Joint Transport Research Centre of the OECD

International Transport Forum

Survey on price and demand elasticity in terms of reliability in freight railway services

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Content

1. Introduction

The freight traffic market reveals ongoing increasing growth rates for the future. However, railway companies face a continuing necessity to improve their revenue and cost situation in order to cope with rising competitiveness as well as intermodal and especially with road traffic.

The two transport modes rail and road show system intrinsic advantages and disadvantages. The rail advantages (environmentally friendly, large transport volumes, high safety) and its disadvantages (limited flexibility, noise exposure, large public funding) face road advantages (freedom to choose routes, door-to-door services, high flexibility) and disadvantages (polluting, ban to drive during night time and on weekends, high congestion sensitivity). It is the customer's opinion which of these intrinsic factors he values higher and lower.

The customer's choice is of course influenced by several other parameters. In addition to the price, the reliability of transport services is an important one. In this context, unreliability of train services threatens the successful development of the rail freight market but data and studies on reliability are still scarce to deduce meaningful conclusions. The sensitive topic reliability is analysed mainly internally in the railway companies and rarely in scientific publications. This survey therefore aims to broaden the scope of analyses and examines possible impacts of reliability on rail transports.

Starting with a market analysis in chapter 2 including an overview over the rail freight market and analysing (un-)punctuality, one of the important indicators for reliability and price systems, the adjacent market survey in chapter 3 analyses preferences in terms of rail and road transports. Implications and recommendations conclude this work in chapter 4. Further additional information is compiled in the appendix.

2. Market analysis

Considering the investigation target the market analysis on freight rail transport is focussed on the following aspects:

- Development and structure of freight quantity
- Parties in rail cargo and their functions
- Quality and volume of rail infrastructure
- Unpunctuality and actions to increase the punctuality
- Regional focus on EU-countries

2.1 The rail freight market

The transport volume will rise in the forthcoming years for rail, road and inland navigation modes. However, the modal split is going to be shifted towards a higher share of road transport because rail and inland navigation growth is less intensive then the road transport increase. Figure 1 illustrates the transport development until year 2030. The positive development of the overall transport market is a chance for the rail freight segment to gain higher market shares, e.g. by an improved transport quality. Even without an enlargement of the share the European rail freight market reveals a rise of about 40 bn tkm until 2030 equivalent of about the annual total transport volume of the French national railway SNCF-Fret. Over the last years the prognosis might have been exceeded by the strong freight growth since the current actual trend is even more positive than indicated - especially in the rail freight market.

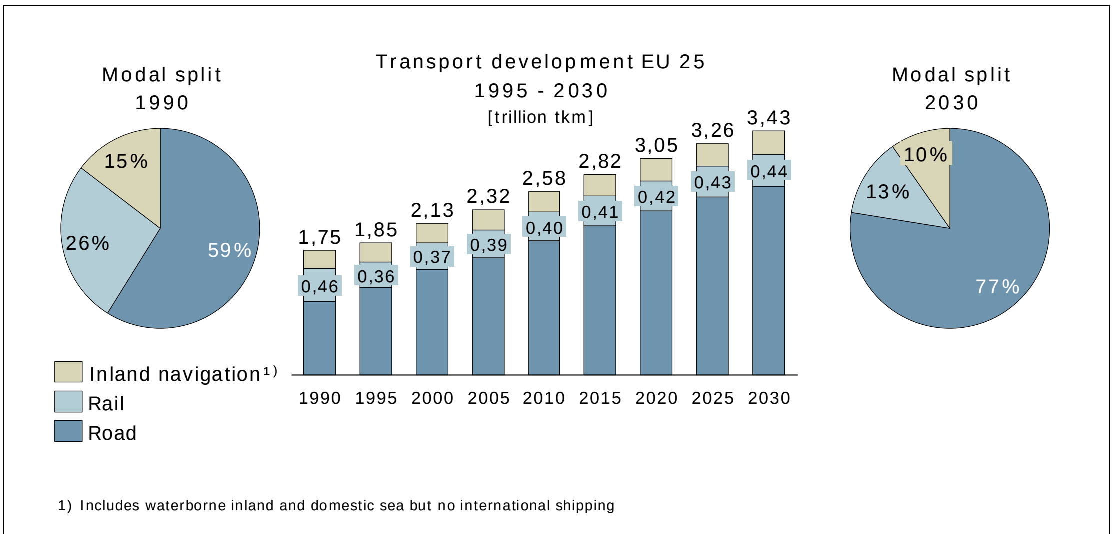


Figure 1: Freight transport development traffic (Source: European Energy and Transport)

The rail freight demand is similar to market demand. The development of the transport carriers in rail freight therefore depends on the changes of certain freight groups and their affinity to freight groups. The composition of the transport volume is very inhomogeneous as shown in figure 2. Half finished and finished merchandises account for about one third of the transport performance. This category consists predominantly of containerised products. The goods show variable time sensitivity. A high time sensitivity is visible for containerised, chemical and petroleum freight, a medium sensitivity for other nourishment & animal food and a low sensitivity for fertiliser, solid mineral fuels, ore & metal waste, agricultural & forestry products and stones & soils. A correlation between time sensitivity and rail modal split share is not evident.

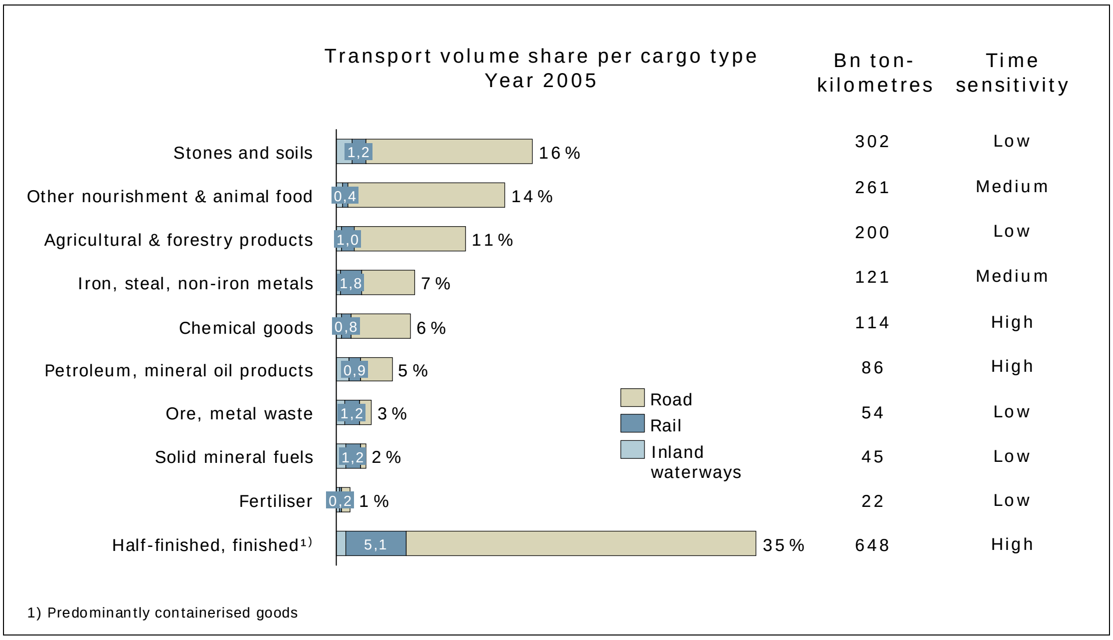


Figure 2: Cargo groups (Source: Eurostat)

The transportation of goods on rails is a complex interaction between several parties. The following shortly explains the parties:

- Rail freight operating companies

  Private or public companies using their own or provided rail network to transport goods on rail tracks with mostly own equipment, e.g. Railion, Rail Cargo Austria (RCA) or European Rail Shuttle (ERS)

- Infrastructure companies

  Usually public companies are responsible for maintenance, renewal and operating the rail network, e.g. DB Netz, Réseau Ferré de France or Banverket. In terms of building new infrastructure companies are dependent on public funding which is controlled by regional and national governments.

