding the overall impact of restructuring on costs, the position is more complicated. At typical traffic densities, it appears that the holding company model reduces costs compared with vertical separation. While vertical separation does not have much effect on costs at average train density levels, at high levels of train density it increases costs. However, on less dense systems, vertical separation seems to have lower costs. We particularly warn against extrapolating relationships to organizations which are very different from those for which they were estimated. We do not believe our results to be applicable to small local railways.

A decision to impose vertical separation throughout Europe would raise costs by at least €5.8 billion/year for no accompanying benefits. If rail traffic density rises, as would be a result of the European Commission's strategy to raise rail's modal share, then the costs of imposing complete vertical separation everywhere will rise dramatically.

Where vertical separation is put in place, additional measures to align incentives should be considered. Vertical separation with enhanced alignment of incentives is assumed to work best where a single railway undertaking is dominant in each region and this operator can form an alliance with the appropriate region of the infrastructure manager (as identified in the British context).

For the holding company model to work well, the operators which are in the holding would retain a substantial market share over the whole system. Clearly the gains for this form of alignment will be much more limited if the operators in question have only a small share of the market.

We have examples of institutional separation of essential functions and of enhanced compliance mechanisms that seem to be working well, but we have no clear evidence on their benefits and it is not clear to what extent these experiences are transferable.

Our overall conclusion must therefore be that there is no evidence to support implementation of a single structure on all railways regardless of their circumstances.

10 Analytical conclusions

We have already presented our analysis of the costs and benefits of alternative structures for the rail industry. In this chapter we present some more general conclusions arising from our analysis. Here, we begin with the implications of the qualitative work, and then return to the econometrics and overall conclusions.

Misalignment issues are important and need to be paid much more attention

There is evidence from the literature that vertical separation leads to additional transaction costs and costs from misalignment of incentives. Whilst the former appears only to add around 1% to total rail system costs, the latter appears to be more important, with estimates of up to 20% for particular case studies.

The high proportion of costs that are infrastructure costs and the complex interaction of infrastructure and operations as described in the rail industry model are very different to other utilities and transport modes, so solutions which work well there may not work for the rail industry.

Efficient setting of track access charges and a performance regime are important ways of contributing to the correct alignment of incentives in a vertically separated system, by giving train operators appropriate incentives regarding services to operate, equipment to use and reliability, and by giving infrastructure managers appropriate incentives regarding reliability and maintenance possessions.

Nevertheless, these misalignments of incentives cannot be fully removed by the combination of track access charges based on short run marginal social cost and a performance regime. Such access charges will not for instance give infrastructure managers appropriate investment incentives; nor will they incentivise train operators to assist infrastructure managers to minimise the costs of the required capacity and capability of the infrastructure. Investment plans and efficiency may therefore need to be overseen by the regulator to ensure that they meet the needs of railway undertakings in a cost-effective way. However, the regulator will not have the quality of information available to an integrated company, particularly as both parties will have incentives to distort the information the regulator receives to achieve their own interests.

Where a single operator carries a large part of the traffic over part or all of a system, a better alignment of incentives is likely to be achieved if this operator works closely with the infrastructure manager, either through a holding company or an alliance of some form. However, careful thought still needs to be given to how the holding company or alliance will work to overcome potential misalignment problems.

The need for coordination differs according to the situation of the railway

Railways in need for changes (upgrading, enhancements, extensions, scaling down) are likely to have different and more coordination needs than steady-state railways (railways that have a very low need for infrastructure adjustments). Railways in need for changes are more likely to find it more difficult to work under an unbundled regime than steady-state railways with sufficient capacity to accommodate all traffic.

While much of the academic literature on railway separation looked at the effect of various unbundling options on competition and efficiency, implicitly assuming a steady-

state railway, the examples we reviewed show that incentive misalignment issues arise especially when railways are not in a steady state but have to evolve. While this can be true for large-scale investments such as new high-speed lines, it is probably even more crucial for smaller investments and more marginal improvement needs. It is important for future research to pay much more attention to the processes at the interface between infrastructure management and train operations. An inappropriate configuration of these interfaces can easily frustrate optimization processes that are inherently system-wide, resulting in a sub-optimal situation where both the track manager(s) and the train operator(s) optimise on their own side of the fence, forgetting about the system-wide effects of their actions and generating a railway that is socially too expensive and remains short in terms of performance compared to what is technically feasible.

There is no clear evidence that additional measures are needed to prevent discrimination in the holding company model

Given that we find no evidence that the holding company model is currently inferior to complete vertical separation in terms of competition and market share, there is no clear evidence that existing arrangements to prevent discrimination are inadequate. These include a requirement for the regulator to deal with problems of discrimination in all countries, whilst examples of separation of essential functions and of enhanced compliance measures are found in particular countries.

There is no evidence that vertical separation is necessary in order to obtain the benefits expected from competition.

There is no evidence in practice that vertical separation leads to more intra-competition than the holding company model, nor that it leads to a higher rail modal share for either freight or passenger traffic. Recent trends show that changes in market concentration in the rail freight market vary substantially between countries but without any clear or significant relationship to the degree of separation. Whilst passenger market opening plus vertical separation seems to be better than vertical integration for passenger market share, we cannot conclude on whether it is better than passenger market opening plus a holding company.

The most effective model in terms of its impact on costs differs with circumstances

Our econometric evidence, based on data that has been subject to more checking and supplementation than previous studies, finds weak evidence that the holding company model reduces costs compared with complete vertical integration. It finds stronger evidence that it vertical separation raises costs for higher density systems and that it reduces costs for main line rail systems with on average lower density. We have seen plausible arguments as to why vertical separation might raise costs particularly for higher density systems, but the finding that it reduces costs for lower density systems is puzzling given that this does not appear to be due to greater competition. It has been argued that this is due to greater transparency and specialisation, but we do not find this fully convincing.

Our findings also implicitly indicate that there could be cases where switching models could be beneficial, either from a holding to vertical separation, or from vertical separation to a holding.

It should be noted that all countries have a mix of more or less dense routes with differing proportions of freight traffic. This might imply that it might be optimal to have a variety of structures within countries according to the characteristics of the region, but much more in depth work would be needed before such a conclusion could be drawn. Our relationships are estimated at the aggregate level only.

The econometric results show that horizontal separation appears to have led to a very substantial reduction in costs. Perhaps this is because such separation has usually been associated in Europe with selling off the freight operations, and has therefore imposed strong pressure to reduce costs (careful examination of the staffing and costs and shedding of unprofitable traffic as was the case in Britain), thus the reduction, at least in that case, was not solely caused by separation itself. The cost reduction may also be driven by the increased cost and transparency resulting from the separation of the passenger and freight businesses; in central and eastern Europe, profits from freight traffic have often been used to cross-subsidise passenger traffic. It could also be the case that horizontal separation may have occurred disproportionately in countries where a positive result was expected; then such positive results should then not automatically be expected for all countries.

Vertical separation seems to have a less favourable impact on costs for railways with a high degree of freight traffic, suggesting that coordinating freight operations with infrastructure management is more demanding than for passenger. Possibly this is because freight runs to a less regular timetable than passenger and varies more from day to day.

We suspect that some of the beneficial impacts on costs of moving away from a completely vertically and horizontally integrated system, which do not seem to be associated with competition, arise simply because major structural reforms lead to a careful examination of costs and staffing levels. Other cleverly engineered reform could also have this effect.

Overall, different structures work best in different circumstances

We do consider our evidence to suggest that different structures work best in different circumstances, possibly even including different parts of the same country where traffic characteristics vary (different traffic density, different mixes of passenger and freight traffic, many small operators or one main operator)

For instance the holding company model seems to work best where traffic is relatively dense and includes a relatively high proportion of freight traffic. Vertical separation seems to work better when traffic is less dense, with a greater proportion of passenger traffic. Where vertical separation is in place, a combination of regional competitive tendering and alliancing (or even infrastructure leasing) to realign incentives between infrastructure manager and railway undertaking may constitute an efficient solution where traffic is dominated by a single operator as is often the case with a franchising regime. This solution depends on the ability to separate out the infrastructure used for regional services from the core main line network, which may not be possible in all countries.

Areas for further research

Most previous studies of the railway unbundling issue have suffered from inadequate and unreliable data, and perhaps that is one reason why results vary so much from study to study. We have made a good start in this project on dealing with this problem, but more

needs to be done. We strongly recommend that the European Commission initiate further in depth research in this area in collaboration with the European rail industry.

The precise consequences of misalignment issues should be researched in greater detail along the line of the suggested rail sector model in order to enable the monetary quantification of their consequences, and to examine more closely mechanisms for their alleviation whether in vertically separated railways or holding companies.

A positive effect induced by a reform does not guarantee that reform to be the best possible one. A reform that generates performance improvements may prevent reaching the higher level of performance improvement that a more suitable reform could have delivered. In the railway sector, the choice of an optimal reform path should therefore be based on a thorough understanding of the nature of the existing inefficiencies and, importantly, of the actual reasons creating those inefficiencies. Detailed benchmarking exercises, comparing the practices of railway sectors functioning under different structural regimes (from full vertical integration to full vertical separation) should therefore be strongly encouraged. This would generate essential new insights for the development of coherent structural options for the railway sector. It may well appear out of such analysis that major structural changes, such as vertical separation, are less potent than other, non-structural amendments to the existing regimes in reaching performance improvements.

11 Policy recommendations

Freedom to choose a structural option

Subject to providing for non-discriminatory access for competitors, EU Member States should be free to choose the structure for their railways that best suits their individual circumstances, thus allowing competition between different organisational models. This should include both the possibility of switching from a holding model to vertical separation, and the possibility of switching from vertical separation to a holding model.

Importance of alignment of incentives

Where vertical separation is adopted (and indeed where there is a holding company which is not active in coordinating decisions of its train operating and infrastructure subsidiaries) careful thought must be given to measures to ensure correct alignment of incentives between infrastructure manager and railway undertakings. This includes, but must go beyond, efficient setting of track access charges and performance regime bonuses and penalties.

Whatever the structure of the railway, the need for coordination mechanisms must be recognised

The infrastructure manager and railway undertakings must be encouraged to work together at a number of levels ranging from long term investment planning through to day-to-day traffic control. The implementation of feed-back loops across the whole sector from the measurement of operational performances to timetabling, resource planning and investment planning are essential. The circulation of personnel between infrastructure managers and operators from the one to the other is essential to guarantee a full understanding of the issues at stake in the sector. Separation can easily lead to a knowledge loss and to sub-optimisation.

Dense networks need particularly close co-ordination

Where traffic is dense, there is a particularly strong need to ensure close coordination. This may suggest complete vertical integration, a holding company structure, with an active holding company, or hybrid arrangements (such as joint ventures) between the infrastructure manager and the leading train operator.

The importance of dense networks will increase if the goals of European transport policy in increasing the usage of rail are realised.

Strengthening alternative regimes to guarantee freedom from discrimination in network access

Non-discriminatory network access has to be guaranteed whatever the regime chosen, in combination with mechanisms that allow for closer cooperation. To this effect, regulators need to get enough financial and personnel resources. The transferability of alternative approaches to vertical separation that allow for a non-discriminatory network access (such as the separation of essential functions and enhanced compliance and regulatory mechanisms within a holding model) should be studied in more depth to allow adapting them to local circumstances.

Annexes

A. Country analysis: Great Britain: Rail Value for Money Study (McNulty): results and discussion

The GB rail industry has experienced several reforms. A major decision was the split up between infrastructure provider and train operating companies (and rolling stock leasing companies). Facing increasing costs, the government initialised a "Rail Value for Money Study" finished in 2011. This study was led by Sir Roy McNulty.

General findings

In general, past reforms have resulted in several improvements for the GB rail sector, in particular: (i) growth in passenger and freight markets (including a reverse of a 50-year trend of reduction in passenger traffic), (ii) continued improvement in safety, (iii) increasing customer satisfaction and (iv) improved operational performance and significant investment. Nevertheless, compared to other European railways, the UK rail industry shows a significant efficiency gap, with rail costs that should be 20-30% lower. Among others this is due to a lower level of train utilisation (fewer passenger km per train-km) and a lower level of infrastructure utilisation (fewer train-km per track km). Thus, efficiency improvements of 30% are seen as achievable by 2019.

The study has identified some main barriers to efficiency, which we group as (i) general findings/barriers (shown in the following) and (ii) barriers due to misalignment (shown in next subsection). A general barrier has been the unclear role of the Government and the industry. There exists no sufficient clarity about what Government policy is, how different strands of policy fit together, or how the different levels of policy, objectives strategies and implementation are linked, including a missing long-term planning. Moreover, the Government is involved in (too many) details that are cost relevant.

Within the organisational structure, rail infrastructure management (by Network Rail - NR) was criticised as heavily centralised and insufficiently concerned with the needs of its (local acting) customers. At operational levels, weaknesses in HR/IR management, which have allowed excessive wage drift, at all levels, and the continuation of inefficient working practices have supported increasing costs. Moreover, the current fare system does not send efficient pricing signals to passengers, particularly in terms of managing (costly) peak demand and is seen as extremely complex.

Barriers to efficiency due to misalignment

The study views the current market organisation with its high level of fragmentation as an important reason for inefficiencies. According to McNulty, there are many players with many interfaces that have not worked well in terms of securing co-operative efforts at operational interfaces or active engagement in cross-industry activities which need to be undertaken for the common good. There exists a lack of an effective supply chain that starts with the customer (passenger and freight) and taxpayer, and focuses the efforts of all concerned on meeting the needs in a cost-effective manner. Here, for example, train operating companies are criticised to take at times very short-term views in an industry that requires long-term planning, whereas we think that this might be usual for listed profit oriented enterprises.

Analysing the incentives within the industry, McNulty stresses this system as ineffective and misaligned. This holds notably for the incentives on NR and the operators (TOCs),

which are almost completely different. Examples are: limited incentives for TOCs to manage rolling stock leasing costs and track access costs, system of incentives with a bias towards capital expenditure rather than making better use of existing capacity, relatively short franchise periods, overly-prescriptive franchises (with a low level of freedom for operators), insufficient risk transfer from Government, and difficulty in agreeing changes to franchise agreements (e.g. with respect to necessary infrastructure adjustments).

Moreover, the industry's legal and contractual framework is seen as complex, with adverse effects on attributes and relationships, engendering additional costs. At operational levels, a lack of implementation of best-practice in a number of areas which need to be managed from a whole-system perspective and which are key drivers of costs, are further critical aspects (notably for asset management, programme and project management, supply chain management, and management of standards and innovation).

All of the above, and particularly the interfaces issue, meant that whole-system approaches are difficult to apply in an industry that often needs them. Players within GB rail are, according to the McNulty Study, more inclined to follow approaches which maximise their position within their own "silo", rather than optimising outcomes for the industry as a whole, for example in the areas of technology and innovation. The lack of leadership at industry level then has contributed to the problems in relationships and culture that, in consequence, have resulted in the inefficiencies observed.

Assessment of misalignment

McNulty states that there are 'few effective incentives across the wheel/rail interface.' (section 5.3.4). Given that GB has a complex system of track access charges designed to reflect the wear and tear caused by each type of rolling stock and the contribution of the service to delays caused by congestion, and also a complex performance regime designed to incentivise each party to contribute to reliable performance, this is a surprising conclusion. On the other hand, questions arise (i) whether there is the necessary potential to improve this system further or (ii) whether there exists a well functioning system at all.

Nevertheless, it has to be kept in mind that that several misaligning incentives can be detected for GB. For example, no train operator has any incentive to help NR to reduce total system costs, since franchised TOCs are fully protected from increases in track access charges under the terms of the franchise agreement, whilst other TOCs only pay marginal cost. On the other side, NR has no sufficient interest in assisting operators to boost revenue by means of improved journey times, ability to run at night or weekends.

Key recommendations for the rail sector in Great-Britain

From a general perspective, the study recommends a stronger leadership from the top, in particular by clearer definition of the roles of Government and industry, clearer objectives and a greater degree of long term planning (including better use of existing capacity). A further recommendation is a structure of devolved decision making, notably (i) less prescriptive franchises to allow TOCs more freedom to respond to the market, (ii) decentralisation and devolution of Network Rail (iii) greater degree of local decision-making by local authorities, including piloting lower-cost regional railways.

For market organisation, it recommends changes to structures and interfaces, notably by devolution and decentralisation of Network Rail and introduction of diverse ownership of some infrastructure management concessions. Moreover, a closer alignment of route-level infrastructure management with TOCs, either by (i) cost and revenue sharing (and joint

targets), (ii) joint ventures or alliances or (iii) full vertical integration though a concession of infrastructure management and train operations combined is suggested.

Incentives, according to McNulty, need to be stronger for TOCs to reduce costs and to cooperate more effectively with Network Rail. Here, there is also need for a closer alignment of NR and TOC incentives. Furthermore, responsibilities for the efficient management of existing capacity need to be clarified. In relation to NR a.o. (i) comparative regulation of route-level units, (ii) introducing a degree of independent ownership of infrastructure management concessions and (iii) a consideration about directing all subsidy for NR through track access charges are other suggestions. Nevertheless, this system needs a clear-cut regulation, why implementing a single regulator with a new focus on whole-system outputs and with necessary resources, skills and standing to support an expanded role. Additionally, a clearer safety leadership at industry level by a special agency to lead the industry in achieving technical excellence, an improved oversight and management of cross-industry information systems and increased standardisation and more effective procurement of rolling stock are further starting points.

At operational levels, a stronger focus on partnership working from inception through to the supply chain, identifying the optimum approaches to maintain, renew or enhance the railway, is seen as necessary. This will require, among others, (i) industry wide adoption of best-practise frameworks to encourage whole-system, whole-life approaches, (ii) considering of trade-offs between infrastructure, rolling stock and operations in order to better select the optimum maintenance approaches and (iii) earlier involvement of suppliers and contractors as well as much wider use of partnering approaches.

Outlook

At the end, McNulty's solution is a varying degree of approaches for vertical integration, while stressing that "one size will not fit all". These range from informal agreements to cost and revenue sharing to legal integration for the duration of the franchise agreement. The latter is only seen as appropriate for areas where a single franchisee dominates train operations. McNulty generally favours allowing NR and operators to negotiate on their own, subject to approval from the Regulator and the avoidance of discrimination.

In the following, two consultants' reports particularly contribute to these conclusions. Lek (2011) argues that vertical integration will reduce transaction costs and improve incentives (for instance to find cost effective ways of enhancing the infrastructure and to undertake maintenance in the most cost effective manner). However, it may reduce competition, not just because of fear of discrimination but also because there may be fewer bidders for franchises if infrastructure is included. Franchises might give the franchisee responsibility for infrastructure operations, maintenance and enhancement, but of course key functions such as charging and allocation of capacity would remain with NR.

The Chiltern case study (First Class Partnerships, 2011) seeks to quantify the benefits of vertical integration for a particular case study where a long franchise with responsibility for operating, maintaining and upgrading the infrastructure exists. It concludes that vertical integration would reduce overheads and support services costs whilst leading to more cost effective maintenance, renewals and enhancements (e.g. through more appropriate timing of renewals expenditure) and through more reuse of displaced materials on more minor lines. It estimates these bets as £300-360k out of a spending of £1-9 billion, or 16-19%.

Currently there is no sign of anyone moving towards a fully vertically integrated franchise in GB, but various alliances of different depths are being negotiated. The deepest alliance is that for South West Trains, currently in place under the name “Wessex”, and where the infrastructure manager and the operator have a joint management team, reporting to a single managing director.

B. Country analysis: Lithuania: a vertically integrated freight railway

The situation of the railways in the Baltic States is different from that in other member states of the EU, as can be illustrated with the example of Lithuania. The Lithuanian railway company, AB Lietuvos geležinkeliai (LG), is a fully state-owned and vertically integrated company. Infrastructure, freight transport and passenger transport are all provided by LG although since 2008 this has been organised into separate divisions with separate accounting. Essential functions (capacity allocation and track access charges) are delegated to a state railway inspectorate and open access exists since 2007 in freight transport, although so far no new entrants have appeared. The track access charges are set by the State Railway Inspectorate on the basis of traffic forecast, and the full cost principle is leading. The Lithuanian railway is clearly freight oriented, differently from most European railway systems. Passenger services receive no state funding and the volume of freight with comparatively high track access charges makes that the railway is essentially profitable, including the infrastructure. The broad gauge used, instead of the European standard gauge, makes it more complex to achieve European interoperability, as freight has to be reloaded at the Polish border.