- Freight forwarding companies

  Companies organising multimodal transport chains, including logistics services like warehousing, supply chain management, e.g. UPS, DHL or Wincanton

- Shipper

  Companies who send goods from one place to another using usually logistics service provider, e.g. Arcelor, PSA Peugeot Citroën or BASF

In terms of internationalisation the parties' orientation in the rail freight market is totally different. Rail freight companies are currently trying to widen their markets from national to an international focus. The railway infrastructure companies are operating business on their respective domestic markets, whereas the freight forwarders are mostly operating internationally. A vast number of shippers exist in Europe and they are usually performing internationally, too.

Changes in the rail freight market are currently mainly to be affiliated to the rapid changes in terms of requriments of the industry as demander as well as according changes in the general rail freight market The liberalisation tendencies over the past years herein expedite the market development in rail freight.

The following trends are important for the strategic preparation of rail freight companies:

- Ongoing growth, especially containerised transports in port hinterland traffic
- Increasing border crossing traffic
- Concentration tendencies e.g. M&A, consortia, networks
- Increase and heterogeneity of customers' requirements (Punctuality, reliability, flexibility, logistic services, tracking & tracing)
- Ongoing and intensified competitiveness

There are trends within the rail freight industry to focus rail service on dedicated industries, corridors and regions. Three categories of specialisation are visible for freight train companies:

- Industry focus
    - Partially orientation of sales and production on specific industries (e.g. automotive, paper, timber)
    - Exclusive rail freight service for dedicated industries by several new entrants
- Corridor focus
    - Build up of railway specific international corridor networks through subsidiaries and cooperation with local railways
    - Orientation of production on corridors (locomotive and train driver rotation, aligned fleet management etc.)
- Regional focus
    - Local focus, mostly as part of a wider network
    - Last mile service of single wagon load systems
    - Shunting at major industry sidings (industry railway)

Conclusions

- The freight market reveals sufficient growth for a positive future development
- The rail freight market will be further liberalised and the railways have to cope with intensified competition and with complex customer requirements
- Railways have to face ongoing intra-modal competition (rail-rail) and inter-modal competition (rail-road, rail-vessel). Therefore a railway needs a strategy matching both competitor types

2.2 (Un-) reliability

This report is focused on the aspect of (un-)reliability, which seems to have an important impact on the transport choice. Unreliability of train services is a big challenge for freight railway services. An illustration of delay causes, its underlying reasons and possible ways of improvement are described in this chapter.

Characteristics of infrastructure

In order to check the reliability in detail the available infrastructure and its usage is to be investigated first of all. The network and the network utilisation are two components causing perturbation and reliability problems. Both are very inhomogeneous in Europe. Figures 3 and 4 reveal the different network and operational characteristics.

Figure 3 compares the network complexity in terms of line categories, degree of electrification and share of multiple routes between the sample's European countries. The complexity influences the level of reliability because an advanced technological network standard with a high share of main or high speed lines, a high degree of electrification and a high share of multiple routes are more vulnerable to perturbations than a low developed network.

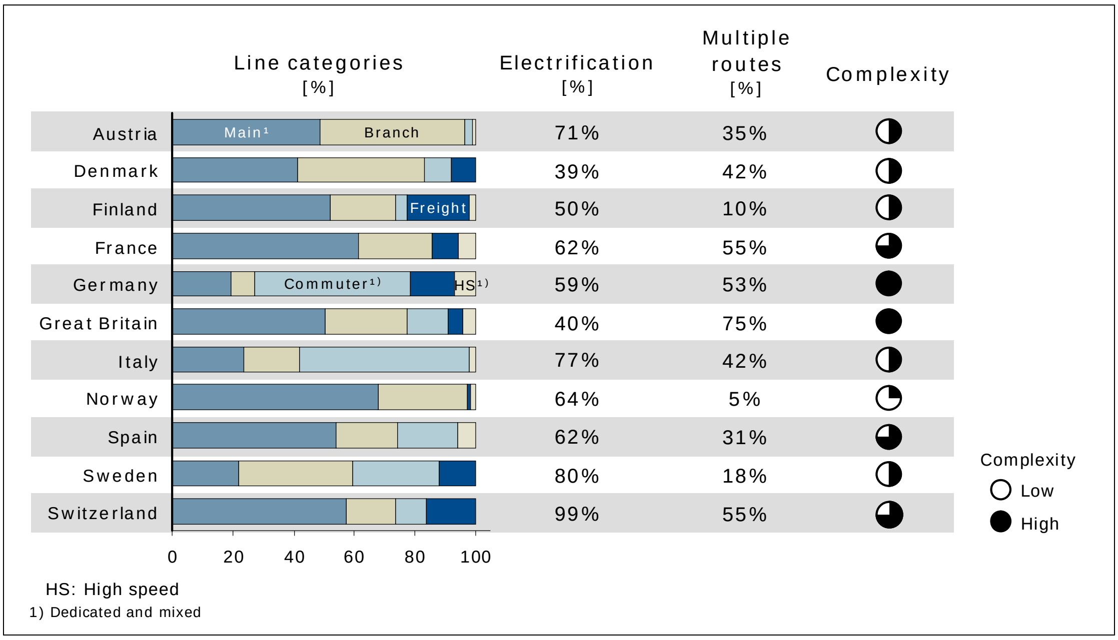


Figure 3: Network characteristics

Other than the structures of the network their efficiency is an important factor that needs to be considered in terms of reliability. Figure 4 shows that also train frequencies differ among European countries. The most utilised networks are in Switzerland and the Netherlands, whereas Finland and Ireland have a low utilised network. Perturbations on high utilised networks have extensive impacts on reliability because more trains are affected by one perturbation compared to lower utilised networks.

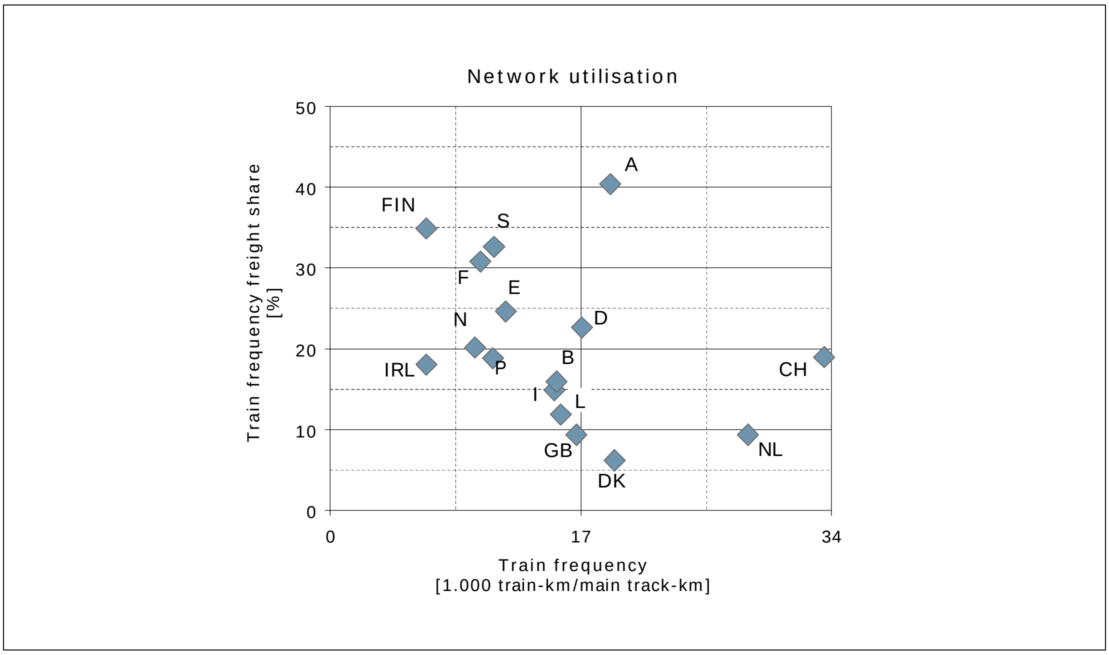


Figure 4: Network utilisation

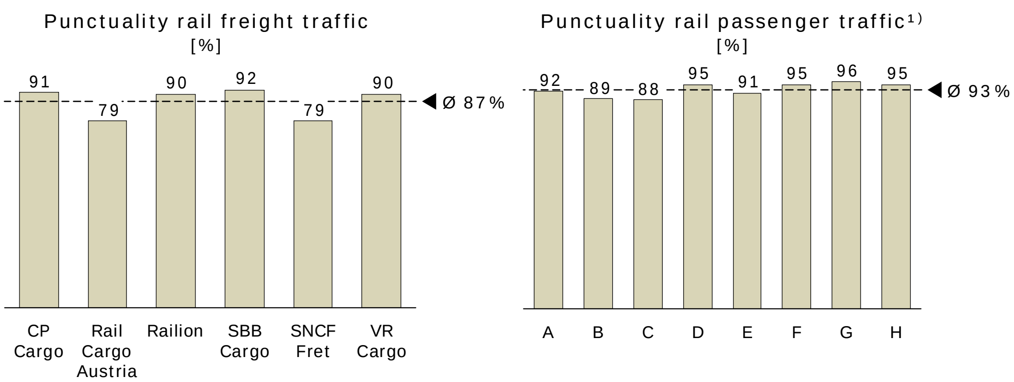
The freight shares of the network utilisation also present an inhomogeneous distribution. Austria stands out with highest freight share of about 40%. Great Britain, Denmark and the Netherlands have freight shares of 10% or lower.

The significance of infrastructure for the railway sector appears in financial data as well. The total annual railway network expenditures for new projects in Europe, maintenance, renewal and traffic control sum up to about 35 ban Euro. The calculated network asset value for rail and superstructure is about 300 ban Euro.

Punctuality

Punctuality is one of the most important factors in terms of reliability and an aspect where some quantified information is available. Punctuality differs between the railways and also between freight and passenger traffic.

The punctuality data of selected western European railways of figure 5 represents the share of punctual trains and reveal a wide range of reliability. On average, rail traffic punctuality is more than 5 percentage points lower than punctuality in passenger traffic.



- Freight train punctuality definitions are not known in detail but thresholds differ between companies from 5 min to 30 min
- Passenger trains are defined as still punctual if they arrive with a delay between 5 min and 7 min

1) Due to confidentially reasons data is made anonymous. Sample consists of western European countries. Data is normalised

Figure 5: Punctuality data

Even if the infrastructure has an influence on punctuality, a link between structures and network utilisation on punctuality cannot be drawn directly.Therefore, the basic factors on punctuality and reliability are shown precisely and they are already analysed considering possible actions on improvement.

Causes of unreliability and ways of improvement

The performance of a railway company is influenced by infrastructure and operations. Infrastructure related perturbations are responsible for about 30% of unreliability and operation related perturbations of about 40% as shown in figure 6. Signalling is by far the main cause of infrastructure delay

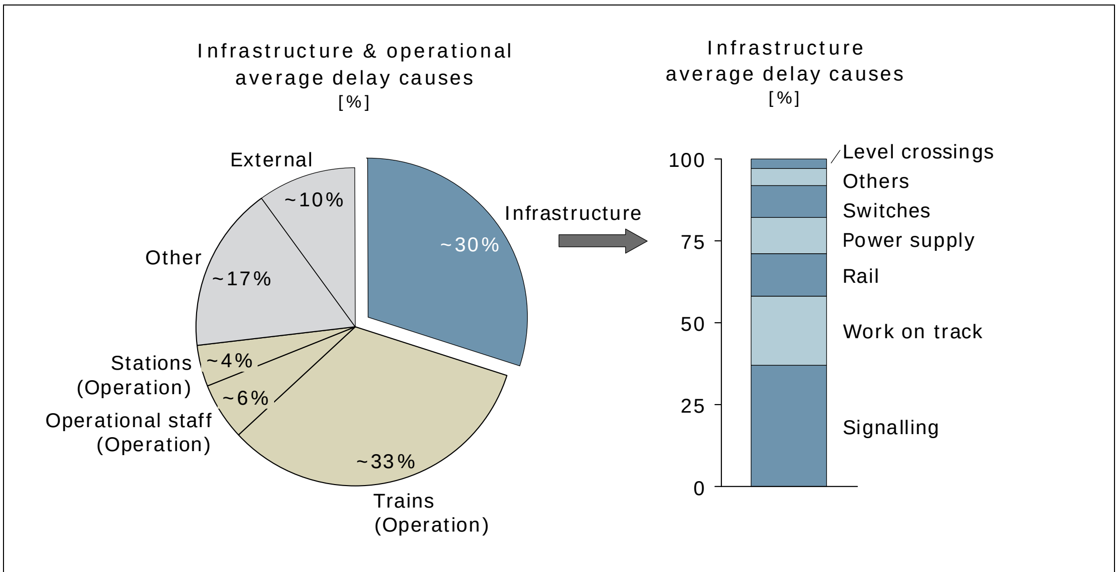


Figure 6: Infrastructure and operational delay causes

The perturbations have different effects on the duration of a delay. Power supply incidents cause by far the longest average delay times. The delay length of the other assets varies. The different delay levels of a railway are affected by different infrastructure parameters, e.g.:

- Network utilisation – in a high utilised network more trains are affected by one incident
- Renewal and maintenance policy – the implementation of a special repair task force and an efficient emergency process flow reduce the delay length
- Perturbation management – a comprehensive database helps to identify and to analyse vulnerable components

Figure 7 gives an overview how perturbations of infrastructure and operation lead to unreliability. Unreliability reasons are categorised in structural delays, temporary failures, operational staff and process flow.