The revenues of the railway in 2011 were composed for 84,5% of freight and only 5,1% of passengers, besides other activities. The market share of rail in freight transport (compared to other modes) is high; 44% in the case of Lithuania. In the last decade, a substantial raise of both freight (+ 8,7%) and passenger volumes (+ 6,8%) could be observed after earlier downturns after the independence from the former Soviet Union and the global economic crisis. The Baltic rail transport market still depends strongly on freight transit activities towards the Russian Federation. Freight transport streams from Russia are submitted to competition between the various ports and railways of the Baltic States. A particular situation facing LG is the daily unpredictability of the traffic streams from Russia. This requires the ability to react quickly to changing circumstances, with a number of trains that can vary from 15 to 35 at very short notice. The integrated IM/RU solution is considered by LG as an essential condition to allow for this.

Only 7% of the network is electrified but major developments are currently taking place with huge investments in modernization of infrastructure (trans European railway lines), rolling stock, signalling and electricity supply. LG also starts the construction of two inland intermodal terminals this year near the two biggest Lithuanian cities Vilnius and Kaunas. 59% of all investments are borne by LG, 35% by the EU.

C. Questionnaire on quantitative data

Introduction

We would like to ask for your cooperation in the following:

- Could you please check and fill in the excel document attached to this note (further explanation is provided below)?
- Could you please return the attachment to us, preferably by email (a.s.j.smith@its.leeds.ac.uk) not later than Wednesday 9th May?

We would like to thank you very much in advance for your cooperation!

Should any further questions arise, please do not hesitate to contact us:

Questions concerning this questionnaire (the part regarding *quantitative data*) should be addressed to: Andrew Smith, A.S.J.Smith@its.leeds.ac.uk

Supporting Information for the Quantitative Data Spreadsheet

Purpose of this Survey and Overview

The aim of this study is to inform the question as to whether different approaches to railway organization and / or the introduction of competition influence the cost of running railway systems. This assessment will be made based on statistical modeling techniques applied to data on costs and key cost drivers. The purpose of this questionnaire / data collection exercise is to enhance the quality of an existing dataset that has been collected, based on UIC statistics, so that we can have the greatest confidence possible in the results, whilst recognizing the relatively compressed timescale of the study.

The existing dataset has been used in a previous study (see Mizutani and Uranishi (2011) and covers thirty companies for the years 1994 to 2007 (see Annex 2.2). We aim to re-run the model used in that paper, using an enhanced and updated dataset, including adding the UK to the dataset.

In respect of costs, our aim is to obtain the total cost of the main rail infrastructure manager in each country, plus the total costs of passenger and freight operators running on that main infrastructure. Where there is separation, the constituent company data is added together (passenger, freight, infrastructure), with infrastructure charges netted out to avoid double counting.

We are therefore sending this questionnaire to CER members with the aim of obtaining data for the main infrastructure manager and to the main, incumbent integrated operator or operators (where relevant) and to the main, incumbent freight operator in each country covered by the previous study (see Annex 2.2; plus Latvia and Bulgaria as requested by CER).

We are also sending the questionnaire to a wider group of smaller CER-member operators. To the extent that we are unable to collect cost data for the

whole industry, which is inevitable given the large number of small operators, we will scale up the cost data that we do collect in line with data on train-km and market share of the main operators.

The data collection for the UK will be handled differently, as the project team already holds data for the UK which simply needs to be added to the dataset.

The Main Data Sources for Our Existing Dataset contained in the Attached Spreadsheet

The main data source for the attached spreadsheet is UIC International Railway statistics. For DB and NS, who participated in a pilot exercise, the dataset includes the changes made in our previous correspondence. There are also some cells where the data has been derived from other sources such as Jane's Railways or Annual Reports (marked blue in the spreadsheet); estimated based on other categories in the UIC data, for example, estimating train-km based on changes in tonne-km from year to year (marked in pink); or estimated by using an adjacent year or years (marked yellow). Blank cells indicate that we have no information.

Our request to you

- The first request is for you to look at the relevant existing data for your company / country that we have in our data and correct the data where it is wrong. Please also add data for the data series that are incomplete (ideally up to 2011). We would be grateful if you could do this directly in the file and colour your changes using red ink. Please also indicate the reason for your correction, if possible, in a separate note (Word) or in the Remarks or comments cell in the spreadsheet and specify the exact definition of the variable that you are using. If you do not have exactly the same value as the UIC definition (see Annex 2.1), please provide information on a similar item, and when you do so, please explain how you define it.
- In Annex 2.1 we provide more detail on the UIC definitions that we have used. Please indicate the source of the data that you have used and if possible provide a photocopy or scan of the source and the corresponding exact data definition. If your data is based on estimations or approximations, please indicate this clearly and explain the method that was used for the calculation.
- Our intention is that the data for train operations should relate to operations in the country concerned only, and not to wider international operations. Thus if you are a train operator only, please only provide details of domestic operations.
- If you are completing the form as an infrastructure manager only (for which there is a separate sheet in the spreadsheet), please, wherever possible, show separately train-km on the network by the main train operator and by other operators (including

international train-km in the country concerned). Further guidance is provided in the attached spreadsheet.

- If you are an integrated operator (infrastructure and operations), please provide information only for your domestic operations, but please also provide information for train-km on the network by the main train operator and by other operators (including international train-km in the country concerned). Further guidance is provided in the attached spreadsheet.
- Please also indicate whether the depreciation charge included in the accounts covers all assets, or whether it excludes assets purchased by government (and if possible provide a rough indication of the proportion of asset valuation that the depreciation charge relates to).
- Please could you provide an indication of the proportion of rolling stock that is leased (as opposed to owned directly) and where possible separately identify lease charges. As noted in Annex 2.1, it is intended that the data on number of freight vehicles includes vehicles owned by customers, even though the associated costs will not be included. The spreadsheet contains separate columns for rolling stock owned by your company and by customers.
- Please also indicate, either in the spreadsheet or in a separate note, where there have been any changes in accounting policy (such as asset revaluation, etc) or other definitional changes in the period considered? These may apply to financial measures, but also to definitional changes on physical measures, such as track length. Please indicate what and when this happened and also whether there is a way of constructing a consistent time series.
- Please can you also tell us whether there are important costs that have been netted out from the data? For example, for train operating company costs, do these include infrastructure charges or have these already been netted out? Please provide the amount of infrastructure charges in either case. For separated systems, or even when there is accounting separation only, are there other intra-industry transfers that you are aware of that need to be netted out when adding infrastructure company costs to passenger and freight operator costs to obtain a measure of whole industry costs? Relating to point 6, have any payments by the public purse (subsidies or other payments) been netted off against costs (either as revenue items or capital – the latter would potentially come through as a lower depreciation charge, or otherwise). If any of these have taken place, please indicate how and where in a separate document (Word) or in the spreadsheet and when possible provide corresponding data.

Finally, we have included in the spreadsheet only those items needed for our study. If you feel a new item should be added, you can add a new column and explain it in the spreadsheet.

How the data will be used and confidentiality

The data will be used, as noted above, to update the econometric study carried out by Mizutani and Uranishi (2011) aimed at understanding the impact of competition and railway organization on costs. We intend to publish this work.

We are assuming that all factual information provided to us in your reply is non-confidential i.e. publicly available information. If any of the information that you provide to us has to be considered confidential please indicate this very clearly in the Excel-table besides the information provided. Such information will then not be included in publications.

It should also be noted that, owing to the compressed timescale for this project, the number of companies included, and the complexity of international railway comparisons, we cannot guarantee to resolve all definitional differences as part of this work, which may mean that some data submitted may not be used in the modelling work. There will come a point where we need to close down data collection / processing and move to model estimation. However, knowledge of the data comparability issues, even if not resolved, will be useful in terms of applying appropriate caveats to the results, as well as taking the analysis forward in future. Some of the data supplied, if not used in this study, could be used in subsequent work when there is more time to explore the data issues in more detail.

We are aware that completing these tables may be very time consuming and that some data we ask for may simply be unavailable, but we ask you to do the best you can; an approximation to what we want is much better than nothing. Thank you once again for your cooperation!

Annex: Definition of UIC Data

The length of railway lines worked (B11)

The length of railway lines worked is obtained by taking these sections including main-line track listed in the Capital Expenditure Account.

The length of lines (route-km) is distinguished in the spreadsheet from total track length (or track-km), where the latter takes account of the fact that 1km of double track = 2 track-km.

Sections not worked are deducted only in cases where they are permanently out of use that is to say, if they are no longer maintained in working order. Lines temporarily out of use continue to form part of the length of lines worked.

The length of a section is measured in the middle of the section, from centre to centre of the passenger buildings, or of the corresponding service buildings, of stations which are shown as independent points of departure or arrival for the conveyance of passengers or freight. If the boundary of the rail network falls in open track, the length of the section is measured up to that point.

The section situated between a station approach and the join to the main line of two lines or more which is used by all trains in either direction over these lines, is only counted once. However, if for one or more of these lines, tracks are normally allocated, the length of these lines is counted separately.

On the other hand, if between two stations there are one or more parallel tracks (siding-lines) to the main line, only the length of the latter is counted.

In the case of regular lines worked exclusively during part of the year (seasonal lines), their length is included in the end-of-year statement.

Electrified lines (B11)

Electrified lines are those provided with an overhead trolley wire or with a third rail.

The length of electrified lines only includes entire line sections which allow the passage of electric tractive units between two stations, or between a station and a tractive unit deposit. Line-section segments which are electrified at station approaches exclusively for shunting purposes, and where electrification is not extended as far as the next station, count as non-electrified lines.

Tractive Stock (B21)

B21 includes tractive units owned by the Railway, or hired by it, which it actually has at its disposal including stock under or awaiting repair, or stable in good or bad working condition.

Ideally this should include only locomotives to avoid double counting with B22. In the spreadsheet, two columns are given, one for locomotives only, and one for tractive stock (locomotives and railcars) since we understand that in the UIC data for some countries these are combined.

Tractive units are not included in these columns when they are:

- 1) leased out by the Railway
- 2) allocated for sale, scrapping or withdrawal
- 3) used exclusively inside workshops and warehouses

Passenger Transport Stock (B22)

This table only concerns railway-owned or leased transport stock. Where relevant, it contains footnotes giving details of privately-owned stock (coaches, railcars and Multiple-Unit trailing stock, vans). Situation at end of year. These columns give details of vehicles belonging to the Railway or leased by it, and actually at its disposal (including vehicles under or awaiting repair, or stabled in good or bad working order)

This should include locomotive hauled vehicles and the number of multiple unit vehicles (e.g. a two-car multiple unit should be shown as two vehicles.

These columns do not include:

- 1) vehicles hired out by the Railway
- 2) vehicles reserved exclusively for service (departmental) transport
- 3) vehicles intended for sale, scrapping or withdrawal

Freight Transport Stock (B23)

This table does not concern wagons used permanently for purposes other than the conveyance

of traffic (e.g. dormitory wagons, transformer wagons and boiler wagons). End-of-year situation.

Ideally this should include all vehicles regularly in use by the company concerned, even if owned by their customers. A separate column is included in the spreadsheet for vehicles owned by your company and by customers.

The following are included in these columns:

1) wagons belonging to the Railway, or leased by it and actually at its disposal, including wagons under or awaiting repair, or stabled in good or bad working order

2) railcars and Multiple-Unit sets fitted for the transport of parcels, even though already enumerated in Table 21, as well as their trailers

The following are not included in these columns:

- 1) wagons leased out by the Railway
- 2) wagons reserved exclusively for works traffic
- 3) wagons intended for sale, scrapping or withdrawal

Staff numbers (B31)

This table contains data on mean annual staff strength (full time equivalents).

The data relates primarily to staff bound to the Railway by an employment contract and paid directly by the Railway.

Method used for calculating the staff strength:

- 1) staff paid on the basis of a monthly or yearly salary: the actual number of units is taken
- 2) staff paid on an hourly basis: the number of units is calculated according to the number of working days taking the statutory number of daily working hours as a working day, and by taking a set number of days corresponding to the Railway's own rules of pay, as a month or year.

The mean figures are obtained by working out the arithmetical mean of the monthly figures for the 12 months of the year. Failing this, the mean staff number for the last days of the year under consideration and of the previous year is used.

For hourly-paid staff, the mean number may also be obtained directly by dividing the total number of working days by the number of paid days in a year.

Passenger / Freight Train.km (B41)

Each Railway shows all train runs performed by its own stock. Where we request this information from a train operator, please exclude operations in countries other than your main operating base where-ever possible, even if these were previously included in your return to UIC (from which our current data has been taken).

Where we request this information from an infrastructure manager, wherever possible please show separately train-km on the network by the main train operator and by other operators.

Distance lengths are recorded per mode of traction and rounded off to the nearest kilometre.

Distances covered by tractive units on shunting duty, as well as train-ferry journeys, are excluded from the table.

Distinction is made between trains assigned to passenger traffic, those assigned to freight traffic and works trains.

The term <<works trains>> is defined in UIC Leaflet 390-1 R.

Trains identified in timetables as passenger trains, freight trains or works trains depending on the prime use to which they are put, are classified directly in the relevant category. Express-parcels and mail trains are in all cases classified as freight trains.

Passenger and freight trains running empty must also be identified with the passenger train or freight-train category depending on the prime use to which they are put.

Where railcars and Multiple-Unit sets are concerned, if none of the runs performed by these vehicles falls in the "empty passenger train" <<mixed trains>> or "passenger works-train" category <<mixed trains>>, the Railway mention this fact in a footnote.

A train comprising coaches, wagons -and vans possibly -and destined for the transport of passengers and freight, is known as a mixed-consist train <<mixed trains>>.

When <<mixed trains>> cannot be classified in either the passenger transport or freight transport category, the runs made by them are computed separately, and subsequently allocated according to one of the following methods classified by order of preference:

- 1) proportionately to the passenger and freight ghtk;
- 2) proportionately to the passenger and freight vehicles or axle-km;
- 3) according to fixed coefficients.

Passenger / Freight gross hauled tonne-km (B42)

Each Railway shows the number of gross tonne-kilometres hauled by the trains included in table 41 (Passenger / Freight Train-km), according to type of traction and train category.

The number of gross tonne-kilometres hauled by any given train is obtained by multiplying the gross tonnage hauled by this train by the number of kilometres covered, allowing where applicable for modifications to the train consist occurring during the journey.

The classification rules for the different train categories are identical to those applicable for table 41. The gross hauled tonne-kilometre figure covering shunting work is not to be included in the table. The gross tonne-kilometre figure in respect of ferry-boat traffic is also to be excluded.

Revenue-earning Passengers / Revenue-earning Passenger-km (B51)

Fare-paying passengers exclusively, irrespective of the reduction rate applied.

Tickets and coupons for international through traffic issued by official sales offices and travel organisations located in countries the Railways of

which do not take part in the TCV should also be taken into account, under the same conditions.

The number of passengers is calculated according to the number of tickets sold, due account being taken of indications on the tickets regarding the number of passengers or journeys, for example

- 1) single tickets: are counted as one passenger
- 2) combined coupon tickets: each coupon is counted as one passenger
- 3) return tickets: are counted as two passengers
- 4) party tickets: the number of persons shown on the tickets is counted: this number being doubled in the case of round trips
- 5) season tickets giving access to a set number of trips over a given route: the logical number of trips accepted is taken into account

Passenger-kilometres are calculated in accordance with one of the following methods:

- 1) by multiplying the number of journeys either by the kilometric distance for each journey or by a mean kilometric distance;
- 2) by division of the receipts (for each class of travel and each type of ticket) by the corresponding kilometric rates. Railways which apply this method must allow for the different reductions in each tariff when calculating the rates applicable.

Revenue-earning Freight carried / Revenue-earning Tonne-km (B61)

This table gives the apportionment of tonnes and tonne-kilometres for rail freight traffic by traffic category. The weight taken into account is the actual weight or chargeable weight of the goods carried.

The number of tonne-kilometres is obtained by multiplying the weight (or the tare weight for empty private owners' wagons) by the charging distance. The Railway indicates the special rules (if any) applied by it in a footnote.

Revenue traffic generally includes all freight moved on behalf of third parties, and which the Railway charges for, as well as military traffic even if this does not produce any revenue, and traffic conveyed free of charge for third parties.

Works traffic is freight traffic (charged or not) carried on behalf of the Railway. However, only freight conveyed between tariff stations, or accompanied by a departmental document, is recorded as works traffic. Freight loaded or unloaded in open track (e.g. permanent way, construction or supply materials) is only included in the statistics as works traffic for transport to or from the tariff station closest to the point of loading or unloading. Finally, Railway vehicles running empty on their own wheels are not considered as works consignments.

Passenger Traffic Turnover (B72)

That is turnover generated by passenger activities. Passengers transport turnover basically consists of :

- 1) income from passengers and baggage traffic (inclusive additional revenues)

2) payments for public services obligations (EU Regulations 1191/69- 1893/91)

Freight Traffic Turnover (B72)

That is turnover generated by freight activities. Freight transport turnover basically consists of:

- 1) income from freight traffic (inclusive additional revenues)
- 2) payments for public services obligations (EU Regulations 1191/69- 1893/91)

Staff Costs, Total (B72)

Staff costs are made up of Wages and salaries plus Social security costs.

Salaries and wages are defined as "the total remuneration, in cash or in kind, payable to all persons counted on the payroll (including homeworkers), in return for work done during the accounting period" regardless of whether it is paid on the basis of working time, output or piecework and whether it is paid regularly or not. Salaries and wages include the values of any social contributions, income taxes, etc. payable by the employee even if they are actually withheld by the employer and paid directly to social insurance schemes, tax authorities, etc. on behalf of the employee. Wages and salaries do not include social contributions payable by the employer.

Employers' social security costs correspond to an amount equal to the value of the social contributions incurred by employers in order to secure for their employees the entitlement to social benefits. Social security costs for the employer include the employer's social security contributions to schemes for retirement pensions, sickness, maternity, disability, unemployment, occupational accidents and diseases, family allowances as well as other schemes. Included are the costs for all employees including homeworkers and apprentices.

Purchases of material and external services, Total (B72)

Raw material represents all the purchases of commodities used as inputs in the production process. Purchases of raw materials and consumables purchased for resale are excluded from this heading.

External services comprise outsourcing costs, property or equipment rental charges, the cost supplies that cannot be held in inventory (i.e. small items of equipment, maintenance-related items, administrative supplies, etc.), maintenance and repair work, insurance premiums, studies and research costs, external personnel charges, fees payable to intermediaries and professional expenses, advertising costs, transportation charges, travel expenses, the cost of meetings and receptions, postal charges, bank charges (i.e. not interest on bank loans, which is booked under interest expense) and other items of expenditure.

Taxes (B72)

A fee charged ("levied") by a government on a product, income, or activity.

Other operating expenses (B72)

Other operating expenses are the recurring ones which are related to the operation of a business, or a device, component, piece of equipment or facility. They include items not mentioned in columns 4-11, i.e. contractual penalties, lump sum payments, membership fees etc.

When enhancements are made to existing pieces of equipment, a value adjustment may be recorded in the Asset to reflect the improvement. A provision is defined as a liability of uncertain timing or amount. Provisions are recorded as a reserve by the enterprise in order to hedge against risks incurred in its operating and financial activities. One can distinguish between the following types of provisions:

- 1) Provision for depreciation,
- 2) Provisions for expenses to be allocated to more than one financial year: these are foreseeable expenses which cannot be fully borne during the financial year in which they are committed.
- 3) Provisions for pensions: these are expenses which may be incurred as a result of legal or contractual obligations involving staff pension rights,
- 4) Provisions for risks and expenses: these are evaluated at the balance sheet date and intended to cover risks and expenses

Depreciation and amortization (B72)

Accounting recognition of an asset's loss in value due to normal wear and tear, and foreseeable obsolescence. Depreciation usually involves distributing the value of an asset over a period corresponding to its expected useful life. Depreciation is an average or expected view of the decline in value of tangible assets. Amortization refers to expensing the acquisition cost less the residual value of intangible assets such as trademarks and copyrights in a systematic manner over their estimated useful economic lives so as to reflect their consumption, expiration, obsolescence or other decline in value as a result of use or the passage of time.

Financial expenses (B72)

Financial expenses consist of interests paid and similar charges. The interests paid correspond to the remuneration in respect of certain financial assets (deposits, bills, bonds and credits) characterised by the payment at predetermined dates of a fixed percentage of the nominal value of the financial asset. They comprise mainly of interest and related charges on debenture loans (and other types of loans), trade credit and credit of current account creditors, foreign exchange losses on debt, net expenses on the disposal of marketable securities, amortisation of bond redemption premiums, additions to provisions for financial liabilities and charges and impairment losses on investments.