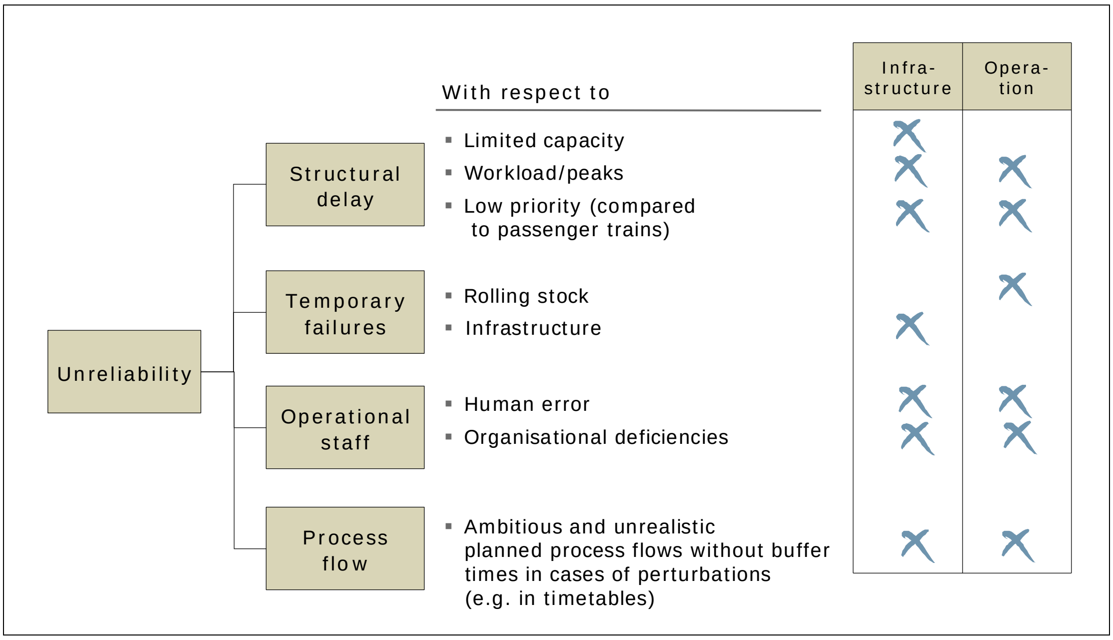


Figure 7: Causes of unreliability

In the following the underlying causes of the categories are explained by means of typical examples in detail. The reasons can occur individually but often perturbations are generated by a linking of different causes.

- Limited capacity: Existing capacity restraints and bottlenecks on relevant corridors (north-south axis) and interfaces (harbour hinterland traffic)
- Workload/peak: Infrastructure utilisation is limited to short termed time periods, which often lead to an overload e.g. in shunting yards or on freight lines
- Low priority: In most countries and corridors passenger trains are privileged in terms of the allocations of train paths, largely irrespective of track access charges
- Temporary rolling stock failures: Failures of locomotives and damaged wagons which could have an effect on track infrastructure, too
- Temporary infrastructure failures: Short term breakdowns but particularly speed restriction sections
- Human errors of operational staff: Late arrival of engine drivers, inaccurate setting of switches or wrong track allocation
- Organisational deficiencies: Inaccurate process flows e.g. missing instructions regarding rerouting and inaccurate communication e.g. between operation and infrastructure

- Ambitious, unrealistic planned process flows: Reliability and punctuality agreements are often based on optimal and efficient process flows e.g. in time-tables. However, these process flows partly do not include buffer times in cases of unplanned but common perturbations

Various approaches to improve reliability exist influencing one or more causes of unreliability of operation and/or infrastructure. Some of these approaches are selected and evaluated with a rough estimation on costs and effects. For example, the implementation of a preventive maintenance strategy to reduce temporary failures (s. no. 11 in figure 8) is a low cost measure but has only a low effect on reliability. On the other hand, the extension of infrastructure by new lines to increase network capacities is very expensive but has a very positive effect on reliability. Figure 8 summarises causes of unreliability with corresponding im-provement measures and related estimated costs and effects.

○ Very low
● Very high

No.	Cause of unreliability	Approach of improvement	Implemen-tation	Estimated costs of improvement	Estimated effect on reliability	Focus on operations or infrastructure
1	Workload/peak	Equalisation of demand	Differentiated pricing system	◔	◑	Operations
2	Limited capacity	Increasing availability	Preventive maintenance	◑	◑	Infrastructure
3	Limited capacity	Increasing availability	Faster perturbation repair	◔	◑	Infrastructure
4	Limited capacity	Increasing availability	Optimal planning of civil works	◔	◑	Infrastructure
5	Low priority	Change of paradigm	-	◑	◑	Operations/ infrastructure
6	Signalling and train control	Higher flexibility	From infra-structure block to moving block	◕	◑	Infrastructure

○ Very low
● Very high

No.	Cause of unreliability	Approach of improvement	Implementation	Estimated costs of improvement	Estimated effect on reliability	Focus on operations or infrastructure
7	Running at sight	Train control system; ETCRS	Speed controlled running	○	◔	Infrastructure
8	Limited capacity	Infrastructure investments	Small scale investments	◑	◕	Infrastructure
9	Limited capacity	Infrastructure extension	New (dedicated) lines	●	●	Infrastructure
10	Unrealistic planned process flows	Buffering schedules	Carefully allocated higher buffer	◔	◔	Operations
11	Temporary failures	Increasing availability	Preventive maintenance	◔	◔	Operations/ Infrastructure
12	Organisational efficiencies	Process optimisation	Quality management	◔	◑	Operations/ Infrastructure

Figure 8: Overview of reliability improvements

Infrastructure measures like enlarging network capacities and operational measures like optimisation of the transport chain can play important roles in improving reliability. Operational measures seem to have lower effects on punctuality compared to infrastructure measures. However, in principle operational actions are cheaper and could (and should) be realised in short term.

A further promising step towards an improved reliability in the rail freight traffic is to increase investments in infrastructure and interoperability of European power supply and traffic control systems.

Higher investments exceed the network capacities and improve the network quality with the intended consequence of an improved reliability. An ongoing effort to reach a higher level of interoperability between European railway systems makes border train reloading or axle-gauge changeover processes unnecessary and prevents the likelihood of related perturbations. Today reloading and changeover processes last between twelve hours and three days. Furthermore, congestion times at border stations will disappear. Both effects support faster and more punctual rail freight transports. An additional advantage is that the operational cost could be reduced to realise a cheaper freight transport. Figure 9 shows the variety of different power supply and traffic control systems in Europe and underlines the mandatory need for change. De jure a liberalisation of rail traffic takes place in Europe. However, these technical barriers hinder the de facto liberalisation of international transports or activities abroad.

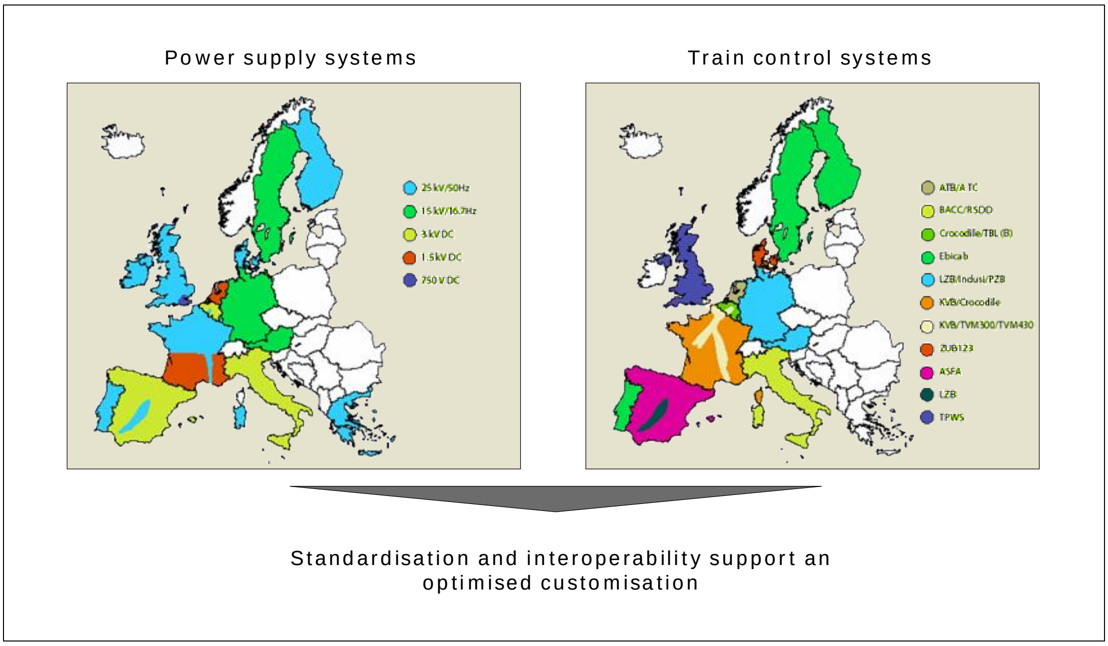


Figure 9: Interoperability of European railways (Source: EU, 2003)

The European Union already targeted this field of action and defined ten pan-European transport corridors with partly harmonised railway systems and rolling stock to foster reliability.