D. Econometric work on costs: Technical aspects of the model

Model

The translog cost functions used here are shown as follows:

$$\begin{aligned}
 \text{(Model 1): } \ln TC = & \alpha_0 + \alpha_Y \ln Y + \sum_j \beta_j \ln w_j + \gamma_N \ln N + \tau_T T + (1/2) \alpha_{YY} (\ln Y)^2 + \sum_j \alpha_{Yj} (\ln Y) (\ln w_j) + \\
 & \alpha_{YN} (\ln Y) (\ln N) + \alpha_{YT} (\ln Y) (T) + (1/2) \sum_k \sum_j \beta_{jk} (\ln w_j) (\ln w_k) + \\
 & \sum_j \beta_{jN} (\ln w_j) (\ln N) + \sum_j \beta_{jT} (\ln w_j) (T) + (1/2) \gamma_{NN} (\ln N)^2 + \gamma_{NT} (\ln N) (T) + \\
 & (1/2) \tau_{TT} (T)^2 + f(D_i, V) + g(D_i, R) + h(D_i, CMP)
 \end{aligned} \tag{1}$$

$$\ln Y = \ln Q + \sum_f \eta_f \ln H_f \tag{2}$$

$$\begin{aligned}
 \text{(Model 2): } \ln TC = & \alpha_0 + \sum_m \alpha_m \ln Q_m + \sum_j \beta_j \ln w_j + \gamma_N \ln N + \tau_T T + (1/2) \sum_n \sum_m \alpha_{mn} (\ln Q_m) (\ln Q_n) + \\
 & \sum_j \sum_m \alpha_{mj} (\ln Q_m) (\ln w_j) + \sum_m \alpha_{mN} (\ln Q_m) (\ln N) + \sum_m \alpha_{mT} (\ln Q_m) (T) + \\
 & (1/2) \sum_k \sum_j \beta_{jk} (\ln w_j) (\ln w_k) + \sum_j \beta_{jN} (\ln w_j) (\ln N) + \sum_j \beta_{jT} (\ln w_j) (T) + \\
 & (1/2) \gamma_{NN} (\ln N)^2 + \gamma_{NT} (\ln N) (T) + (1/2) \tau_{TT} (T)^2 + f(D_i, V) + g(D_i, R) + h(D_i, CMP)
 \end{aligned} \tag{3}$$

Specifications for vertical and horizontal structures are as follows.

$$\text{(Specification 1): } f(D_i, V) = (d_{VS1} + d_{VS2} \ln V) D_{VS} + d_{HS} D_{HS} \tag{4}$$

$$\begin{aligned}
 \text{(Specification 2): } f(D_i, V) = & (d_{HC1} + d_{VS1} + d_{EF1} + d_{HC2} \ln V + d_{VS2} \ln V + d_{EF2} \ln V) D_{VS} \\
 & + d_{HS} D_{HS}
 \end{aligned} \tag{5}$$

Specifications for the effect of freight proportion are as follows.

$$\text{(Specification 1): } g(D_i, R) = (d_{RVS1} + d_{RVS2} \ln R) D_{VS} + d_{HS} D_{HS} \tag{6}$$

$$\begin{aligned}
 \text{(Specification 2): } g(D_i, R) = & (d_{RHC1} + d_{RVS1} + d_{REF1} + d_{RHC2} \ln R + d_{RVS2} \ln R + d_{REF2} \ln R) D_{VS} \\
 & + d_{HS} D_{HS}
 \end{aligned} \tag{7}$$

Specifications for competition in passenger and freight services are as follows.

$$\text{(Specification 1): } h(D_i, CMP) = d_{CP} D_{CP} + d_{CF} D_{CF} \tag{8}$$

$$\text{(Specification 2): } h(D_i, CMP) = d_{CP} CMP + d_{CF} D_{CF} \tag{9}$$

where

- TC : total cost,
- Y : output measure,
- Q : total quantity of output,
- Q_P : quantity of passenger output,
- Q_F : quantity of freight output,
- H_f : characteristics of output ($f = PR$ (passenger revenue share),
- LF (load factor of passenger service), PTL (passenger travel length), FRC (number of freight cars per train))

w_j : input factor price (j (or k) = L (labor), E (energy), M (material),
 K (capital)),

N : total route length,

T : technology (T : percentage of electrified length),

V : train density,

R : proportion of freight service

D_{HS} : horizontal (passenger-freight) separation dummy (horizontal separation = 1, otherwise = 0),

D_{CF} : freight competition dummy (freight competition =1, otherwise = 0),
 (Specification 1 for vertical structure)

D_{VS} : vertical separation dummy (vertical separation =1, otherwise = 0),
 (Specification 2 for vertical structure)

D_{HC} : holding company dummy (holding company = 1, otherwise = 0),

D_{VS} : vertical separation dummy (vertical separation =1, otherwise = 0),

D_{EF} : essential function dummy (essential function =1, otherwise = 0),

(Specification 1 for passenger competition)

D_{CP} : passenger competition dummy

(passenger competition =1, otherwise = 0),

(Specification 2 for passenger competition)

CMP : competition variable

(no competition =0, 1, 2, 3, severe competition = 4).

In these models, we impose the restriction on input factor prices such that $\sum_j \beta_j = 1$, $\sum_k \beta_{jk} = 0$, $\sum_j \beta_{jN} = 0$, $\sum_j \beta_{jT} = 0$, $\sum_j \alpha_{Yj} = 0$, $\sum_j \alpha_{mj} = 0$, $\beta_{jk} = \beta_{kj}$, $\beta_{jN} = \beta_{Nj}$, $\beta_{jT} = \beta_{Tj}$, $\alpha_{Yj} = \alpha_{jY}$, $\alpha_{YN} = \alpha_{NY}$, $\alpha_{YT} = \alpha_{TY}$, $\alpha_{mn} = \alpha_{nm}$, $\alpha_{mj} = \alpha_{jm}$, $\alpha_{mN} = \alpha_{Nm}$, $\alpha_{mT} = \alpha_{Tm}$, $\gamma_{NT} = \gamma_{TN}$. Furthermore, we apply Shephard's Lemma to the total cost function. Then we can obtain the input share equations as follows:

$$\text{(Model 1): } S_j = \beta_j + \alpha_{Yj} (\ln Y) + \sum_k \beta_{jk} (\ln w_k) + \beta_{jN} (\ln N) + \beta_{jT} T, \quad (10)$$

$$\text{(Model 2): } S_j = \beta_j + \sum_m \alpha_{mj} (\ln Q_m) + \sum_k \beta_{jk} (\ln w_k) + \beta_{jN} (\ln N) + \beta_{jT} T \quad (11)$$

where S_j : input j 's share of total cost.

As for the estimation technique, we apply the seemingly unrelated regression (SUR) method by the total cost function and the input share equations. For the estimation, we will divide all observations of each variable by the sample mean, except for time trend.

The full list of variables used, their definitions, and some sample statistics are shown in Table 20.

TABLE 20 DEFINITION OF VARIABLES USED FOR THE ESTIMATION OF COST FUNCTION

Variable	Definition	Unit	Mean	Standard Deviation
TC (Total cost)	Sum of labor, energy material and capital cost	million euro	4,454	5,888
Q (Total output)	Total train-km ⁽¹⁾	thousand km	151,502	197,690
Q_P (Passenger output)	Revenue passenger-km	thousand km	20,485	28,651
Q_F (Freight output)	Revenue tonne-km	thousand km	13,049	19,107
w_L (Wage)	Labor costs per employee	euro	42,782	21,523
w_E (Energy price)	Energy price per 1000 TOE	euro	667,324	234,704
w_M (Material price)	Material costs ⁽²⁾ per rolling stock	euro	94,035	100,477
w_K (Capital price)	Capital costs ⁽³⁾ per route length	euro	225,910	336,833
$w_{E\&M}$ (Energy & material price)	Energy and material costs per rolling stock	euro	105,864	107,549
N (Total route length)	Total route km	km	7,384	8,609
T (Technology index)	Percentage of electrified line	%	52.98	26.11
H_{PRS} (Passenger revenue share)	Share of passenger revenue to total revenue ⁽⁴⁾	-	0.7859	0.1241
H_{LF} (Load factor of passenger)	Passenger per train to capacity ⁽⁵⁾	-	0.3663	0.1308
H_{PTL} (Passenger travel length)	Revenue passenger-km per passenger	km	53.53	36.18
H_{FRC} (Average freight car)	Number of freight car per train	car	18.02	6.34
V (Train density) ⁽⁶⁾	Train-km per route length per day	-	63.35	37.18
R (Proportion of freight rev.)	Freight revenues to total revenues	%	35.75	26.42
D_{VS} (Vertical separation)	Vertical separation dummy (Vertical separation = 1)	-	0.2516	0.4344
D_{FS} (Horizontal separation)	Horizontal separation dummy (Horizontal separation = 1)	-	0.3181	0.4662
D_{HC} (Holding company)	Holding company dummy (Holding company = 1)	-	0.1060	0.3082

Variable	Definition	Unit	Mean	Standard Deviation
D_{EF} (Essential function)	Essential function dummy (Essential function = 1)	-	0.0520	0.2222
CMP (passenger competition)	Passenger competition (0= no competition, 1 ~ 4)	-	0.6071	1.0495
D_{CP} (Passenger competition)	Passenger competition dummy (Passenger competition = 1)	-	0.1497	0.3571
D_{CF} (Freight competition)	Freight competition dummy (Freight competition = 1)	-	0.2994	0.4585
S_L (Share of labor)	Share of labor input expenditure	-	0.3846	0.1199
S_E (Share of energy)	Share of energy expenditure	-	0.0505	0.0307
S_M (Share of material)	Share of material expenditure	-	0.2779	0.1064
S_K (Share of capital)	Share of capital expenditure	-	0.2871	0.1508
$S_{E\&M}$ (Share of material & capital)	Share of energy and material expenditure	-	0.3284	0.1045

Note:

- (1) Total train-km (Q) = Passenger train-km + Freight train-km
- (2) Material costs = Purchases of material and external services
- (3) Capital costs = Depreciation + Financial expenses - Infrastructure charges + Total costs of Infrastructure Manager
- (4) Passenger revenue share (HPRS) = Passenger service turnover / Passenger and freight service turnover
- (5) Load factor of passenger (H_{LF}) = Passengers per train / Capacity

Where

Capacity = Number of wagons per train * Number of seats per passenger wagon

Number of wagons per train = Passenger gross hauled tonne-km / Passenger train-km / 50 ton * 1000

Passengers per train = Revenue passenger-km / Passenger train-km * 1000

- (6) Train density (V) = Train-km/Route-km/365

The full model output for the preferred model is shown below. The variable names are set out above and also described in the main text. A summary of the estimation results that are relevant in terms of the effects of vertical separation are shown chapter 2.

TABLE 21 FULL ECONOMETRIC ESTIMATION OUTPUT FOR THE PREFERRED MODEL

Parameter	Estimate	Standard Error	Parameter	Estimate	Standard Error
QP	0.1278 ***	0.0146	QFWL	0.0348 ***	0.0057
QF	0.3572 ***	0.0258	QFWE	0.0016	0.0033
WL	0.3320 ***	0.0055	QFWM	0.0373 ***	0.0069
WE	0.0380 ***	0.0032	QFWK	-0.0737 ***	0.0054
WM	0.3113 ***	0.0069	QFN	0.1762 ***	0.0333
WEM	-	-	QFT	0.0610 ***	0.0189
WK	0.3187 ***	0.0050	WLN	-0.0982 ***	0.0087
N	0.5101 ***	0.0295	WLT	-0.0189 ***	0.0046
T	-0.0342	0.0324	WEN	-0.0161 ***	0.0048
QPQP	0.0504 ***	0.0169	WET	0.0049 *	0.0026
QFQF	-0.0251	0.0191	WMN	-0.0266 ***	0.0100
NN	-0.3325 ***	0.0619	WMT	-0.0141 **	0.0057
WLWL	0.1579 ***	0.0077	WKN	0.1409 ***	0.0079
WLWE	-0.0033	0.0033	WKT	0.0280 ***	0.0043
WLWM	-0.0541 ***	0.0053	NT	-0.1747 ***	0.0377
WLWK	-0.1006 ***	0.0050	TT	0.0039	0.0084
WEWE	0.0472 ***	0.0029	Dvs	0.0041	0.0352
WEWM	-0.0129 ***	0.0030	VDvs	0.3760 ***	0.0546
WEWK	-0.0310 ***	0.0026	RDvs	0.1222 ***	0.0368
WMWM	0.1051 ***	0.0066	DHC	-0.0546 *	0.0302
WMWK	-0.0382 ***	0.0042	VDHC	0.0391	0.0541
WkWK	0.1697 ***	0.0048	RDHC	-0.0132	0.0424
QPQF	-0.0190	0.0160	DHS	-0.2718 ***	0.0259
QPWL	0.0381 ***	0.0044	CMP	-0.0081	0.0110
QPWE	0.0120 ***	0.0027	DCF	0.0388	0.0236
QPWM	0.0057	0.0051	C0	8.8652 ***	0.0169
QPWK	-0.0557 ***	0.0040			
QPN	-0.0193	0.0226			
QP T	-0.0051	0.0209			
Log of likelihood		123.194			
Pseudo R2		0.980			
concavity condition		18.71%			
N		481			
R2 of cost share function					
S(L)		0.542			
S(E)		0.517			
S(M)		-			
S(K)		0.720			

*** Significant at 1 percent, ** 5 percent, * 10 percent.

E. Modal share analysis: table annex

This annex provides detailed tables related to chapter 3 in the main report. The first table provides descriptives of the variables used in the analysis, the second table lists the time spans and number of observations used in the analysis of the modal share.

TABLE 22 DESCRIPTIVES OF SELECTED VARIABLES

Variable	unit	#obs	mean	st dev	min	max
MS International freight	Fraction	334	0.363	0.245	0.012	0.912
MS National freight	Fraction	390	0.209	0.176	0.008	0.819
MS Passenger	Fraction	402	0.094	0.090	0.024	0.412
Rail length/km ²	km/km ²	334	0.063	0.047	0.012	0.239
Rail length/motorway length	Fraction	390	13.824	21.575	0.032	100.752
Employment/cap	Fraction	402	0.438	0.057	0.281	0.557
GDP/cap	€	402	22 883	14 393	1400	80 800

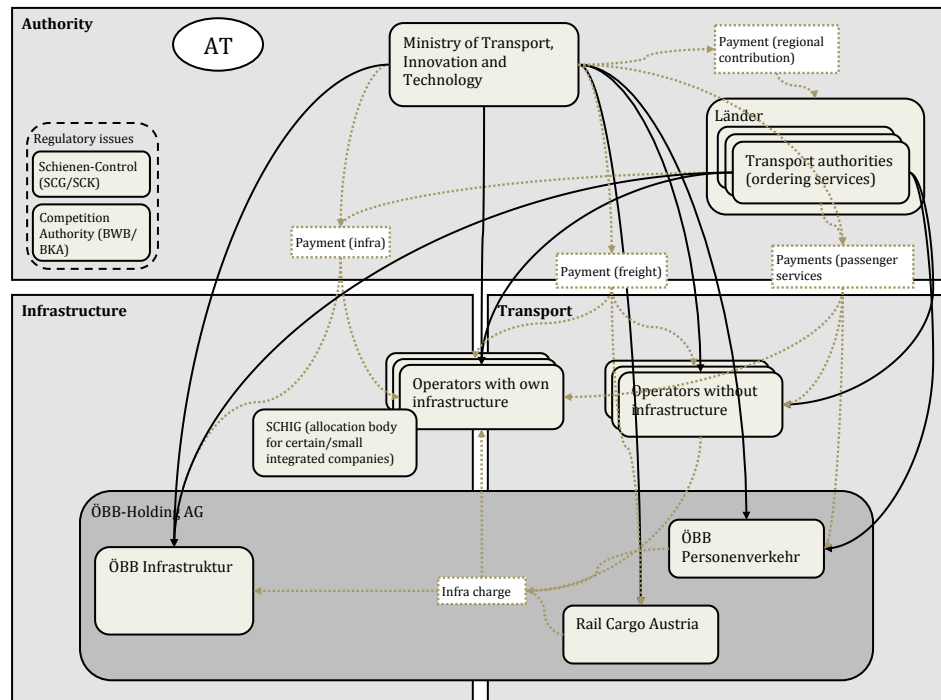
TABLE 23 OBSERVATIONS BY COUNTRY AND YEAR

Country	Int'l freight			Nat'l freight			Passengers		
	from	to	#obs	from	to	#obs	from	to	#obs
Austria	1995	2010	13	1995	2010	13	1994	2008	15
Belgium	1994	2009	16	1994	2009	16	1994	2009	16
Bulgaria	1994	2010	17	1995	2010	16	2000	2010	11
Czech Republic	1994	2009	16	1994	2009	16	1998	2010	13
Denmark	1997	2001	3	1997	2001	3	1994	2008	17
Estonia	1994	2008	14	1994	2008	14	1998	2008	11
Finland	1994	2010	16	1994	2010	17	1994	2010	17
France	1994	2009	15	1994	2009	15	1994	2010	17
Germany	1995	2010	15	1995	2010	15	1994	2009	16
Greece							1995	2008	14
Hungary	1994	2009	16	1994	2009	16	1996	2010	15
Ireland				1994	2008	15	1995	2008	14
Italy	1995	2009	15	1995	2009	15	1994	2010	17
Japan				1994	2003	10	1994	2007	14
Latvia	2007	2010	4	2007	2008	2			
Lithuania									
Luxembourg	2007	2010	4	2007	2009	3	1994	2008	15
Netherlands	1994	2010	17	1994	2007	14	1994	2008	15
Norway	1994	2010	11	1994	2010	11	1994	2009	16
Poland				1994	2010	17	1997	2009	13
Portugal							1997	2008	12
Romania	1994	2010	17	1994	2008	15	1997	2009	13
Slovakia							1998	2009	12
Spain	1995	2010	16	1994	2010	17	1994	2010	17
Sweden	1994	2010	17	1994	2009	16	1994	2009	16
Switzerland	1995	2006	12	1995	2006	12	1994	2009	16
Turkey				1994	2009	12	1994	2008	15
United Kingdom				1994	2010	17	1994	2010	17
Total observations			254			317			384

F. Country Fiches

In this section, we provide an overview of the basic structural characteristics of the national rail sectors of most countries in the European Union, plus Switzerland and Japan. This is summarised in a standardised “country fiche”, with a mix of qualitative and quantitative indicators focusing especially on the functions of the rail sector (notably which institutions control or influence them). When available, indicators relating to public sector financing have been included. This approach allows for a snapshot view of national characteristics of no more than 2 pages per country.

Austria

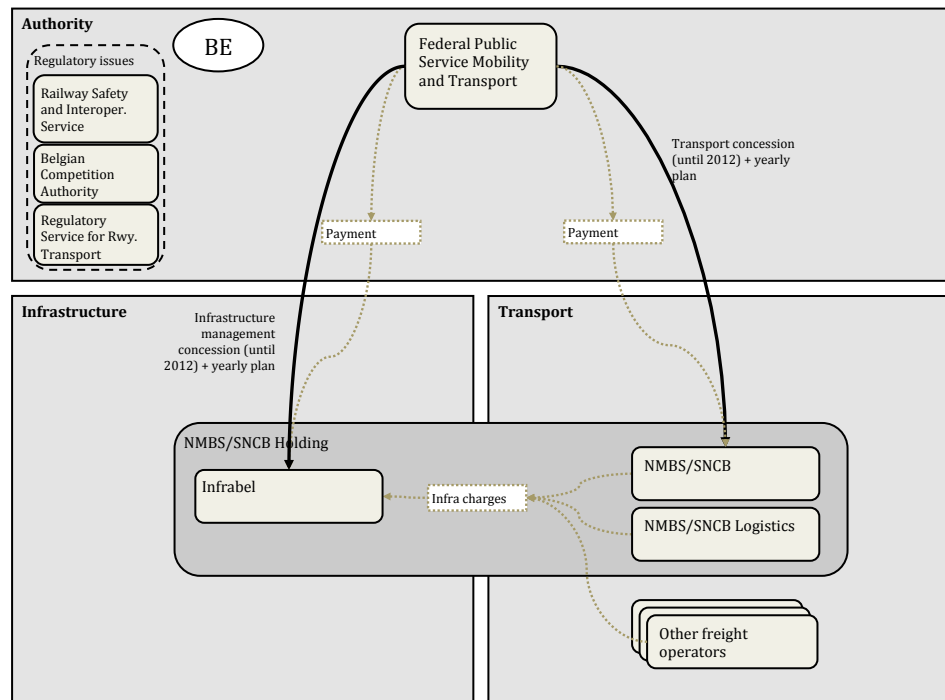


Actors	Relations
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Actors	Relations
TRANSPORT	
Long distance / national Short distance / regional	<ul style="list-style-type: none"> • ÖBB Personenverkehr AG, a shareholding company of the ÖBB Holding AG. The Republic of Austria holds 100% of its shares. • Various small integrated regional companies (e.g. GKB, Montafonerbahn, Salzburger Lokalbahn), owned by regional/national authorities. • Westbahn GmbH: major new entry (open access) on the long-distance market (Wien-Salzburg)
Freight	<ul style="list-style-type: none"> • Rail Cargo Austria AG (RCA), RCA is a shareholding company of the ÖBB Holding AG. • 18 other cargo operators.
INFRASTRUCTURE MANAGEMENT	
Planning, Designing, Building, Ownership, Maintenance	<ul style="list-style-type: none"> • ÖBB Infrastruktur AG is a shareholding company of the ÖBB Holding AG. • Various small integrated regional companies (e.g. GKB, Montafonerbahn, Salzburger Lokalbahn).
CAPACITY MANAGEMENT	
Timetabling, Path allocation, Track Access Charges determination, calculation and collection, traffic control	<ul style="list-style-type: none"> • Infrastruktur AG is providing non-discriminatory access and charging. • SCG is controlling non-discrimination.

Actors	Relations
REGULATORY BODIES	
Sectoral regulator	<ul style="list-style-type: none"> • SCG Schienen-Control GmbH (owned by the national government). • SCK Schienen-Control Kommission (special public authority).
Competition authority	<ul style="list-style-type: none"> • Bundeswettbewerbsbehörde (BWB): administrative authority, not bound by instructions, subordinated to the Bundesministerium für Wirtschaft; competent for investigation and petition. • Bundeskartellanwalt (BKA): institution located in the Bundesministerium für Justiz, bound by instructions, competent for petition and to assure the public interest and the observing of the law.
Safety and licensing	<ul style="list-style-type: none"> • Transport ministry.
Disputes, disagreements	<ul style="list-style-type: none"> • Arbitration board as organisation unit of the Schienen-Control GmbH.

Belgium



Actors

Relations

TRANSPORT

Long distance / national
Short distance / regional

- 'Nationale Maatschappij der Belgische Spoorwegen N.V. / Société Nationale des Chemins de fer Belges (NMBS/SNCB), a limited company for 99% owned by the civil service of public enterprises and the federal governmental agency Mobility and Transport. Legal Monopoly.
- The market share of NMBS/SNCB is 100%.
- The international passenger transport market is open to competition.

- NMBS/SNCB benefits from a legal monopoly for the main rail network (national services). NMBS/SNCB is also submitted to a management contract (Public Service Obligation contract) from the state, attributed by direct award for a period of 4 years (2008-2012).
- NMBS/SNCB received €927,2 million for operations and €553,9 million for investments (price level 2011).
- The regulatory body for contracting and determining specification of services is the Federal Public Service Mobility and Transport (Federale Overheidsdienst Mobiliteit en Vervoer), represented by the minister of Mobility.

Freight

- NMBS/SNCB Logistics NV/SA.
- Nine other actors are active.
- The market share of NMBS/SNCB Logistics NV is 88% (in tonne kilometres).

- Open access.
- There is no authority responsible for contracting and defining specification of services.

INFRASTRUCTURE MANAGEMENT

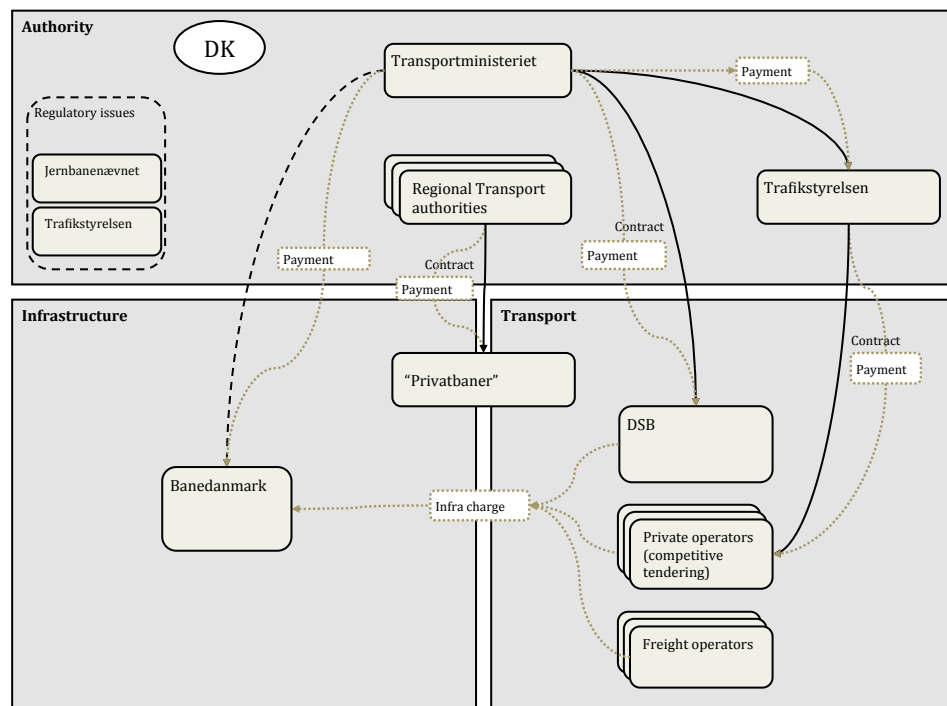
Planning, Designing,
Building, Ownership,
Maintenance

- All tracks are owned by a public enterprise called Infrabel.
- The main actor responsible for infrastructure planning, designing, building and maintenance of the rail network in Belgium is Infrabel.

- Infrabel is authorized by the federal governmental agency Mobility and Transport, represented by the minister of Mobility.
- Infrabel and the Federal Public Service Mobility and Transport agreed a management contract for the period between 2008-2012.
- In 2011 Infrabel received a total amount of €175.5 million for all the infrastructure operations and developments and an amount of €630.9 million for investments in the rail network by the federal governmental agency Mobility and Transport.
- Infrabel and the Belgian State agreed a service maintenance contract which is evaluated each year.

Actors		Relations
CAPACITY MANAGEMENT		
Timetabling, Path allocation, Track Access Charges determination, calculation and collection, traffic control	<ul style="list-style-type: none"> Infrabel is responsible for timetabling, path allocation, collecting of track access charge and traffic control. Based on consultation with the train- and cargo operators, Infrabel NV divides the capacity on the rail network under the various freight and passenger carriers. 	<ul style="list-style-type: none"> Detailed timetables are developed and submitted to Infrabel. Entrance to the rail network is based on allocating slots by Infrabel. Charging rules are regulated and controlled by the Ministry of Economy.
REGULATORY BODIES		
Sectoral regulator	<ul style="list-style-type: none"> Regulatory Service for Railway Transport and for Brussels Airport Operations (Dienst Regulering van het Spoorwegvervoer en van de Exploitatie van luchthaven Brussel-Nationaal). 	<ul style="list-style-type: none"> Regulatory Service for Railway Transport is hosted by the Federal Public Service Mobility and Transport. It is however no hierarchical part of this administration and funded by the railway sector.
Competition authority	<ul style="list-style-type: none"> Belgian Competition Authority (Belgische Mededingingsautoriteit). 	<ul style="list-style-type: none"> Agency of Ministry of Economy.
Safety and licensing	<ul style="list-style-type: none"> Railway Safety and Interoperability Service (Dienst Veiligheid en Interoperabiliteit van de Spoorwegen, DVIS). 	<ul style="list-style-type: none"> Autonomous body, funded by the railway sector.
Disputes, disagreements		

Denmark



Actors	Relations
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TRANSPORT

<p>Long distance / national</p>	<ul style="list-style-type: none"> Danske Statsbaner (DSB), a public company, 100% owned by the state via the Ministry of Transport. 	<ul style="list-style-type: none"> Open access and public service traffic based on contracts that can be tendered or directly awarded by decision of the Transport Minister. DSB has a directly-awarded contract for the transport of passengers on the Intercity train and local train network for a period of 10 years (2005-2014). The Ministry of Transport retains direct responsibilities for negotiated contracts.
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<p>Short distance / regional</p>	<ul style="list-style-type: none"> DSB, Arriva (owned by the German State) and DSB Øresund. Arriva and DSB Øresund (both tendered contracts) have a total market share of appr 25% (train-km) of the regional traffic. Several regional lines ("Privatbaner", the so-called "private railways") owned mainly by the regional transport authorities. 	<ul style="list-style-type: none"> The tendered contracts have been under the responsibility of Trafikstyrelsen. The "Privatbaner" are under contract with their respective regional transport authority.
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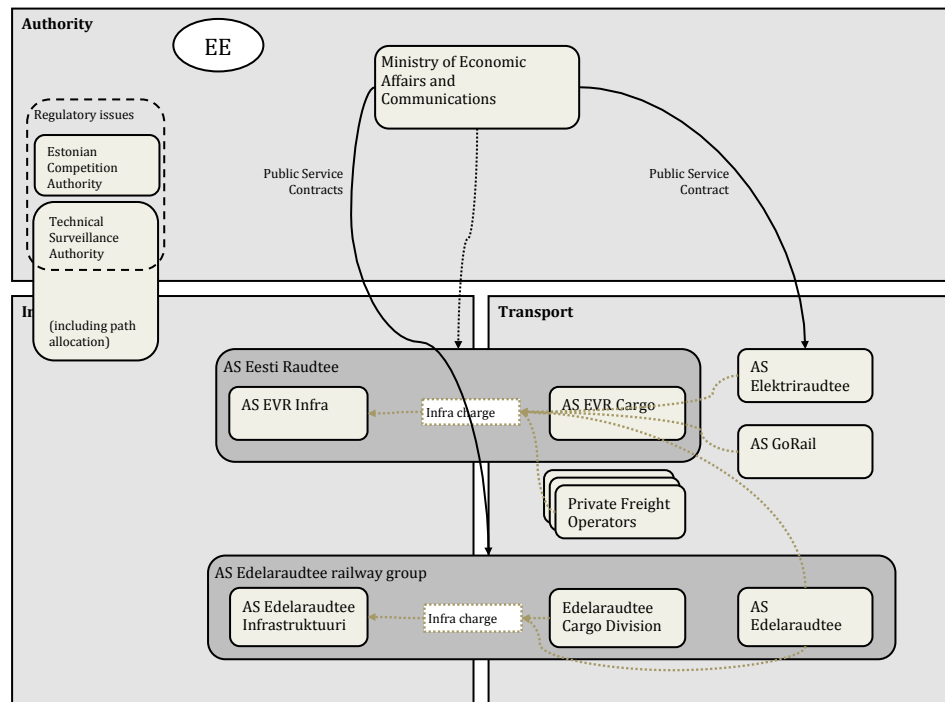
<p>Freight</p>	<ul style="list-style-type: none"> DB Schenker, Green Cargo and others (also regional operators). 	<ul style="list-style-type: none"> Open access.
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INFRASTRUCTURE MANAGEMENT

<p>Planning, Designing, Building, Ownership, Maintenance</p>	<ul style="list-style-type: none"> Banedanmark, a national agency under the Ministry of Transport. 	<ul style="list-style-type: none"> Banedanmark was integrated into the Ministry as a national agency in 2008. The annual payment from the state to Banedanmark for management, maintenance, and renewal of the rail infrastructure plus new investments is appr 550 mio€ In 2009 the Danish government approved funding of €3.3 billion over several years (till 2021) to Banedanmark for investments in new signaling (ERTMS).
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Actors		Relations
CAPACITY MANAGEMENT		
Timetabling, Path allocation, Track Access Charges determination, calculation and collection, traffic control	<ul style="list-style-type: none"> Banedanmark. 	
REGULATORY BODIES		
Sectoral regulator Disputes, disagreements	<ul style="list-style-type: none"> Jernbanenævnet (Danish Rail Regulatory Body). 	<ul style="list-style-type: none"> Independent national authority under the Ministry of Transport.
Competition authority	<ul style="list-style-type: none"> Jernbanenævnet (Danish Rail Regulatory Body). 	<ul style="list-style-type: none"> Independent national authority under the Ministry of Transport.
Safety and licensing	<ul style="list-style-type: none"> Trafikstyrelsen (Danish Transport Authority). 	<ul style="list-style-type: none"> National agency under the Ministry of Transport.

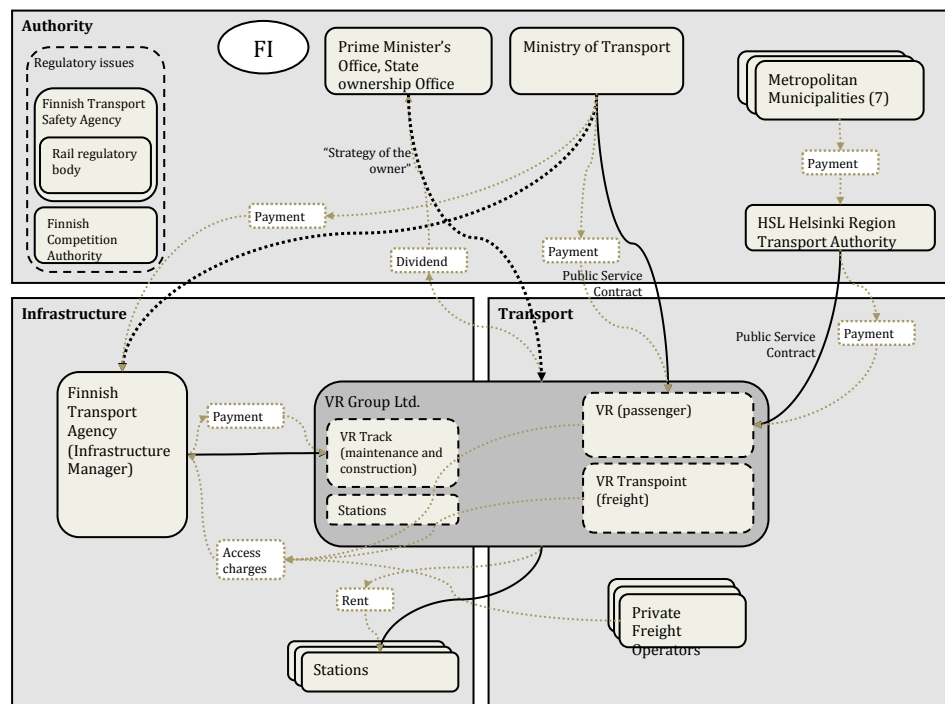
Estonia



Actors	Relations	
TRANSPORT		
Long distance / national	<ul style="list-style-type: none"> AS Edelaraudtee, part of the Edelaraudtee railway group (a private company), operates the passenger services from Tallinn to Narva, Orava, and Valga. over lines belonging to EVR. GoRail, part of the GoGroup, a private company. It operates an international train to Moscow. 	<ul style="list-style-type: none"> Open access. There are 2 Public Service Contracts between the Ministry of Economic Affairs and Communications and Edelaraudtee, one for operations on Edelaraudtee's own network and one for operations on the network of EVR Infra.
Short distance / regional	<ul style="list-style-type: none"> AS Elektriraudtee, a company directly owned by the Ministry of Economic Affairs and Communications, operates the electric lines around Tallinn. 	<ul style="list-style-type: none"> Elektriraudtee operates services on infrastructure of EVR Infra.
Freight	<ul style="list-style-type: none"> AS EVR Cargo, Edelaraudtee cargo division, and various other operators. EVR Cargo is part of AS Eesti Raudtee, a public company 100% owned by the State, and operates cargo services on it's the infrastructure of EVR Infra. 	<ul style="list-style-type: none"> Open access.
INFRASTRUCTURE MANAGEMENT		
Planning, Designing, Building, Ownership, Maintenance	<ul style="list-style-type: none"> AS EVR Infra, part of AS Eesti Raudtee, owns about 80% of the railway infrastructure. AS Edelaraudtee Infrastruktuuri, part of the Edelaraudtee group, owns about 20% of the railway infrastructure. 	
CAPACITY MANAGEMENT		
Timetabling, Track Access Charges collection, traffic control	<ul style="list-style-type: none"> AS EVR Infra. AS Edelaraudtee Infrastruktuuri. 	
Path allocation, Track Access Charges determination	<ul style="list-style-type: none"> The Technical Surveillance Authority determines the access charges and is the independent path allocator. 	<ul style="list-style-type: none"> Technical Surveillance Authority is an independent regulator under jurisdiction of the Ministry.

Actors	Relations
REGULATORY BODIES	
Sectoral regulator Disputes, disagreements	<ul style="list-style-type: none"> • Technical Surveillance Authority.
Competition authority	<ul style="list-style-type: none"> • Estonian Competition Authority.
Safety and licensing	<ul style="list-style-type: none"> • Estonian Competition Authority, issues activity licenses. • Technical Surveillance Authority, issues safety certificates.

Finland

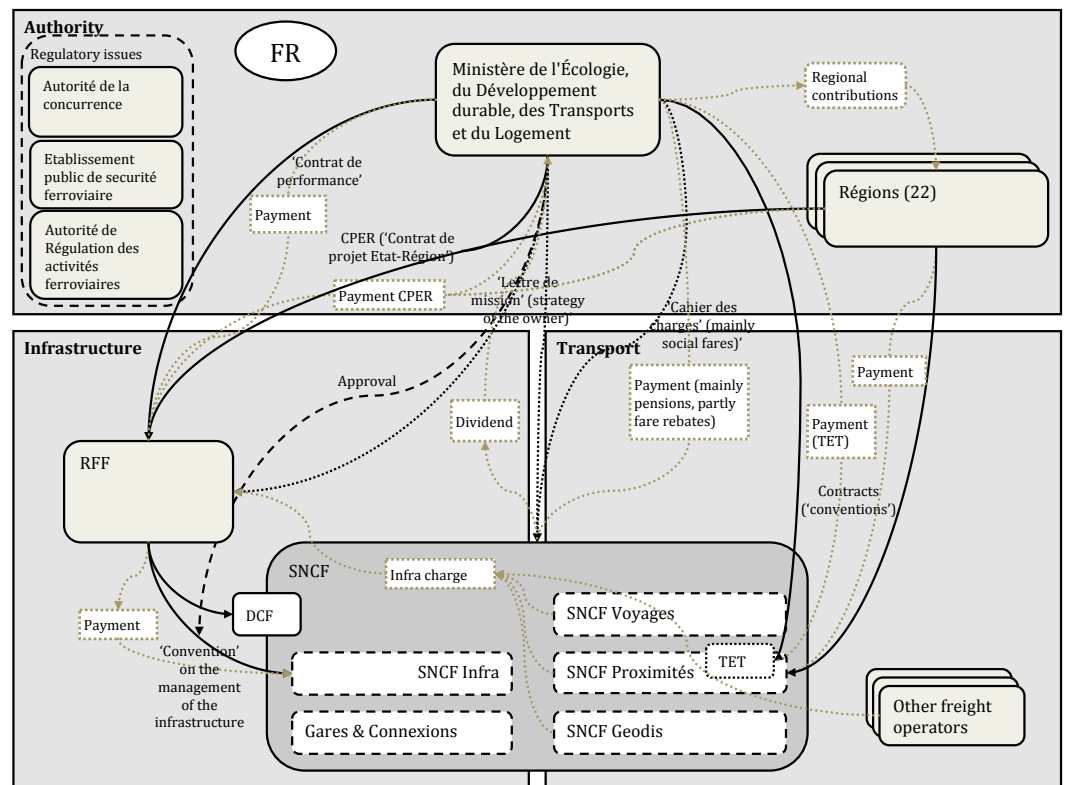


Actors	Relations
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Actors	Relations
TRANSPORT	
<p>Long distance / national</p>	<ul style="list-style-type: none"> • VR, part of the VR Group Ltd., a public company 100% owned by the State . • VR has a market share of 100%.
<p>Short distance / regional</p>	<ul style="list-style-type: none"> • Direct award of contract with exclusive rights. • VR has the exclusive right for transport of passengers on the Intercity train and local train network. • The responsible authority for contracting and specification of services is the Ministry of Transport. • The Ministry of Transport compensates VR for public services.
<p>Freight</p>	<ul style="list-style-type: none"> • VR covers all transport services for 7 metropolitan municipalities. • VR has a market share of 100%. • Direct award. • The responsible authority for contracting and specify services is the Helsinki Region Transport Authority (HSL). • Payments are done by HSL, based on a Public Service Obligation with VR.
INFRASTRUCTURE MANAGEMENT	
<p>Planning, Designing, Building, Ownership, Maintenance</p>	<ul style="list-style-type: none"> • VR Transpoint, part of the VR Group Ltd., a public company 100% owned by the State. • Various other freight operators. • VR Transpoint has a market share of 100%. • Open access. • A government authority under the Ministry of Transport, partly funded by the State. • Building and maintenance of the infrastructure is contracted by the Finnish Transport Agency. • Contract payments for maintenance and construction are done by the Finnish Transport Agency.