Unreliability generates costs. These costs of unreliability can be defined by long and short term components. Short term components are costs of underutilisation and transaction costs. Underutilisation negatively influences the capital costs and labour costs of a railway company. Transaction costs comprise e.g. costs for delayed shipment to customers, coordination of production lags or payments for waiting times.

Revenue declines and a shift of the modal split towards higher road shares affect the cost situation of railway companies in the long term. Revenue declines are triggered by lower transport volumes and lower prices. The shift of the modal split causes also higher external environmental costs and a further deterioration of the already tense road congestion situation.

A number of projects are implemented to improve rail freight traffic. Briefly outlined, some examples are described below:

Political authorities

- German Federal Ministry of Transport: The new draft master plan for freight traffic and logistics aims for accelerated implementation of European Train Control System (ETCS) in German freight corridors, temporal de-concentration of freight traffic and improved separation of freight and passenger traffic

Railways

- Canadian Pacific: During the last years Canadian Pacific boosted its reliability from about 65% to about 90% predominantly by operational improvements and at the same time increased earning per ton kilometre by about 20%. Canadian Pacific optimised the operational functions along its transport chain and uses a professional capacity management. Furthermore, it continued an aggressive pursuit of compliance in scheduling shipments to optimise capacity and delivery, implemented a tracking & tracing IT support system and built up co-operative arrangements with other railways in haulage services, directional running, enhanced freight interchange, and reciprocal access to terminals and service areas

Technical improvements

- Asset diagnosis systems: Strukton Preventive Maintenance and Failure Diagnosis System invented an early warning system of switch failures. Switches were clustered in order to determine assets "worth" to be monitored. Criteria are the number of incidents and the effects on traffic. The system leads to major improvements in switch performance due to:
  - Measuring the effects of maintenance before resumption of operations of a switch
  - Measuring the effect of modification
  - Long-term control recognising the impact of maintenance on performance and quality
  - Supplying very precise information to maintenance and repair teams

Industry

- Woolworth: Woolworth decided to carry textiles from Halkali, Turkey to Herne, Germany by rail instead by lorry in order to ensure a more reliable transport through reduction of weather caused delays, improved planning through defined arrival times and improved steering of incoming goods and therefore an optimised further processing
- Technocell Dekor: Technocell Dekor shifted an annual transport volume of 30.000 t of pulp from road to rail transport. The advantage is a more reliable transport due to growing congestion problems on roads. Additionally, through the implementation of a road charge also in Germany the rail transport became cheaper compared to road

These are only some examples on changes in the rail freight transport from various scopes concerning the improvement of quality and reliability.

Conclusions

- Unreliability has various underlying infrastructure and operational reasons
- There are several approaches for reliability improvements which have to be structured and calculated by railways, infrastructure companies and freight forwarders
- Based on such a reliability database the respective companies are able to identify the most efficient cost and effect investments
- An improved reliability ensures a high quality transport service for the customers

2.3 Price systems

In this chapter price systems are analysed in terms of transport charges to be paid by the railway clients' and in terms of track access charges to be paid by the railways themselves. The price levels influence the income situation and thereby possible investments to improve the reliability.

Transport charges

The calculation of the railway clients' transport charges is influenced by a number of parameters (figure 10). The combination of the factors determines the final price for the transport.

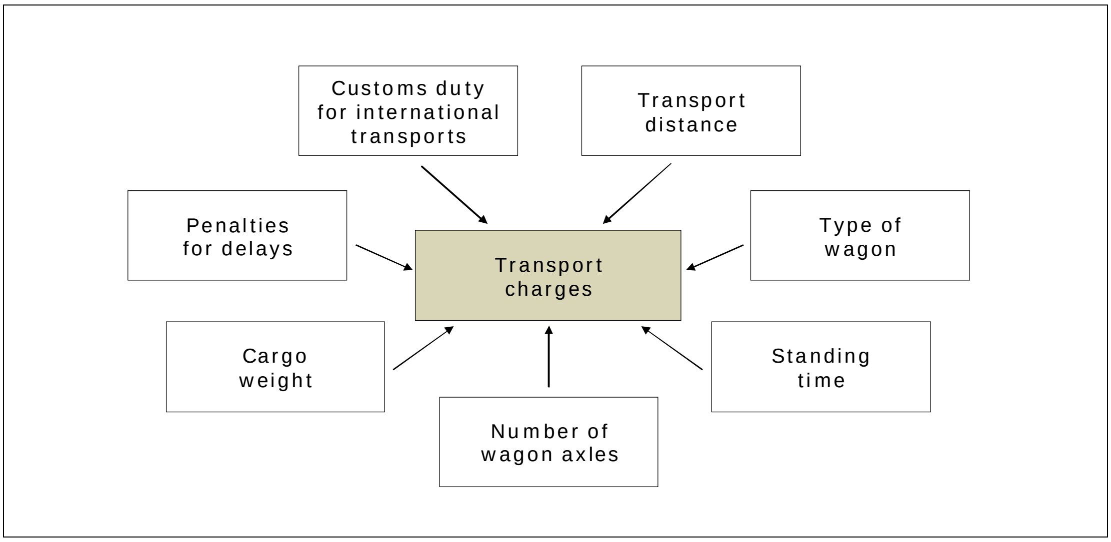


Figure 10: Rail freight transport charges

Transport quality guarantees are introduced at several railways, but until now it is not common practice. The quality promises regarding transport time, level of punctuality (minimum percentage of punctual trains) and penalties for delays especially for border crossing traffic are compared to road transport rather weak or not existing at all.

Some railways have abandoned quality products due to relevant higher production costs for resources and infrastructure and a more complex production process e.g. quality single wagon load products at Deutsche Bahn.

Quality agreements for block trains and single wagons are mostly concluded with key accounts on an individual basis. For example, Rail Cargo Austria offers a rail product for international piece goods named "*RailExpress*" which ensures a defined punctuality for a considerable price surcharge. The service includes door-to-door transport. This product is around 125% more expensive than the comparable product "*RailStandard*" which does not include any delivery time guarantee. "*RailExpress*" goods are transported in high quality trains ensuring higher punctuality but not higher system speed. In case of delays customers get charges reimbursed in full. The delivery deadline is a maximum transportation period of 24 hours per 200 kilometres. A lot of countries have according flat rate values.

Track access charges

Track access charges invoiced by the infrastructure companies and to be paid by railways are determined by specific components of track and operation. Figure 11 explains these components based on an example of DB Netz AG.

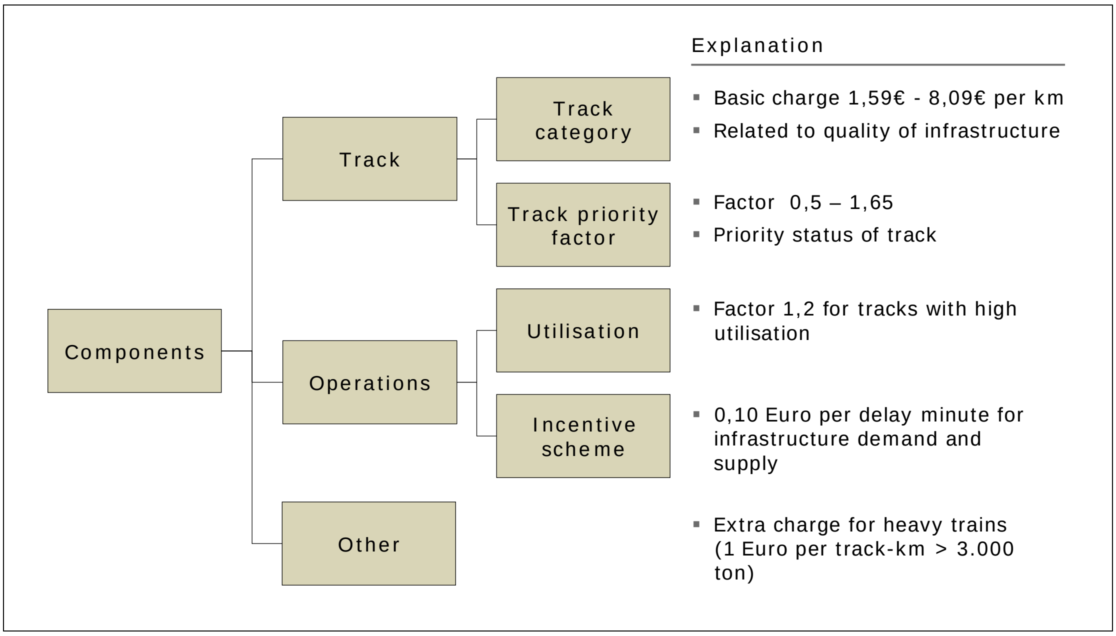


Figure 11: DB Netz AG example of track access charges

The main components to calculate track access charges are track and operation related. With a higher qualitative infrastructure or higher utilised lines the access charge rises.

Between the European countries, costs for infrastructure use reveal significant differences. The general cost share of a rail freight company for infrastructure track access is between 4% and 30% of its total costs.

To calculate the feasibility of sufficient infrastructure investments the cost recovery rates of the network need to be analysed. From the railway infrastructure companies' point of view, additionally to the level of access charges the network utilisation is the key success factor. Track access levels in combination with the network utilisation lead to cost recovery rates. Mostly, earnings by track access charges cannot cover the full amount of the infrastructure companies' cost (Figure 12).

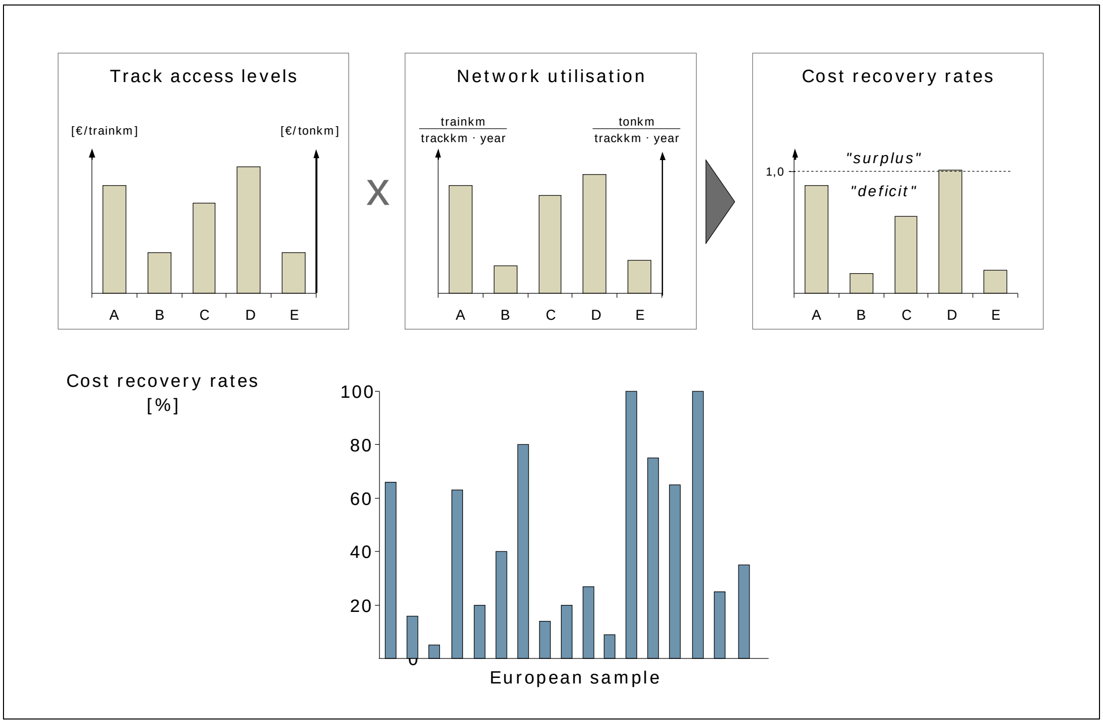


Figure 12: Track access – infrastructure companies' view

3. Market survey

Several hundreds European forwarders, shippers and logistic service providers have been contacted by post, e-mail and personal contacts and were asked to fill out a specific questionnaire with general issues of rail freight services and special questions in terms of preferred transport alternatives. Part one of the questionnaire includes general questions to characterise the company and their requirements regarding (rail) freight transports e.g. turnover, employees, type of company and preconditions for an increased transport by rail. Part two consists of the preference analysis.

The target of this choice-based conjoint analysis is to identify the weight of individual parameters in a complex decision between two transport alternatives. The analysed parameters and their specifications are:

- Price
  - Specifications: +20%, +10%, 0%, -10%, -20%
  - +10% means that the price is 10% higher; -10% means that the price is 10% cheaper
- Punctuality
  - Specifications: +20%, +10%, 0%, -10%, -20%
  - +10% means that the punctuality is 10% higher; -10% means that the punctuality is 10% lower
- Transport time
  - Specifications: +20%, +10%, 0%, -10%, -20%
  - +10% means that the transport time is 10% longer; -10% means that the transport time is 10% shorter
- Transport mode
  - Specifications: Railway, lorry

32 logistic related companies took part in the survey. The results show tendencies of freight market companies. The conjoint results have to be regarded relatively i.e. in relation to further parameters and in the context of the chosen specifications.

In addition to the questionnaire based investigations many interviews were made with experts from the rail freight business. The aim of the interview was to check hypothesis and to make a good estimation on market development and potentials in optimisation, especially in the area reliability and rail freight transport. The experts are leaders from railway companies, shipping agents and forwarder companies as well as branch associations and branch organisations.

3.1 General characteristics of participants

More than half of the responses came from large market-influencing companies with more than 200 m Euro turnover and more than 500 employees. The yearly average transport volume of the participating companies with a turnover of more than 200 m Euro is about 22 m tons whereas the average yearly transport volume of companies with a turnover lower than 200 m is 0.7 m tons.