Actors		Relations
CAPACITY MANAGEMENT		
Timetabling, Path allocation, Track Access Charges determination, calculation and collection, traffic control	<ul style="list-style-type: none"> • Timetabling is done within the VR group. • The Finnish Transport Agency allocates paths. • Track access charges are determined by governmental decree. • Calculation of the charge is done by VR Track. VR Track also is in charge of traffic control on behalf of the Finnish Transport Agency.. 	<ul style="list-style-type: none"> • Services of VR Track are paid for by the Finnish Transport Agency.
REGULATORY BODIES		
Sectoral regulator Disputes, disagreements	<ul style="list-style-type: none"> • The Rail regulatory body, part of the Finnish Transport Safety Agency (TraFi). 	<ul style="list-style-type: none"> • TraFi falls under authority of the Ministry of Transport.
Competition authority	<ul style="list-style-type: none"> • The Rail regulatory body. • Issues that are not specifically mentioned by the EU-legislation to be responsibility of the Rail regulatory body are done by the Finnish Competition Authority. 	
Safety and licensing	<ul style="list-style-type: none"> • Finnish Transport Safety Agency (TraFi). 	

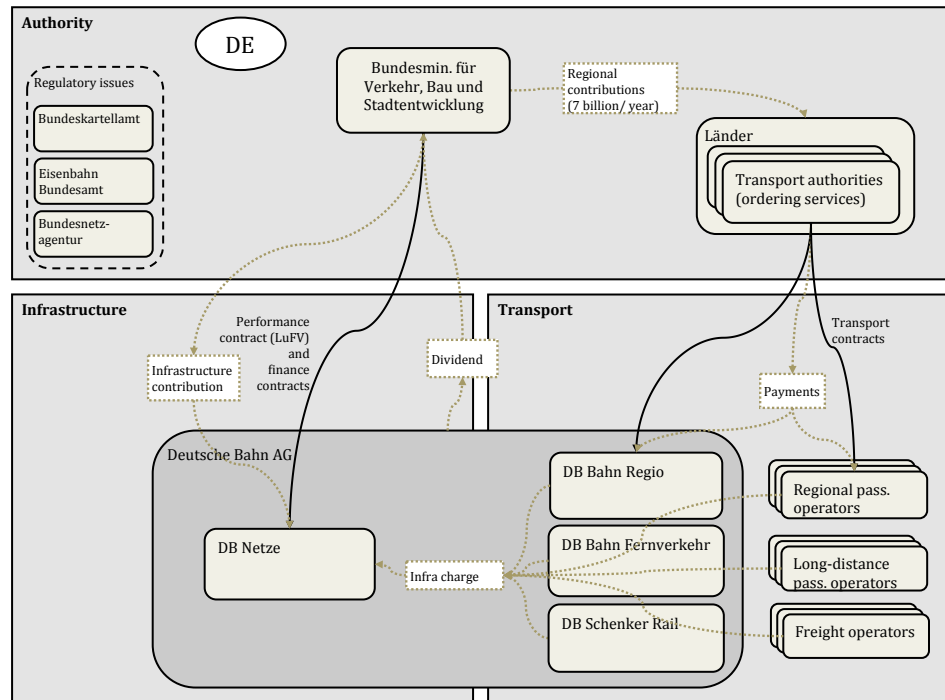
France



Actors		Relations	
TRANSPORT			
Long distance / national	<ul style="list-style-type: none"> • Société Nationale des Chemins de fer Français (SNCF), 100% state owned company . • The market share of SNCF is close to 100%. • Eurostar operates services towards London. Thello (Veolia/Trenitalia) operates a night train to Italy. 	<ul style="list-style-type: none"> • SNCF has a legal monopoly for national services. • The Ministry of Ecology, Energy, Sustainable Development and Planning is the regulatory body for contracting and determining the specification of services. • The SNCF paid a dividend of €199 million to the state in 2011. 	
Short distance / regional	<ul style="list-style-type: none"> • SNCF is the only rail operator for regional-/ short distance passenger transport. 	<ul style="list-style-type: none"> • Direct award. • The state and regions share this role; the state partly delegated this role to the French regions, which are the contracting authorities for the regional rail services. • In 2010 the State allocated a 3-year public service contract to SNCF for the TET services (regional/long-distance services). • According to the French Court of audit, on a 10-year average, 70% of the funds come from regional authorities and 30% from passenger revenues. 	
Freight	<ul style="list-style-type: none"> • Various freight operating companies (shareholding companies and private companies) including: SNCF Geodis, B-Cargo, CFL-Cargo, Euro Cargo, Europorte France,... In total 21 RUs hold a security certificate for rail operations • SNCF Geodis has a marketshare of 70%. 	<ul style="list-style-type: none"> • Open access. • No responsible authority. 	
INFRASTRUCTURE MANAGEMENT			
Planning, Designing, Building, Ownership, Maintenance	<ul style="list-style-type: none"> • All tracks are owned by Réseau Ferré de France (RFF), a public enterprise (établissement public industriel et commercial). • RFF is responsible for designing and building the infrastructure. • RFF is also by law responsible for maintenance but the maintenance is contracted to SNCF or other actors. 	<ul style="list-style-type: none"> • Enhancements of infrastructure on closed lines and new developments are attributed by competitive tendering. • The task of infrastructure design can be delegated by RFF to SNCF or other private companies. • Investments with own capital €1.9 billion (2010). • In 2010 local authorities financed €93 million for investments in (new) infrastructure. (CPER; Contrat de Plan Etat-Région.) 	

Actors		Relations
CAPACITY MANAGEMENT		
Timetabling, Path allocation, Track Access Charges determination, calculation and collection, traffic control	<ul style="list-style-type: none"> RFF. Traffic control and timetabling is delegated to Direction des Circulations Ferroviaires (DCF). 	<ul style="list-style-type: none"> Establishment of DCF as an independent part of SNCF, under the sole control of RFF. ARAF (National regulatory body) gives its opinion about RFF's proposal concerning track access charges and also controls the calculation of access charges for specific services. In 2010 € 746 million was paid in track access charges.
REGULATORY BODIES		
Sectoral regulator Disputes, disagreements	<ul style="list-style-type: none"> Autorité de Régulation des Activités Ferroviaires (ARAF). 	<ul style="list-style-type: none"> ARAF cooperates with the Competition Authority on various issues. ARAF has financial autonomy through the benefit of a tax on the rail track access charges.
Competition authority	<ul style="list-style-type: none"> Autorité de la concurrence. 	<ul style="list-style-type: none"> Independent public body. The "Autorité de la concurrence" communicates to ARAF any referral dealing with ARAF competences and can ask ARAF for opinion on any question regarding railway matters.
Safety and licensing	<ul style="list-style-type: none"> Etablissement public de sécurité ferroviaire (EPSF). 	<ul style="list-style-type: none"> Administrative public body acting on behalf of the Ministry of Ecology, Energy, Sustainable Development and Planning with financial and management autonomy. ARAF can give an opinion of a complaint against discriminatory treatment by EPSF. EPSF collects a tax on the rail track access charges.

Germany

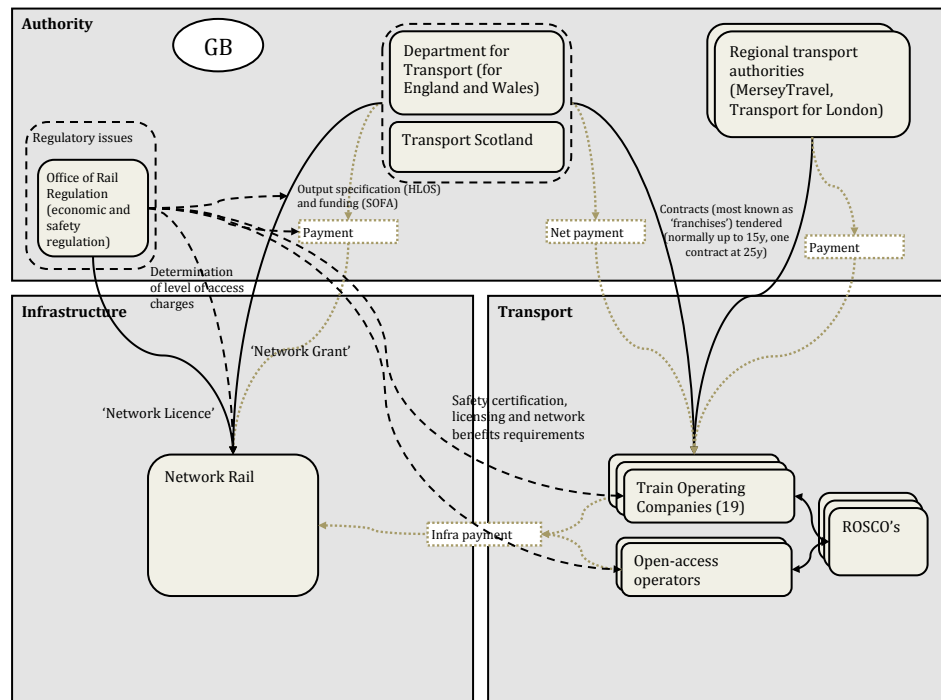


Actors Relations

Actors	Relations
TRANSPORT	
Long distance / national	<ul style="list-style-type: none"> • Deutsche Bahn Fernverkehr, public limited company owned by Deutsche Bahn AG (100% state owned). • Competitors market share is less than 1% based on traffic-performance (passenger-km).
Short distance / regional	<ul style="list-style-type: none"> • Open access. • No authority is responsible. Long-distance passenger transport is provide on a purely commercial basis. • Deutsche Bahn AG paid a dividend of €525 million to the state in 2011.
Freight	<ul style="list-style-type: none"> • Currently 5 limited companies; DB Regio, Veolia, Transdev, Netinera, BeNEX and Keolis (SNCF). • Entrant operators owns a market share of 25% based on traffic performance (passenger-km). • Open access. • Competition for the market for Public Service Obligation (PSO) is based on 'Direct award'. • Proportion of train-km awarded in the year 2010 through competitive tendering: 37%. • Public Transport authorities are appointed by regional government (Länder). The Public Transport authorities order and pay for the transport services. • In 2010 the Public Transport authorities contributed a total amount of €4.370 million to the regional train operators. • Great variety of working models across "Länder".
INFRASTRUCTURE MANAGEMENT	
Planning, designing, ownership and maintenance	<ul style="list-style-type: none"> • 4 Main actors; DB Schenker, SBB Cargo, Captrain (SNCF) , TX Logistics (Trenitalia). • Market entrants own a market share of 26% based on traffic performance (freight-km). • Budesministerium für Verkehr, Bau un Stadenentwicklung (Ministry of Transport, building and city planning) is responsible for the infrastructure planning (based on federal transport infrastructure plan). • Mainly the Deutsche Bahn Netz AG is owner and responsible for designing the infrastructure. • Some train operators do have their own infrastructure and therefore are responsible for designing their own infrastructure. • Budesministerium für Verkehr, Bau und Stadenentwicklung makes a cost-benefit-analysis based on macroeconomic perspectives and determinates priorities for infrastructure managers and concludes a finance contract with responsible infrastructure manager. • Maintenance is fully financed from own funds by the infrastructure manager. • Train and freight operators deliver input to cost-benefit-analysis (esp. transport demand prognosis).

	Actors	Relations
Building	<ul style="list-style-type: none"> Deutsche Bahn Netz AG. 	<ul style="list-style-type: none"> Deutsche Bahn Netz AG has a profit & loss transfer agreement with Deutsche Bahn AG. Investments in new infrastructure are subject to individual contracts. Replacement investments are subject of a multiannual contract; The Performance and Financing Agreement ("LuFV"), signed by DB infrastructure companies and the Federal Government, the contract provides public financing with a volume of €2.5 billion per year until 2013. Smaller investments grants are provided by regional bodies, EU or the Federal economic stimulus programs.
CAPACITY MANAGEMENT		
Timetabling, Path allocation, Track Access Charges determination, calculation and collection, traffic control	<ul style="list-style-type: none"> Deutsche Bahn Netz AG. 	<ul style="list-style-type: none"> Path allocation is regulated by Bundesnetzagentur (BNetzA), access is provided under private contracts between Deutsche Bahn Netz and Rail-/ Freight Operators. BNetzA examines both the processes and the results of train timetable scheduling. Deutsche Bahn Netz AG is subject to legal charging rules and is under regulatory control by BNetzA. Infrastructure access is regulated by BNetzA. Coordination between traffic control staff of DB Netz.
REGULATORY BODIES		
Sectoral regulator	<ul style="list-style-type: none"> Bundesministerium für Verkehr, Bau und Stadtentwicklung. 	<ul style="list-style-type: none"> Responsible for defining, laws and policy according the railway sector.
Competition authority	<ul style="list-style-type: none"> Bundeskartellamt. 	<ul style="list-style-type: none"> Independent public entity, reports to the Ministry of Economics.
Safety and licensing	<ul style="list-style-type: none"> Eisenbahnbundesamt (EBA). 	<ul style="list-style-type: none"> Public entity, Independent authority under supervision of the Ministry of Transport. Supervisory and authorising authority for Train-/ Freight Operators and for Infrastructure companies.
Disputes, disagreements	<ul style="list-style-type: none"> Bundesnetzagentur (BNetzA). 	<ul style="list-style-type: none"> Independent authority, legal oversight by Ministry of Economics, technical oversight by Ministry of Transport.

Great Britain (excluding Northern Ireland)

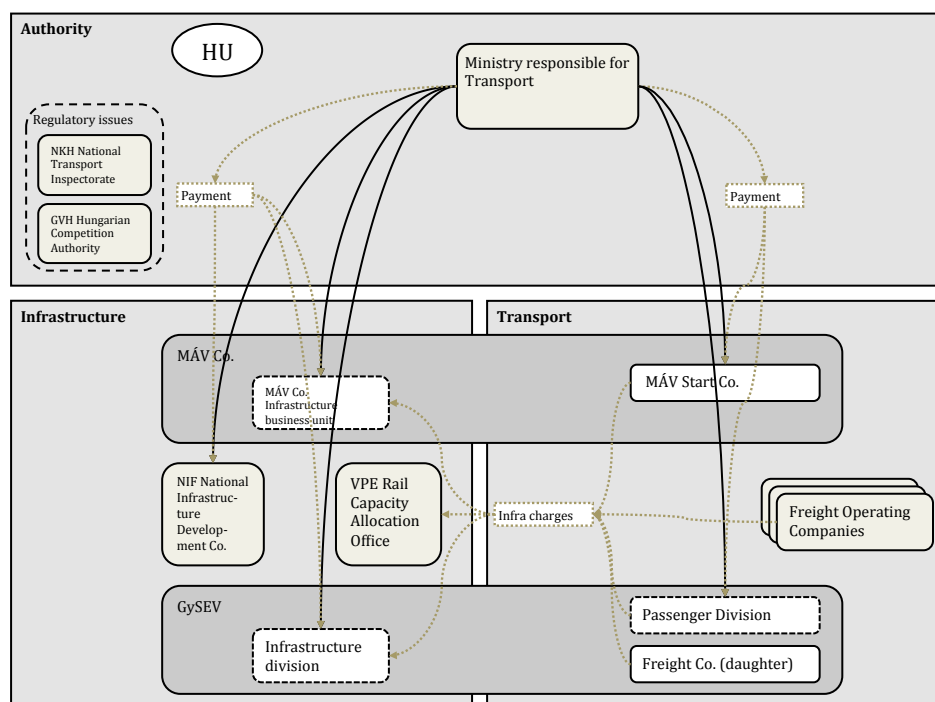


Actors	Relations
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Actors	Relations
<p>TRANSPORT</p> <p>Long distance / national Short distance / regional</p>	<ul style="list-style-type: none"> • 19 Private operators (shareholding companies) provided passenger services throughout the country based on contracts known as 'franchises'. • Various open access operators. • Rolling stock is leased to passenger operating companies by private rolling stock companies (Rosco's). <ul style="list-style-type: none"> • Mainly competitively tendered contracts (most known as 'franchises'). These are let for periods ranging from short periods up to 25 years. • Department for Transport is the authority responsible for contracting, determining the specification of services and monitoring in England and Wales. Transport Scotland (the national transport agency for Scotland) is responsible for Scotland. The regional transport authorities 'MerseyTravel' and 'TfL - Transport for London' are responsible for contracting and determining the conditions for Merseyside and London. • Open access services: access is limited and regulated by the ORR. • Total track access charges paid by train- and freight operators to the infrastructure manager in 2011 was £1.6 billion.
<p>Freight</p>	<ul style="list-style-type: none"> • Four main freight operating companies (shareholding companies and private companies). <ul style="list-style-type: none"> • Open access.
<p>INFRASTRUCTURE MANAGEMENT</p> <p>Planning, Designing, Building, Ownership, Maintenance</p>	<ul style="list-style-type: none"> • Most tracks are owned by Network Rail, a special public enterprise ('not for dividend' company, limited by guarantee). A small but not insignificant mileage is owned by TfL (London Underground infrastructure). • The main actor responsible for the infrastructure planning, designing, and building of the rail network in Great Britain is Network Rail. <ul style="list-style-type: none"> • The Office of Rail Regulation monitors Network Rail's performance, based on a 'Network Licence'. • The relationship with train- and freight operators is based on a contractual level. • Total government funding for operations and investments by Department for Transport (Office of Rail Regulation) over the year 2011; £3.66 billion.