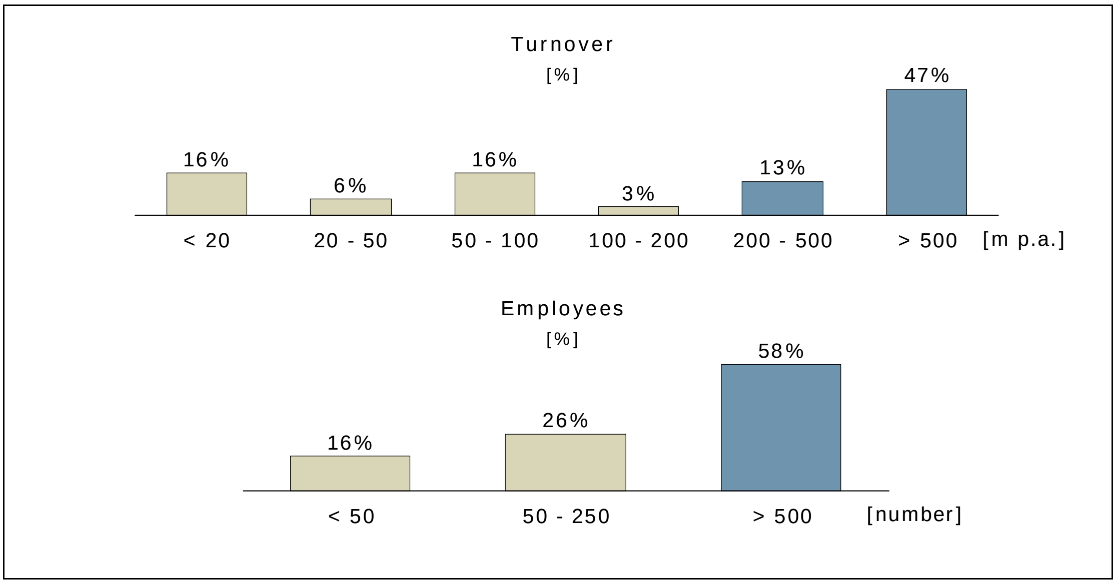


Figure 13: Structure of participants - turnover & employees

In average, 30% of the yearly turnover on transport is spent by the participants as illustrated in figure 14. The participants transport a broad variety of cargo e.g. chemical goods, iron, steal, non-iron metals, petroleum, mineral oil products, vehicles, machines, half-finished, finished and special goods. The yearly average transport volume of the participants adds up to 13 m tonnes.

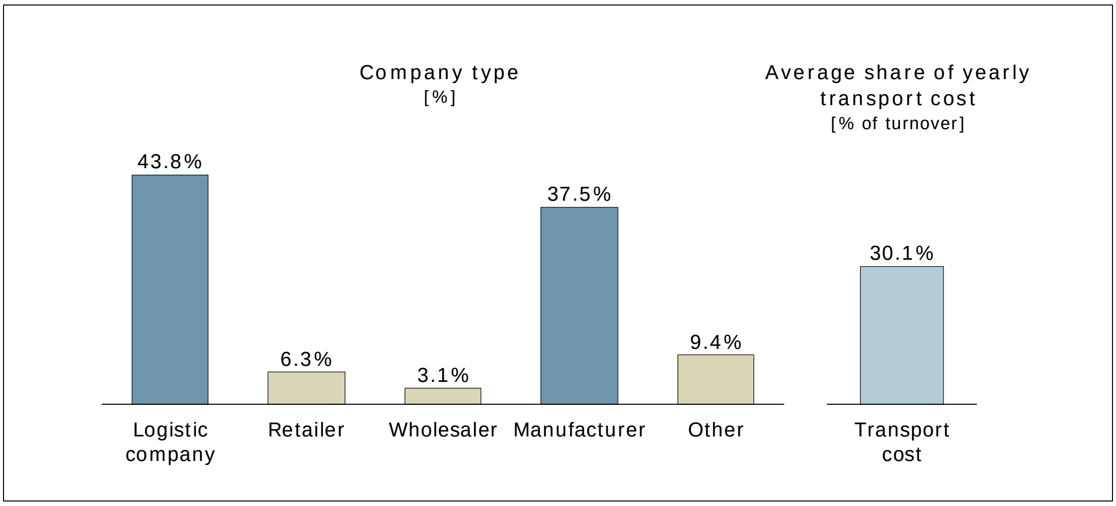


Figure 14: Structure of participants – company types & transport costs

The choice of a transport mode is influenced certainly by price, punctuality and transport time. From the participants' point of view the price is the crucial criteria to select a transport mode (Figure 15). About half of their decision is based on the price level. Punctuality conditions influence nearly 25% of the decision.

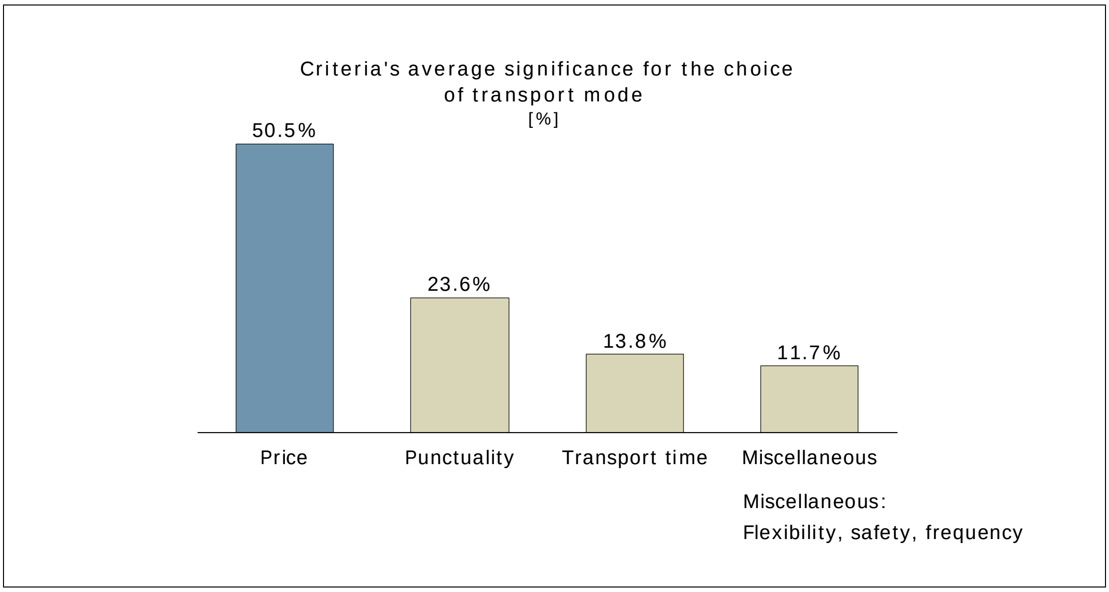


Figure 15: Determination criteria

For a deeper insight in the transport decision process, the participants were asked to judge selected preconditions that have to be realised in order to transport more cargo by railway. In this context, cheaper prices, higher reliability, flexibility and availability are the main preconditions to support rail transport (Figure 16). Thereof cheaper prices are the key precondition. 94% of the participants at least partly agree with the importance of cheaper prices. Whereas 88%, 84% and 77%

evaluate higher availability, reliability and flexibility as at least partly important. According to the participants faster transport times and additional services play an inferior role in the transport process.

		Agree completely	Agree mostly	Agree partly	Do rather not agree	Do not agree
Cheaper prices	67% =	32%	35%	26%	3%	3%
Higher reliability	55% =	29%	26%	29%	6%	10%
Faster transport times	33% =	23%	10%	45%	16%	6%
Improved supporting logistics	47% =	10%	37%	27%	17%	10%
Higher flexibility	64% =	27%	37%	13%	20%	3%
Higher availability	55% =	26%	29%	32%	6%	6%
Additional services	20% =	17%	3%	17%	43%	20%

Figure 16: Preconditions to transport more cargo by railway

In preparation for the preference analysis the participants were asked to characterise the transport process of a typical good. Figure 17 shows that transports are carried out nationally and internationally. About 60% of the participants already use tracking and tracing systems to pinpoint the cargo's location.