Actors	Relations
CAPACITY MANAGEMENT	
Timetabling, Path allocation, Track Access Charges determination, calculation and collection, traffic control	<ul style="list-style-type: none"> • Network Rail allocates the path allocation, timetabling, calculation & collecting of track access charge, and for traffic control in Great Britain. • Track access charges are collected via contractual arrangements. • Performance schemes exist between train operators and Network Rail.
REGULATORY BODIES	
Sectoral regulator, Safety and licensing	<ul style="list-style-type: none"> • Office of Rail Regulation, a statutory board which is the combined economic and safety regulatory authority. • The Office of Rail Regulation has competition enforcement powers. • It is funded through the licensing of the train operators.
Competition authority	<ul style="list-style-type: none"> • Office of Rail Regulation. • Carries out functions of the UK Competition Authority (OFT). • The Office of Rail Regulation is funded through the licensing of the train operators.
Disputes, disagreements	<ul style="list-style-type: none"> • Office of Rail Regulation. • Sets up control documents (Network Code). 'The Network Code' is amended by the Class Representative Committee (e.g. representing NR and operators) and subject to approval by ORR. Disputes initially go through an dispute resolution process heard by an industry committee with final appeal to the ORR

Hungary

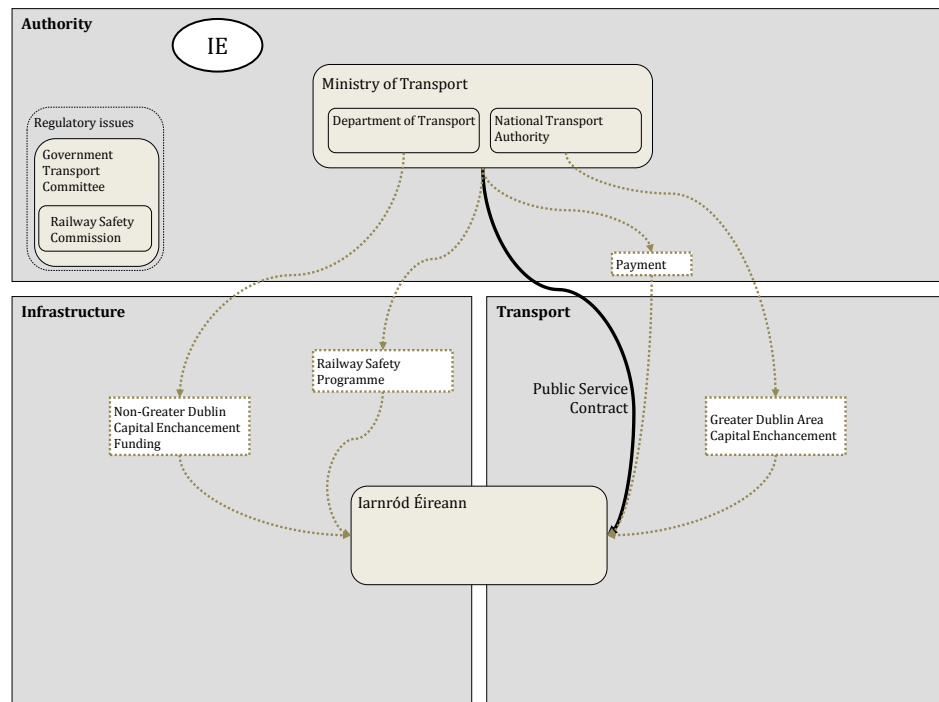


Actors	Relations
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Actors	Relations
TRANSPORT	
Long distance / national Short distance / regional	<ul style="list-style-type: none"> • MÁV-START Co. (passenger operator), a public company 100% owned by MÁV Co. (itself owned by the Hungarian state). • Győr-Sorpon-Ebenfurti Vasút Zrt (GySEV Passenger Unit), a shareholding company owned by the Hungarian and Austrian state and a private actor.
Freight	<ul style="list-style-type: none"> • Legal monopoly / direct award. • GySEV/MAV-Start Co.(pasenger operator) have the exclusive right for the transport of passengers on the intercity train and local train network. • Payment from state based on Public Service Obligation (PSO). • The responsible authority for contracting and specify services is the Ministry responsible for Transport
INFRASTRUCTURE MANAGEMENT	
Planning	<ul style="list-style-type: none"> • Open access.
Designing and building	<ul style="list-style-type: none"> • Ministry responsible for Transport. • Contractual relationship with Infrastructure Manager. • Funds from State budget and the European Union.
Maintenance	<ul style="list-style-type: none"> • National Infrastructure Development Co. (NIF) and Hungarian IMs (MÁV Co. and GySEV). • For designing; contractual relationship with Ministry responsible for Transport. • For building; contractual relationship with private companies. • Funds from state budget and the European Union.
Ownership	<ul style="list-style-type: none"> • The Infrastructure Manager of MÁV and GySEV. • Contractual relationship with National Transport Inspectorate. • Funds from state budget and railway undertakings.
Ownership	<ul style="list-style-type: none"> • National Asset Holding. • Contractual relationship with Ministry responsible for Transport.

Actors		Relations
CAPACITY MANAGEMENT		
Timetabling, Path allocation, Track Access Charges determination and calculation	<ul style="list-style-type: none"> VPE Rail Capacity Allocation Office, a special public enterprise. 	<ul style="list-style-type: none"> Regulatory body is involved in the supervision phase. Funded by state budget and IMs (MÁV Co. and GySEV).
Track Access Collection and Traffic control	<ul style="list-style-type: none"> IMs of GySEV and MÁV Co. 	<ul style="list-style-type: none"> Access charges collected by the IMs. Contractual relationship with Ministry responsible for Transport. Funded via track access charges and state budget.
REGULATORY BODIES		
Sectoral regulator, Safety and licensing, Disputes, disagreements	<ul style="list-style-type: none"> Nemzeti Közlekedési Hatóság (NKH), National Transport Inspectorate. 	<ul style="list-style-type: none"> Independent agency of government Funded by state budget and market players.
Competition authority	<ul style="list-style-type: none"> Gazdasági Versenyhivatal (GVH), Hungarian Competition Authority. 	<ul style="list-style-type: none"> Independent agency of government. Funded by state budget.

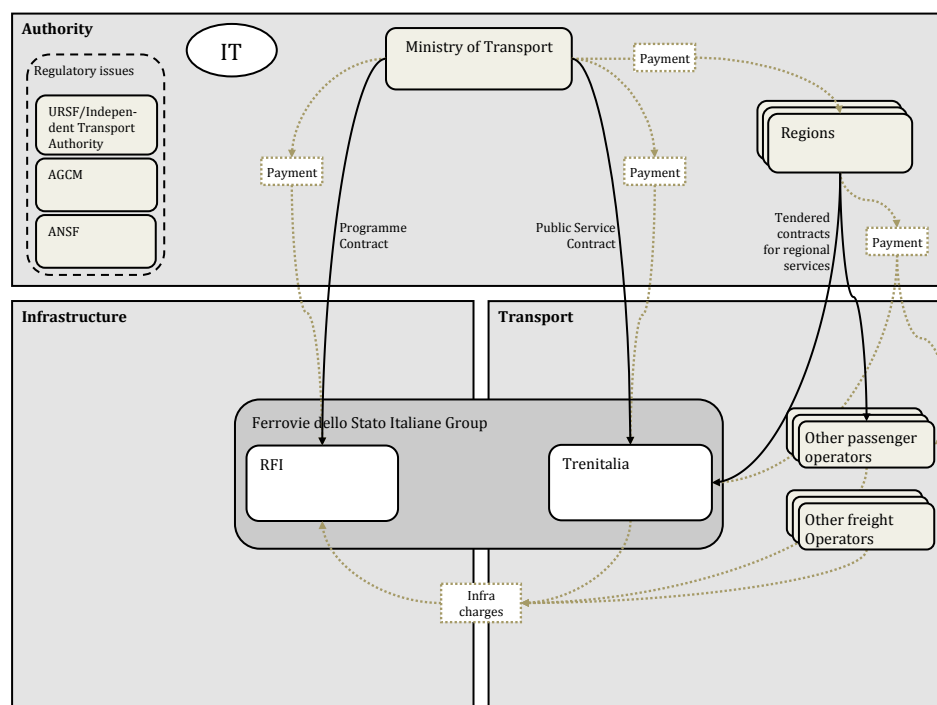
Ireland



Actors	Relations
TRANSPORT	
Long distance / national Short distance / regional	<ul style="list-style-type: none"> Iarnród Éireann (Irish Rail) a subsidiary company of a State-owned company, Coras Iompair Éireann (CIÉ). It operates passenger services nationwide and commuter rail services. Direct award of Public Service Contract. Iarnród Éireann falls under the remit of the Department of Transport, Tourism and Sport. Subvention by the Ministry of Transport, Tourism and Sport, payment under the Public Service Contract.
Freight	<ul style="list-style-type: none"> Iarnród Éireann (Irish Rail), Iarnród Éireann has a market share of 100%. Open access. The Department of Transport, Tourism and Sport is responsible for contracting and specification of services.
INFRASTRUCTURE MANAGEMENT	
Planning, designing, ownership, maintenance and building.	<ul style="list-style-type: none"> Iarnród Éireann (Irish Rail). Iarnród Éireann is an integrated rail company providing both the infrastructure manager activities and railway undertaking service provision. Some maintenance activities is done by external contracting via Iarnród Éireann. Agreement on Infrastructure development is reached with Department of Transport or National Transport Authority for the Greater Dublin Area. Maintenance and renewal of infrastructure is funded by the National Transport Authority. Funding for new passenger extensions via the National Transport Authority. Maintenance is funded under Transport 21 Capital Investment Framework.
CAPACITY MANAGEMENT	
Timetabling, Path allocation, Track Access Charges determination, calculation and collection, traffic control	<ul style="list-style-type: none"> Iarnród Éireann. Under supervision of the Department of Transport. Track access charges rules are developed and implemented on an accounting basis by Iarnród Éireann. Allocation of charges is done on an accounting basis only.

Actors	Relations
REGULATORY BODIES	
Sectoral regulator, Competition authority Disputes, disagreements	<ul style="list-style-type: none"> As the Member state is in receipt of a derogation there is no current requirement for an independent regulator.
Safety and licensing	<ul style="list-style-type: none"> Railway Safety Commission, part of the Government Transport Committee.. An independent regulatory agency of the Ministry of Transport, Tourism and Sport. Has a safety regulatory role, including licensing as infrastructure manager and railway undertaking.

Italy



Actors Relations

TRANSPORT

Long distance / national

- Trenitalia S.p.A. part of the Ferrovie dello Stato Italiane Group (a public shareholding company 100% owned by Ministry of Economy).
- In April 2012 a private company called Nuovo Trasporto Viaggiatori (NTV, operating under .italo and owned by private Italian investors and for 20% by SNCF) entered the market to connect major Italian cities with high-speed services. In 2015 NTV wants to reach a market share of 20% in terms of train-km.
- A joint venture between ÖBB, DB en LeNord operates international train services with cabotage on the Italian side.

- Open access with reciprocity clause.
- The Ministry of Transport provides a national public service contract and specifies services with rail operator(s).
- In 2010 €267 million was provided by the Ministry of Transport.
- The public service contract concerns only certain services of Trenitalia (Night and North_South longest link trains). The most part is operated without a contract).
- The Ministry of transport issues licenses to Trenitalia and other railway companies.

Short distance / regional

- Trenitalia S.p.A.
- In Lombardy, Trenord (50% owned by Trenitalia and 50% owned by Ferrovie Nord Milano) operates all regional passenger trains.
- Trenitalia S.p.A. has a market share of 96,71% in terms of train-km.

- Competent authorities (regions) may choose between direct award of public service contracts and competitive tendering procedure.
- Finances: In 2010 €1737 million was funded by the State Treasury for Regions.

Freight

- Trenitalia S.p.A. and various freight operators.
- Other operators have a market share of 27% in terms of train-km. In cross border markets with higher remuneration the average newcomers' market share is about 50%.

- Open access with reciprocity clause.
- In 2010 €92 million was funded by the Ministry of Transport.

INFRASTRUCTURE MANAGEMENT

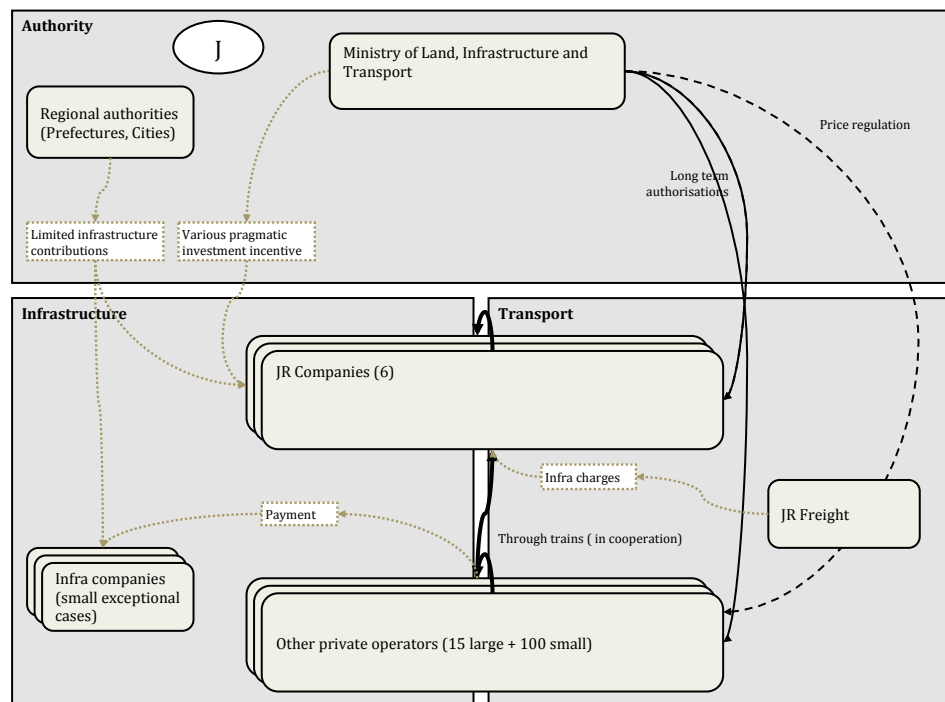
Planning, designing, ownership, maintenance and building.

- Rete Ferroviaria Italiana S.p.A (RFI), part of the Ferrovie dello Stato Italiane Group, a public shareholding company (100% owned by Ministry of Economy) owns the infrastructure and is responsible for designing, building and maintaining the infrastructure.

- RFI act as the national railway infrastructure manager, as set forth in the Act of Concession (with the Ministry of Transport) and on the basis of the "Programme Contract". Organisational, accounting and legal separation within the Ferrovie dello Stato Italiane Group to stimulate independency of the infrastructure manager.
- In 2010 RFI acquired €2.201 million for building infrastructure and €975 million for maintaining the infrastructure network.

Actors	Relations
CAPACITY MANAGEMENT	
<p>Timetabling, Path allocation, Track Access Charges determination, calculation and collection, traffic control</p>	<ul style="list-style-type: none"> • A department of Rete Ferroviaria Italiana S.p.A (RFI) operating in exclusive and separated premises is responsible for timetabling, path allocation, collection of track access charge and traffic control. • The ministry of Transport is responsible for the establishment of infrastructure charging. <ul style="list-style-type: none"> • Capacity allocation process occurs according to the rules and deadlines set in the Network Statement. Network Statement contains also the services access conditions and it is subject to the binding opinion of the national regulatory authority (URSF). • RFI calculates and collects the charges payable by the Rail companies.
REGULATORY BODIES	
<p>Sectoral regulator, Disputes, disagreements</p>	<ul style="list-style-type: none"> • Ufficio per la Regolazione di Servizi Ferroviari (URSF). An independent Transport Authority will be established in the next few months and will take over URSF's competences. <ul style="list-style-type: none"> • The URSF reports to the Ministry of Transport. • Funded by the Ministry of Transport (€1 million per year).
<p>Competition authority</p>	<ul style="list-style-type: none"> • Autorità Garante della Concorrenza e del Mercato (AGCM). <ul style="list-style-type: none"> • Independent institution, makes decisions based on the law without the possibility of interference by the government or other organs of political representation. • Partially self-financing and partially subsidized by the Ministry of Economic Development (2010; €70 million).
<p>Safety and licensing</p>	<ul style="list-style-type: none"> • Agenzia Nazionale per la Sicurezza delle Ferrovie (ANSF). <ul style="list-style-type: none"> • Independent body from all the railway actors. The Ministry of Transport and Infrastructure supervises the agency. • Received payments from the state of €12 million over the year 2010.

Japan



Actors

Relations

TRANSPORT

Long distance / national
Short distance / regional
Freight

- Various vertically integrated private railway companies (infrastructure managers and railway undertakings).
- In 1987 the Japanese National Railways was divided into 6 regional integrated private railway companies (the "JR" companies). Three of them are fully privatised.
- 15 main other vertically integrated private companies and many other small private operators exist.
- JR Freight operates freight services across the networks of all JR companies and pays access charges.

- The Ministry of Land, Infrastructure and Transport gives authorisations to (new) operators who fulfill the necessary conditions instead of issuing licenses to railway undertakings.
- The railways are submitted to intermodal competition (air, coach, road) and to yardstick competition (regulated by the Ministry and comparing the performances of various classes of railways).
- Railway companies are submitted to the principle of profitability (both train operations and infrastructure have to cover their costs by ticket revenues). However, some public contribution programmes also exist.
- Railway operators often operate through trains onto each other's networks (also onto urban underground railways). They do this mostly in cooperation with each other.

INFRASTRUCTURE MANAGEMENT

Planning, designing, maintenance and building.
Ownership

- Integrated companies, see transport.
- There are a few separate infrastructure companies in some exceptional cases.

- See transport.

CAPACITY MANAGEMENT

Path allocation, Track Charges determination and calculation
Timetabling, Collection of charges, Traffic control

- Integrated companies, see transport.
- There are a few separate infrastructure companies in some exceptional cases.

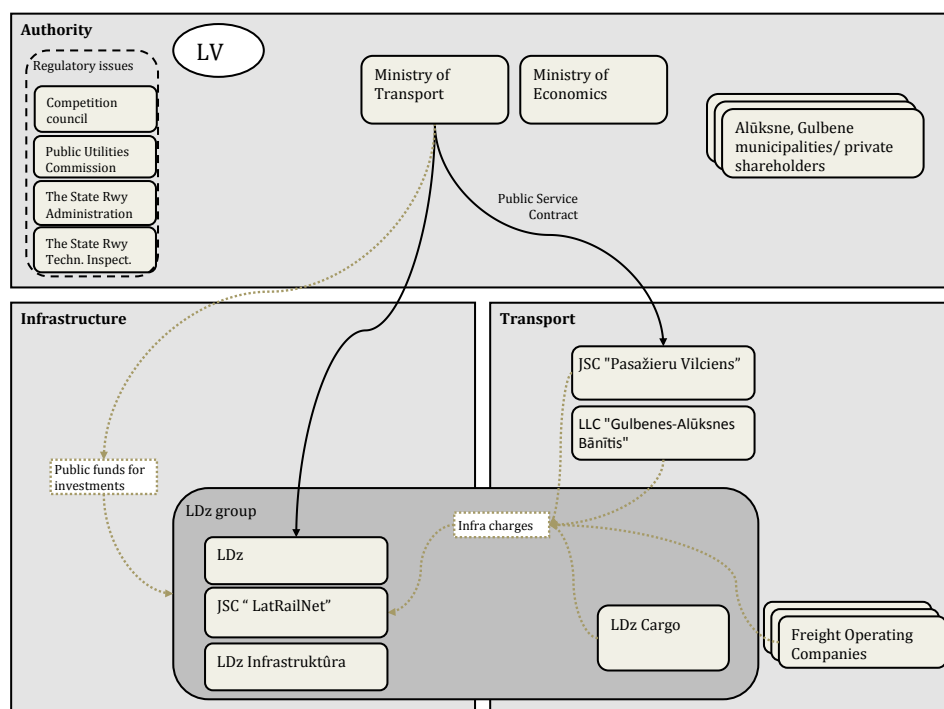
- See transport.

REGULATORY BODIES

Sectoral regulator,
Disputes, disagreements
Competition authority
Safety and licensing.

- The Ministry of Land, Infrastructure and Transport.

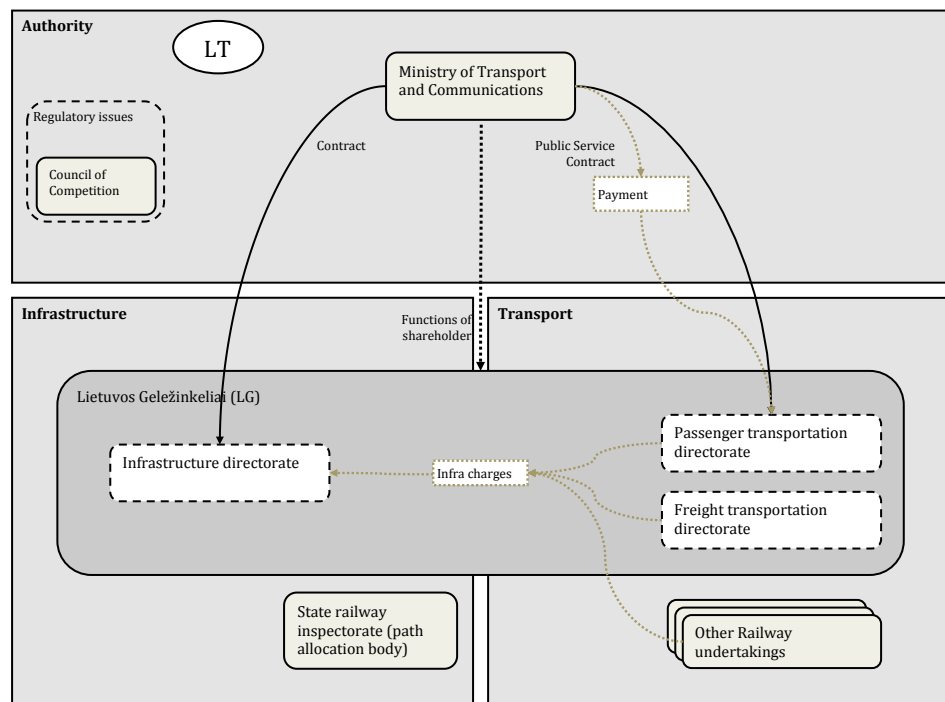
Latvia



Actors	Relations
TRANSPORT	
Long distance / national	<ul style="list-style-type: none"> JSC "Pasažieru Vilciens" a public company, 100% owned by the Ministry of Transport. JSC "Pasažieru Vilciens" owns a market share of 100%.
Short distance / regional	<ul style="list-style-type: none"> JSC "Pasažieru Vilciens" (owned by the Ministry of Transport) and LLC "Gulbenes-Alūksnes Bānītis" a limited liability company (LLC), owned by various municipalities and private shareholders. Market shares in train/km: JSC "Pasažieru Vilciens" - 6898 (98,95%); LLC "Gulbenes-Alūksnes Bānītis" - 73 (1,05%).
Freight	<ul style="list-style-type: none"> JSC "LDz Cargo" (owned by SJSC "Latvijas Dzelzceļš"), and the private companies JSC "Baltijas Tranzita Serviss" and JSC "Baltijas Ekspresis". Market shares in train/km: JSC "LDz Cargo" - 10093 (90,97%); JSC "Baltijas Tranzita Serviss" - 601 (5,42%); JSC "Baltijas Ekspresis" - 401 (3,61%)
INFRASTRUCTURE MANAGEMENT	
Planning and designing,	<ul style="list-style-type: none"> SJSC "Latvijas Dzelzceļš", a public company 100% owned by the Ministry of Transport.

	Actors	Relations
Building, maintenance and ownership	<ul style="list-style-type: none"> • Infrastructure ownership - SJSC "Latvijas Dzelceļš"; • Maintenance - SJSC "Latvijas Dzelceļš"; Building / Major development projects allocated on competitive basis; • Building / Renewals - LLC "LDz Infrastruktūra". 	<ul style="list-style-type: none"> • LLC "LDz Infrastruktūra" a LLC owned by SJSC "Latvijas Dzelceļš". • Institutional separation with SJSC "Latvijas Dzelceļš". • Public Funds as % from total investments -12,66; State Funds: €3.219.545,- and EU Funds: €148.994,-
CAPACITY MANAGEMENT		
Path allocation and determination charges of specific service(s)	<ul style="list-style-type: none"> • JSC "LatRailNet" a joint stock company with SJSC "Latvijas Dzelceļš" as share holder. 	<ul style="list-style-type: none"> • A subsidiary of SJSC "Latvijas Dzelceļš".
Timetabling, traffic control and Track Access Charges collection	<ul style="list-style-type: none"> • SJSC "Latvijas Dzelceļš", a State Joint Stock Company, shareholder: Ministry of Transport 	
Track Access Charges calculation	<ul style="list-style-type: none"> • Public Utilities Commission - charging methodology, • JSC "LatRailNet" - charge setting" 	<ul style="list-style-type: none"> • Public Utilities Commission: Administration under Ministry of Economics.
REGULATORY BODIES		
Sectoral regulator	<ul style="list-style-type: none"> • State Railway Administration 	<ul style="list-style-type: none"> • Direct administration of Ministry of Transport.
Competition authority	<ul style="list-style-type: none"> • Competition Council 	
Safety and licensing	<ul style="list-style-type: none"> • State Railway Technical Inspectorate, State Railway Administration and Public Utilities Commission. 	<ul style="list-style-type: none"> • State Railway Technical Inspectorate, State Railway Administration are a direct administration of Ministry of Transport. • Public Utilities Commission is an independent body of the Ministry of Economics.
Disputes, disagreements	<ul style="list-style-type: none"> • State Railway Administration and Public Utilities Commission. 	<ul style="list-style-type: none"> • State Railway Technical Inspectorate, State Railway Administration are a direct administration of Ministry of Transport. • Public Utilities Commission is an independent body of the Ministry of Economics.

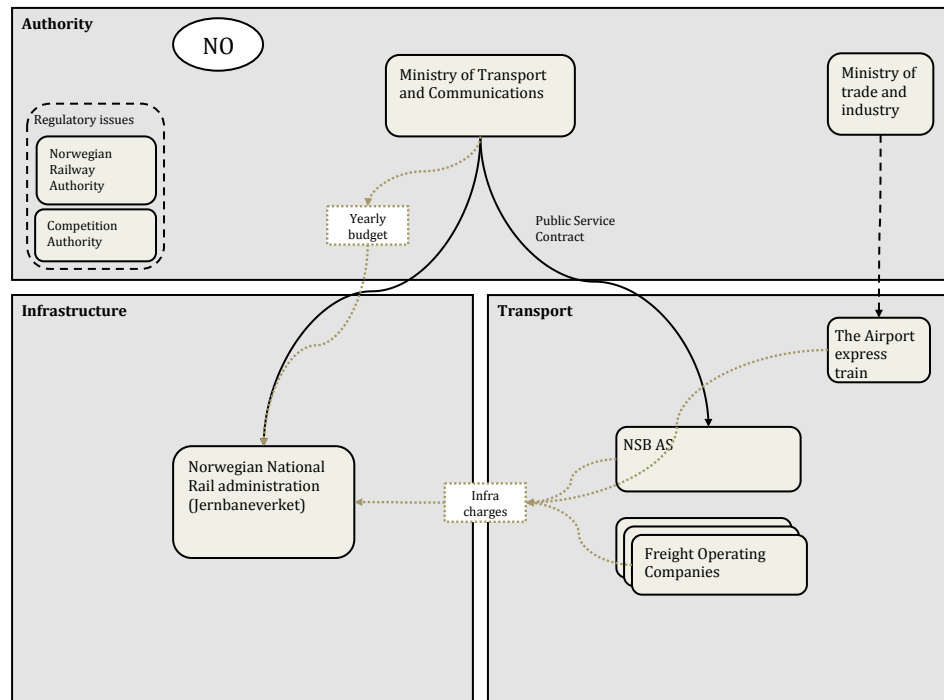
Lithuania



Actors	Relations
TRANSPORT	
<p>Long distance / national Short distance / regional</p>	<ul style="list-style-type: none"> • AB Lietuvos Geležinkeliai (LG): passenger transportation directorate. • LG is a public company 100% owned by the State.
<p>Freight</p>	<ul style="list-style-type: none"> • Open access. • Responsible authority is the Ministry of Transport and Communication. • Annual contract with the Ministry of Transport and Communications with regard to the provision of Public Service Obligation (PSO) for the entire country. • €0.06 million Euro for compensation of losses of domestic passenger transportation.
INFRASTRUCTURE MANAGEMENT	
<p>Planning, designing, maintenance and building.</p>	<ul style="list-style-type: none"> • AB Lietuvos Geležinkeliai (LG): Infrastructure directorate. • LG is a public company 100% owned by the State.
<p>Ownership</p>	<ul style="list-style-type: none"> • The Ministry of Transport and Communications is performing functions of LG shareholder. • In 2011 LG received a fund for the functioning of the infrastructure by the Ministry of Transport and Communication for planning, designing and building of new infrastructure (€67.7 million) and €0.1 million for financing of returning of loans. • The ministry of Transport and Communications is performing functions of LG shareholder. • €67.8 million. (€67.7 million for investments).

Actors		Relations
CAPACITY MANAGEMENT		
Path allocation, Track Charges determination and calculation	<ul style="list-style-type: none"> • State Railway Inspectorate allocates the capacity. • Ministry of Transport and Communications sets rules for minimal access charge. 	<ul style="list-style-type: none"> • Agency of Ministry of Transport and Communications. • Contracts between train operators based on Access agreements.
Timetabling, Collection of charges, Traffic control	<ul style="list-style-type: none"> • AB Lietuvos Geležinkeliai (LG). 	<ul style="list-style-type: none"> • The ministry of Transport and Communications is performing functions of LG shareholder.
REGULATORY BODIES		
Safety and licensing	<ul style="list-style-type: none"> • State Railway inspectorate. 	<ul style="list-style-type: none"> • Agency of Ministry of Transport and Communications. • Activities of the ministry are financed by State budget.
Sectoral regulator, Competition authority, Disputes, disagreements	<ul style="list-style-type: none"> • Council of competition. 	<ul style="list-style-type: none"> • Fully independent from all actors acting in railway transport sector. • Activities of the council are financed by State budget.

Norway



Actors

Relations

TRANSPORT

Long distance / national
Short distance / regional

- NSB a public company 100% owned by the state via the Ministry of Transport and Communications
- NSB AS
- Gjøvikbanen AS (100% subsidiary of NSB AS)
- The Airport Express Train (owned by the Ministry of Trade and Industry)

- The Ministry of Transportation and communications is responsible for contracting and determining specifications of services.
- NSB has the exclusive right for national transport of passengers on the long distance and short distance (2012-2017) with the exception of two lines: Gjøvikbanen and the Airport Express train.
- Gjøvikbanen: the line was put on tender in 2002. Further tendering are on hold under the existing government.
- The Airport Express Train is a commercial line to and from the airport in Oslo.

Freight

- Various freight operators including CargoNet, a subsidiary of NSB.

- Open access.

INFRASTRUCTURE MANAGEMENT

Planning, designing, ownership, maintenance and building.

- Norwegian National Rail Administration (Jernbaneverket), a subordinate administrative agency of the ministry of Transport and Communication.
- The infrastructure is owned by the state.
- Jernbaneverket is responsible for designing, planning, building and maintenance of the infrastructure.

- Access agreement with all railway undertakings.
- Responsible authority is the Ministry of Transport and Communication.

CAPACITY MANAGEMENT

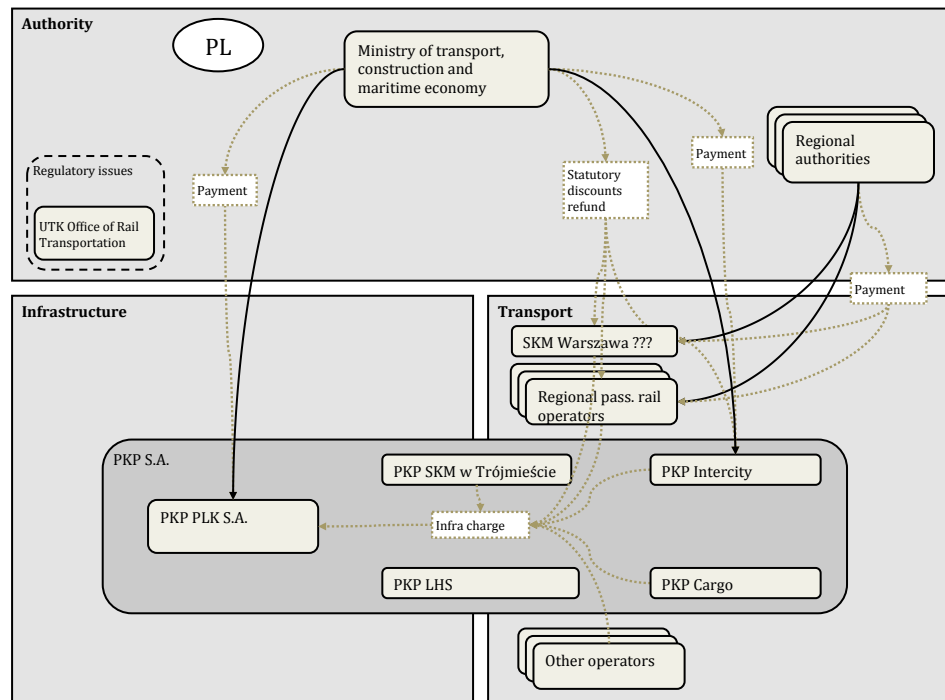
Timetabling, Path allocation, Track Access Charges determination, calculation and – collection, traffic control

- Norwegian National Rail Administration (Jernbaneverket) responsible for the path allocation, traffic control and collecting the Track Access Charges.

- The level of track Access Charges is set by the Ministry of Transport and Communications.

Actors	Relations
REGULATORY BODIES	
Sectoral regulator	<ul style="list-style-type: none"> <li>• The Ministry of Transport and Communication. <li>• Responsible for the overall policy of the railway sector.
Competition authority	<ul style="list-style-type: none"> <li>• Konkurransetilsynet (competition authority).
Safety and licensing, Disputes, disagreements	<ul style="list-style-type: none"> <li>• Statens Jernbanetilsyn (Norwegian Railway Authority). <li>• The Norwegian Railway Authority is the control and supervisory authority for rail traffic in Norway. It directs its efforts towards ensuring that rail traffic is operated in a safe and appropriate manner. It is responsible for ensuring that rail operators meet the conditions and requirements set out in rail legislation that governs the traffic. The authority is also responsible for drawing up regulations, awarding licences for rail activity and approving rolling stock and infrastructure. <li>• It also has a regulatory body function, to monitor railway markets and to act as an appeal body for rail companies if they believe they have been unfairly treated.

Poland

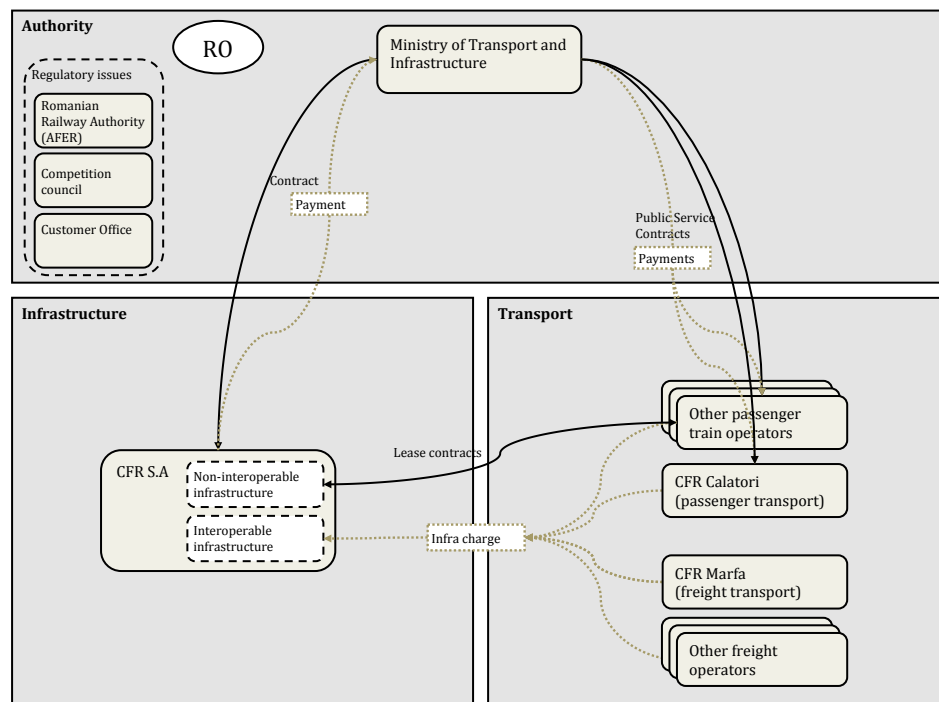


Actors	Relations
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Actors	Relations
TRANSPORT	
<p>Long distance / national</p>	<ul style="list-style-type: none"> • PKP Intercity JSC (IC), a public company 100% by the Polish State. • Przewozy Regionalne Ltd. (PR), a public company owned by various regional authorities.
<p>Short distance / regional</p>	<ul style="list-style-type: none"> • Partly competitive tendering, partly open access. • Responsible authorities are the Ministry of Transport and the regional authorities. • The Railway Transport Office (UTK) is the regulatory body. • Market share by train-km is: PR 37,5%, IC: 62.5%. • The PSO-compensations for PKP Intercity were €1,5 million (2008), €42,4 million (2009), €65,6 million (2010), €48,6 million (2011).
<p>Freight</p>	<ul style="list-style-type: none"> • 4 main actors: Przewozy Regionalne Ltd. (PR), Koleje Mazowieckie Ltd. (KM), PKP SKM w Trójmieście Ltd. (SKM Trój.) and SKM Ltd. w Warszawie (SKM Wwa). • Mainly direct award and competitive tendering. • Responsible authority for PR, KM, SKM Wwa and SKM Trój are the regional authorities. • Market share by train-km is: PR 44,4%, SKM Trój. 19,4%, KM 27,6%, SKM Wwa 5,8%, others 2,8%. • In 2011 the state provided a contribution of €873 million to PR.
INFRASTRUCTURE MANAGEMENT	
<p>Planning, designing, ownership, maintenance and building.</p>	<ul style="list-style-type: none"> • 5 main actors (partly owned by the state and partly owned by private companies). PKP CARGO, DB Schenker Rail Polska, CTL Logistics, LOTOS Kolej. • Up to 71 actors owning a licence for rail freight transport services. • Open access. • Market share in terms of volume of transported goods: PKP CARGO 52,32%, DB Group 19,73%, CTL Group 6,59%, LOTOS Kolej 4,22%, PKP LHS 4,05%.
<p>Planning, designing, ownership, maintenance and building.</p>	<ul style="list-style-type: none"> • PKP Polskie Linie Kolejowe S.A (PLK), a public company 100% owned by the state. • The State is owner of the infrastructure. • Contractual relationship with train operators. • Annual financial contribution provided by the state for the purpose of maintenance. • No public financing for building new infrastructure.

Actors	Relations
CAPACITY MANAGEMENT	
Timetabling, Path allocation, Track Access Charges determination, calculation and collection, traffic control	<ul style="list-style-type: none"> • PKP Polskie Linie Kolejowe S.A (PLK). • Charging rules are set by the Ministry of Transport Construction and Maritime Economy, TAC are set by infrastructure manager (PLK) • General rules for timetabling are set by the Ministry of Transport Construction and Maritime Economy, detailed rules are set in the Network Statement issued by infrastructure manager (PLK).
REGULATORY BODIES	
Sectoral regulator, Disputes, disagreements. Competition authority. Safety and licensing.	<ul style="list-style-type: none"> • Office of Rail Transportation (UTK). • The Office of Rail Transportation tasks are situated in four main areas: passenger rights, railway market regulation (provision of non-discriminatory access to rail infrastructure for rail operators), railway transport safety and technical coherence of the railway system. • Budget is set annually by Parliament.

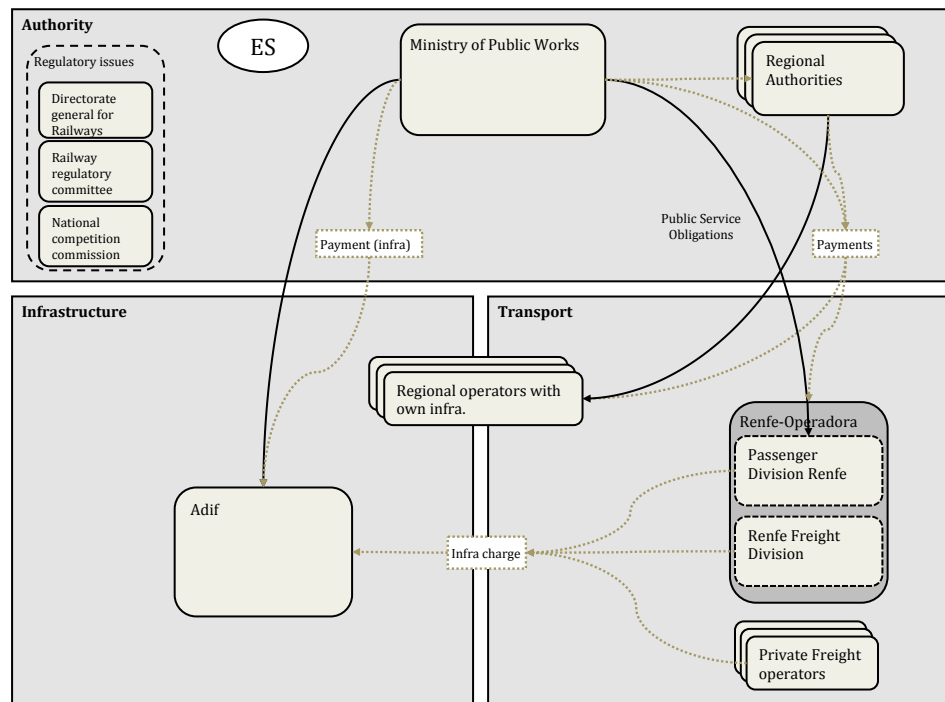
Romania



Actors		Relations	
TRANSPORT			
Long distance / national	<ul style="list-style-type: none"> CFR Calatori, a public company 100% owned by the State, provides long distance services. 	<ul style="list-style-type: none"> Direct award via Public service Contract. The Ministry of Transport and Infrastructure is responsible for contracting the services. 	
Short distance / regional	<ul style="list-style-type: none"> CFR Calatori provides passenger railway transport services on short and medium distances. 4 Private companies also provide such services: S.C. Regional S.R.L., S.C. Transferoviar Calatori S.R.L., S.C. Regiotrans S.R.L., S.C. Servtransinvest S.A. 	<ul style="list-style-type: none"> Direct award via Public Service Contract to these companies by the Ministry of Transport and Infrastructure. In 2011, around 15% of Romanian railway tracks (known as non-interoperable infrastructure) have been leased to four private companies. 	
Freight	<ul style="list-style-type: none"> Several operators. CFR Marfa is the biggest market player, a public company, 100% owned by the State. 	<ul style="list-style-type: none"> Open access. CFR Marfa owns a 60,8 % market share based on volume of transported goods. 	
INFRASTRUCTURE MANAGEMENT			
Planning, designing, ownership, maintenance and building.	<ul style="list-style-type: none"> The Infrastructure manager is CFR SA, a public company 100% owned by the State. Note that CFR S.A., CFR Calatori and CFR Marfa are three fully separate companies. The State is owner of the infrastructure. 	<ul style="list-style-type: none"> Contractual relationship with the train operators and performance contract with the ministry of Transport and Infrastructure. Financial contribution provided by the state for maintenance and building of infrastructure. 	
CAPACITY MANAGEMENT			
Timetabling, Path allocation, Track Access Charges determination, calculation and – collection, traffic control	<ul style="list-style-type: none"> CFR SA. 	<ul style="list-style-type: none"> Level of track access charges is calculated by CFR SA and approved by the government. Train operators are paying track access charges to the infrastructure manager. 	

	Actors	Relations
REGULATORY BODIES		
Sectoral regulator, Safety and licensing, Disputes, disagreements	<ul style="list-style-type: none"> Romanian Railway Authority (AFER). 	<ul style="list-style-type: none"> Independent agency of the Ministry of Transport and Infrastructure.
Competition authority	<ul style="list-style-type: none"> Consiliul Concurenti (competition council). 	

Spain



Actors

Relations

TRANSPORT

Long distance / national
Short distance / regional

- Renfe Operadora, a public company 100% owned by the Ministry of Public Works.

- Legal monopoly.
- The regulatory body for contracting and specification of services for long and short distance is the Ministry of Public Works. A payment is made to the railway operator according to the commitments of the Public Service Obligation.
- The Autonomous Government of Catalonia is responsible for contracting and determining specification of commuter services of Catalonia and some intra-regional services
- Open access for international traffic.

Freight

- The public operator Renfe Operadora and eleven private operators.
- Renfe Operadora has a market share of 91% train-km.

- Open access.

INFRASTRUCTURE MANAGEMENT

Planning, designing, ownership, maintenance and building.

- Adif, a public company 100% owned by the Ministry of Public Works, is owner of the infrastructure and is responsible for planning, designing, building and maintenance of the infrastructure.

- Adif is supervised by the Ministry of Development.

CAPACITY MANAGEMENT

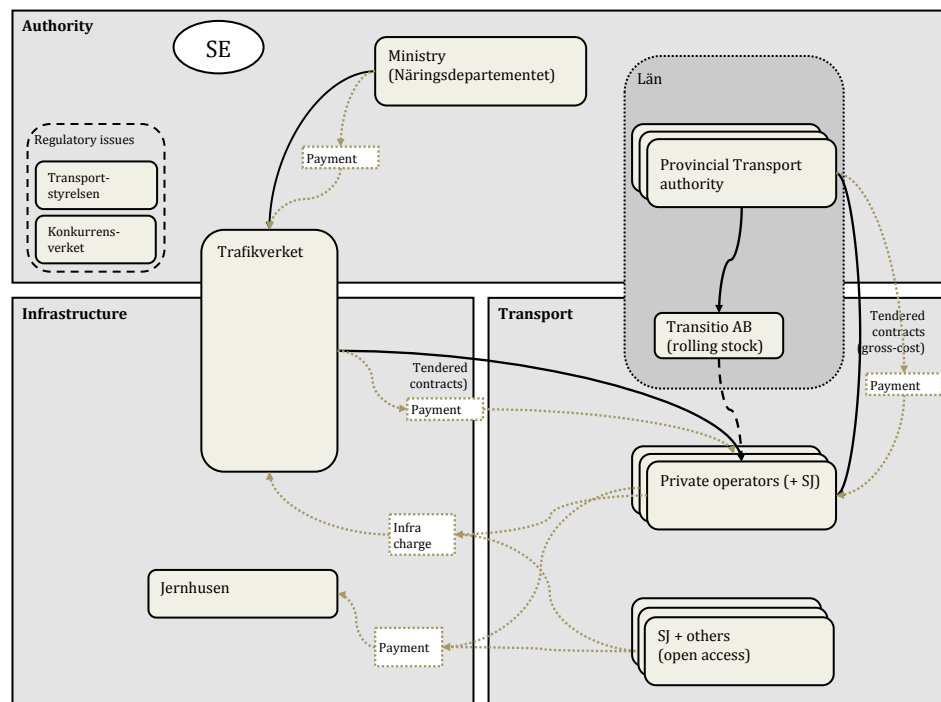
Timetabling, Path allocation, Track Access Charges determination, calculation and collection, traffic control

- Adif is responsible for the path allocation, traffic control and collection of track access charges,
- The department of Infrastructure and Planning is responsible for determination of track access charges.

- The infrastructure & Planning and Transport department take care of licensing and other regulatory issues.

Actors	Relations
REGULATORY BODIES	
Sectoral regulator, Disputes, disagreements	<ul style="list-style-type: none"> • Comité de Regulación Ferroviaria (Railway Regulatory Committee). • Agency of the Ministry of Public Works, 100% funded by the Ministry of Public Works.
Competition authority	<ul style="list-style-type: none"> • Comisión Nacional de la Competencia (National Competition Commission). • Independent public body entrusted to preserve, protect and promote the existence of effective competition in markets nationwide. • 100% financed by the State.
Safety and licensing	<ul style="list-style-type: none"> • Directorate-General for Railways. • Agency of the Ministry of Public Works.

Sweden

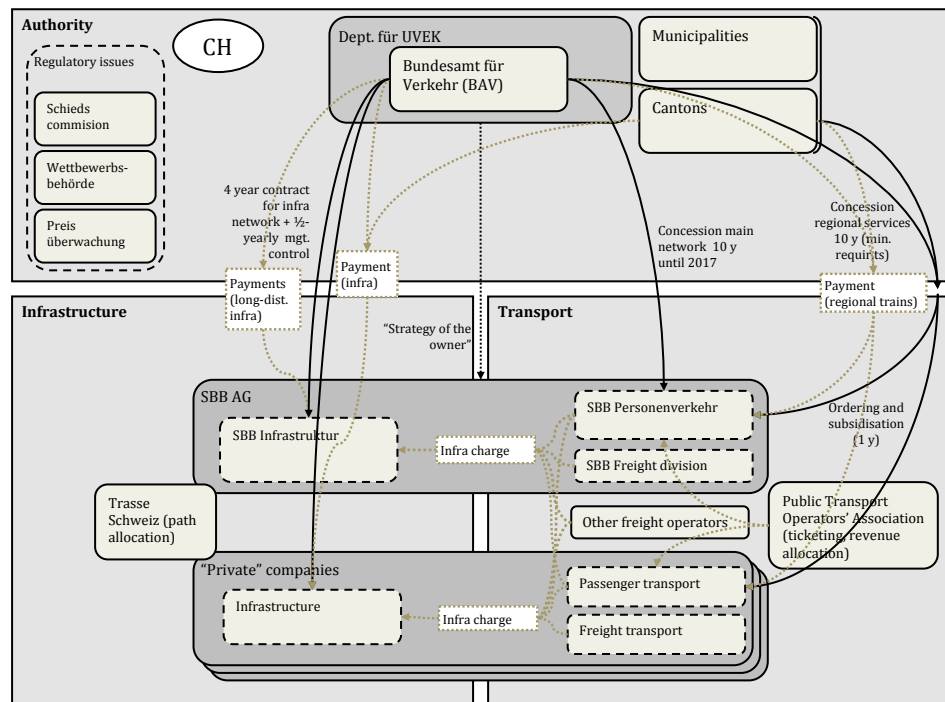


Actors	Relations
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Actors	Relations
TRANSPORT	
<p>Long distance / national</p>	<ul style="list-style-type: none"> • SJ AB, a public company, 100% owned by the Ministry of Industry and Trade. • Other companies; the biggest are Veolia and Norrlandståg (owned by SJ). • SJ has a market share of 56.2% of long-distance and regional passenger train travel (over 100 km).
<p>Short distance / regional</p>	<ul style="list-style-type: none"> • Open access for all lines; competitive tendering of non-profitable lines. • The regulatory body for contracting and specification of services is the Road and Rail Department of the Swedish Transport Agency (Trafikverket). • Competitive tendering of all local/regional lines by the Provincial Transport authority. • SJ AB has a market share of 56.2% of long distance and local/regional lines, based on all passenger-km (year 2011).
<p>Freight</p>	<ul style="list-style-type: none"> • Various private operators and the public operator Green Cargo (100% owned by the Ministry of Industry and Trade). • Green Cargo and subsidiaries have a market share of 72% (tonne-kilometres). • Open access.
INFRASTRUCTURE MANAGEMENT	
<p>Planning, designing, ownership, maintenance and building.</p>	<ul style="list-style-type: none"> • The infrastructure is 100% owned by the state (Trafikverket). Trafikverket is also responsible for designing, planning, building and the maintenance of the infrastructure. • The state is owner of the infrastructure. • Railway stations and maintenance facilities are owned by Jernhusen (a public company 100% owned by the state). • Rail- and cargo operators are paying track access charges to the infrastructure manager. • Rail- and cargo operators are paying a fee to Jernhusen for the use of railway stations and maintenance facilities.
CAPACITY MANAGEMENT	
<p>Timetabling, Path allocation, Track Access Charges determination, calculation and collection, traffic control</p>	<ul style="list-style-type: none"> • Trafikverket is responsible for the path allocation, traffic control and collection of track access charges. • The level of track access charges is set by the Ministry of Enterprise, Energy and Communications (Näringsdepartementet). • Trafikverket administers the rules and detailed implementation of track access charges.

Actors		Relations
REGULATORY BODIES		
Sectoral regulator, Disputes, disagreements	<ul style="list-style-type: none"> • Ministry of Enterprise, Energy and Communications (Näringsdepartementet). • Trafikverket (Transport administration). 	<ul style="list-style-type: none"> • Näringsdepartementet is responsible for the overall policy of the railway sector, also responsible for setting the level of track access charges paid from operators to the infrastructure manager. • Trafikverket is responsible for tenders and the coordination of the railway sector.
Competition authority	<ul style="list-style-type: none"> • Konkurrensverket (competition authority). 	<ul style="list-style-type: none"> • Agency of the Ministry of Enterprise, Energy and Communications.
Safety and licensing	<ul style="list-style-type: none"> • Järnvägsstyrelsen (Railway agency). 	<ul style="list-style-type: none"> • Independent public body.

Switzerland



Actors

Relations

TRANSPORT

Long distance / national

- Schweizerische Bundesbahnen (SBB), a public company 100% owned by the State.
- SBB owns a 100% market share.
- SBB consist of four divisions (passenger, infrastructure, cargo and property).

- Licensed legal monopoly for ten years (2007-2017).
- The regulatory body for contracting and determining specifications of services is the Federal Office for Transport.
- Long distance services are self-financing.

Short distance / regional

- More than 40 actors.
- Generally public companies owned by the State and Cantons, sometimes co-partnership with SBB.

- Direct award of concession with an option for competitive tendering.
- The regulatory bodies for contracting and specifications of services are the Federal Office for Transport and the Cantons.
- In 2011 804 million CHF was allocated for compensation or uncovered costs by the Federal Office for Transport and the cantons.

Freight

- Various public companies (e.g. SBB Cargo, BLS Cargo, Crossrail and DB Schenker Rail).
- Total freight: SBB Cargo 62%, BLS Cargo 29%, rest 9%.

- Open access.
- Responsible authority is the Federal Office for Transport
- Government compensation for Combined transport is 236 Million CHF and for railway sidings 16 Million CHF.

INFRASTRUCTURE MANAGEMENT

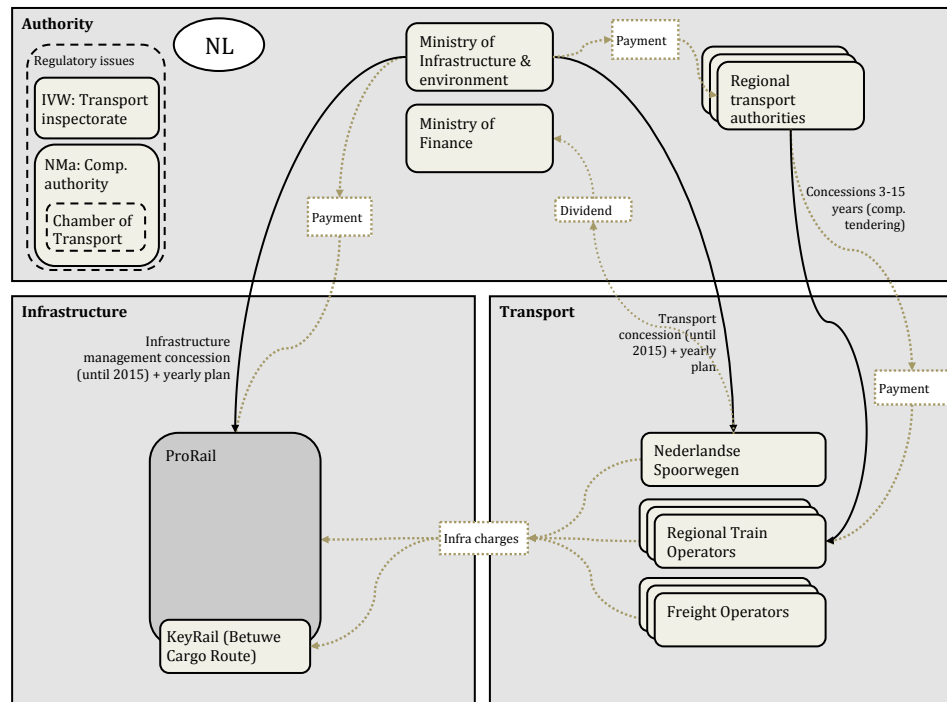
Planning, Designing, Building, Ownership, Maintenance

- SBB (AG).
- Market share of ownership of the normal-gauge infrastructure: SBB 81%, BLS 11%; SOB 3% and further 14 companies with altogether 5%.

- Supervised by the Federal Office for Transport.
- 510 million CHF is allocated by the Federal Office for Transport for, Planning, Designing, Building and the maintaining of the infrastructure.

Actors		Relations
CAPACITY MANAGEMENT		
Path allocation and timetabling.	<ul style="list-style-type: none"> Trasse Schweiz AG for SBB, the Schweizerische Südostbahn (SOB), the port railways Switzerland, the Turbo- and Sentalbahn and the Lötschbergbahn (BLS). Trasse Schweiz allocates paths on 95% of the network. Trasse Schweiz is responsible for timetabling, it mandates SBB to elaborate a draft-timetable and checks the non-discriminatory elaboration. 	<ul style="list-style-type: none"> Non-profit oriented limited company, owned by SBB, BLS, SOB and Swiss Public Transport Operators' Association with a share of 25% each. Trasse Schweiz AG is an independent company. Contracts between Trasse Schweiz AG and SBB/BLS/SOB based on a performance agreement.
Track access charges determination and calculation	<ul style="list-style-type: none"> The Federal Government determinates the track access charges. The infrastructure manager is responsible for the collection of money. 	<ul style="list-style-type: none"> The Federal Government is Legislator and sets the minimum price. There is a compensation for uncovered costs.
Track access collection and traffic control	<ul style="list-style-type: none"> The relevant infrastructure manager. 	<ul style="list-style-type: none"> Supervised by the Federal Office for Transport.
REGULATORY BODIES		
Sectoral regulator, disputes, disagreements	<ul style="list-style-type: none"> Railway Arbitration Commission (RACO). 	<ul style="list-style-type: none"> Independent agency of the Federal Transport Ministry. Responsible for settlement of disputes in network access. Operation costs 0,5 million CHF per year.
Competition authority	<ul style="list-style-type: none"> Federal Competition Authority and Price Supervisor. 	<ul style="list-style-type: none"> A public body. The Price Supervisor looks at fare increases in monopoly markets. The Competition Authority analyses market-dominant positions.
Safety and licensing	<ul style="list-style-type: none"> Federal Office for Transport. 	<ul style="list-style-type: none"> Oversight authority over public transport companies.

The Netherlands



Actors	Relations
TRANSPORT	
<p>Long distance / national</p> <ul style="list-style-type: none"> • 'Nederlandse Spoorwegen NV' (NS), a limited company for 100% owned by the state (Ministry of Finance). • The market share of NS is 100%. 	<ul style="list-style-type: none"> • NS has the exclusive right for the transport of passengers on the main rail network (intercity and local train services). • NS acquired the concession for the main rail network by 'direct award' for a period of 10 years (2005-2015). NS has to submit a yearly contribution to the ministry. • In 2011 NS paid a 'franchise fee' of €20 million to the Ministry of Infrastructure and Environment. • The transport authority for contracting and specification of services is the Ministry of Infrastructure and Environment. • Track access charges paid to the infrastructure manager for the main rail network were €174 million (price level 2009).
<p>Short distance / regional</p> <ul style="list-style-type: none"> • Currently 5 companies; NS, Arriva, Veolia, Connexion and Syntus. • The market share based on the market of local trains was 9% Arriva, 5% Veolia, 5% Syntus and 1% Connexion. (2011). 	<ul style="list-style-type: none"> • The transport authorities for contracting and specification of services are the Regional transport authorities. • Concessions are allocated for a period of 3-15 years and are based on competitive tendering. • There is no overall data available on the provincial/regional funding of the regional lines.
<p>Freight</p> <ul style="list-style-type: none"> • The market is dominated by DB Schenker Rail NV. • There is no overall information of the market share per actor. 	<ul style="list-style-type: none"> • Open access. • There is no authority responsible for contracting and defining specification of services.

Actors		Relations
INFRASTRUCTURE MANAGEMENT		
Planning, Designing, Building, Ownership, Maintenance	<ul style="list-style-type: none"> All tracks are owned by the Ministry of Infrastructure and Environment. The main actor responsible for the infrastructure planning, designing, and building of the rail network is ProRail BV. ProRail BV is a private company for 100% owned by Rail Infra Trust which is owned for 100% by the Ministry of Infrastructure and Environment. The main actor responsible for the infrastructure planning, designing, and building of the rail network of the Betuwe Cargo Route to the German border is KeyRail BV. KeyRail BV is a company owned by the port companies of Amsterdam (15%) and Rotterdam (35%) and ProRail (50%). 	<ul style="list-style-type: none"> ProRail BV is commissioned by the Ministry of Infrastructure and Environment (concession contract). The Ministry of Infrastructure and Environment sets a performance agreement with ProRail BV which results in a yearly management plan. In 2011 ProRail BV received a total amount of €838 million for all the infrastructure operations and developments by the Ministry of Infrastructure and Environment. Over the year 2011 ProRail received an amount of €1.130 million by the Ministry of Infrastructure and Environment to invest in new rail lines.
CAPACITY MANAGEMENT		
Timetabling, Path allocation, Track access charges determination, calculation and – collection, traffic control	<ul style="list-style-type: none"> ProRail BV is responsible for timetabling, path allocation, calculation and collecting of track access charges and traffic control. 	<ul style="list-style-type: none"> Detailed timetables are developed and submitted to ProRail by the operators. Charging rules are regulated and controlled by the transport chamber of the competition authority (Nederlandse Mededingingsautoriteit NMa/Vervoerkamer). Carriers are paying €0,60 per train kilometer per path and €0,03 per consumed kWh and an amount between €0.60 and €7 per station stop, depending on the type of station.
REGULATORY BODIES		
Sectoral regulator	<ul style="list-style-type: none"> Ministry of Infrastructure and Environment. 	<ul style="list-style-type: none"> Responsible for law, rules and policies concerning the rail sector. Also grants concessions on national level and remains ultimately responsible for the functioning and the quality of the rail network.
Competition authority	<ul style="list-style-type: none"> Dutch Competition Authority, Chamber of transport (Nederlandse Mededingingsautoriteit, Vervoerskamer, NMa). 	<ul style="list-style-type: none"> Agency of the ministry of Economic Affairs.
Safety and licensing	<ul style="list-style-type: none"> Inspectorate for Environment and Transport, Inspectie Leefomgeving en Transport. 	<ul style="list-style-type: none"> Agency of the ministry of Infrastructure and Environment.
Disputes, disagreements		

G. References

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