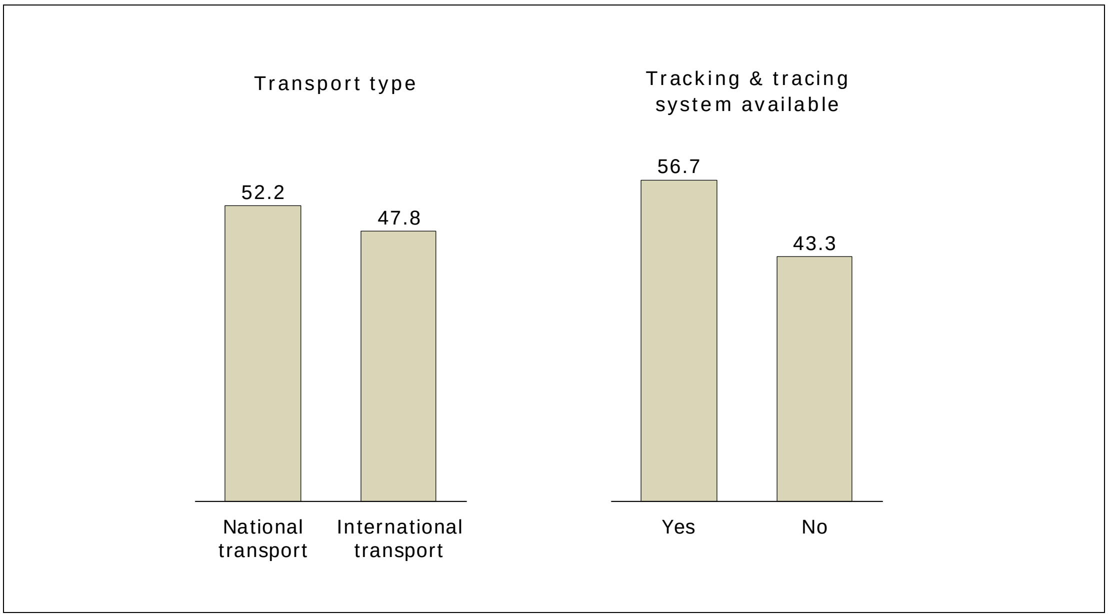


Figure 17: Transport characteristics

The average share of punctual transport with about 83% is slightly below the sample average of 87% described in chapter 2.2. In order to consider the freight still as punctual about 80% tolerate delays of at least half a day.

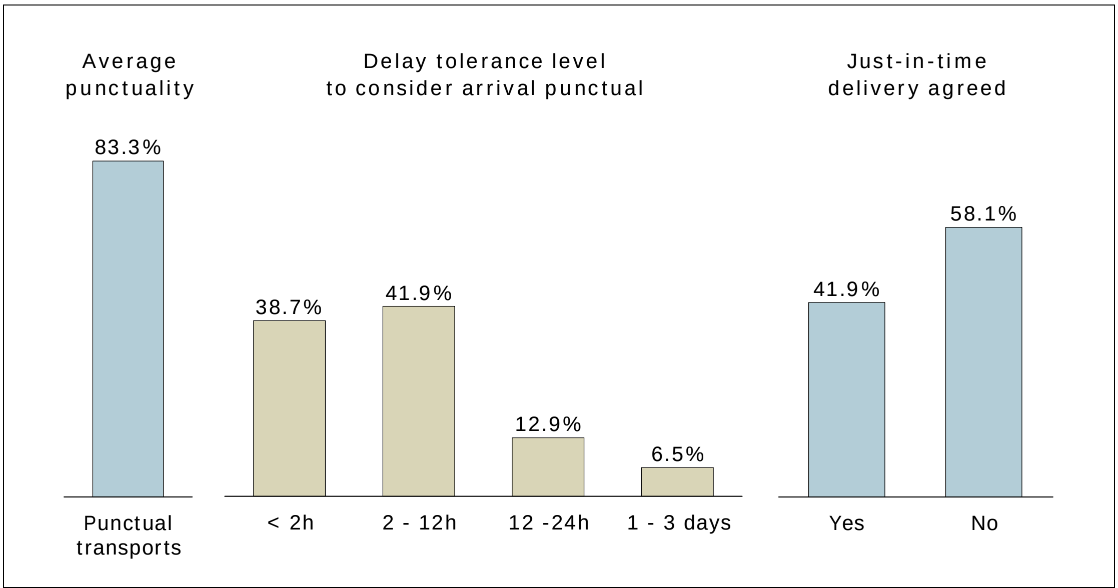


Figure 18: Punctuality structure

The three main reasons of delay stated by the participants are congestions, insufficient staff and rolling stock capacities and operational problems like perturbations in loading and reloading processes. These findings of the survey fit with the main reasons of delays of chapter 2.2 where infrastructure and operational causes are analysed.

The following results of the conjoint-analysis reveal a deeper insight in the participants' underlying preferences to choose a transport.

3.2 Results of the conjoint-analysis

Based on the conjoint questionnaire the significance of the individual parameters price, punctuality, transport time and transport mode can be deduced. Thus, the most important parameter for the choice of a transport type is with 36 out of 100 possible significance points the price. Transport time and punctuality are also important but less than the price factor. The transport mode, railway or lorry, is with 10 points of a minor degree for the decision of a transport type as indicated in figure 19. To some extent this result varies from the participant's stated criteria significance for the choice of a transport mode in the general part of the questionnaire (see figure 15, chapter 3.1) where the significance of the price is even higher, the significance of the transport time considerably lower.

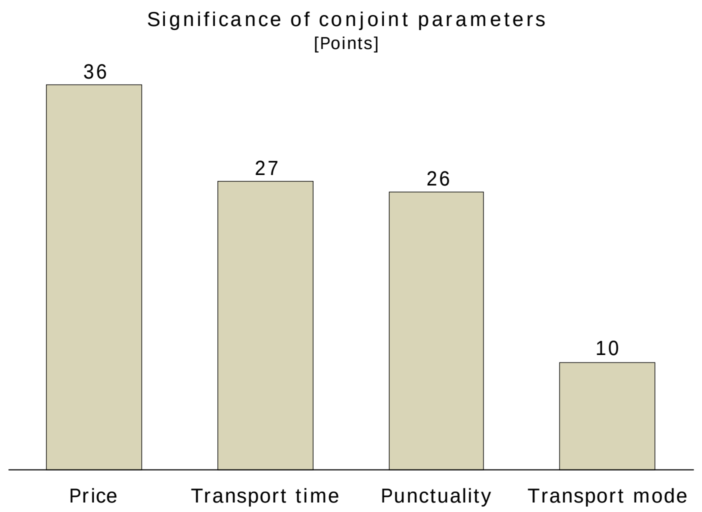


Figure 19: Significance of conjoint parameters

A part-worth utility describes the individual impact of a specific parameter on a transport decision and is analysed detached from other parameters. Positive utilities indicate that this parameter influences favourably the decision. High negative ones indicate that this transport condition might be discarded. Part worth utilities are in the range of +1 to -1 and do not have a unity. The following results show the part worth utilities of the individual parameters and the significance of the parameters' different specifications.

Figure 20 shows the higher the price the lower is the part-worth utility of the price. An actual price has a positive part worth of 0.12. Lower prices reveal higher positive part worth utilities. A price -20% lower than the actual one has a high part-worth utility of 0.53 implying that this specification has a high positive impact on the decision for a transport alternative. If the price increases the part worth utilities will be negative. An increase of +20% reveals a high negative impact on a decision of -0.64.

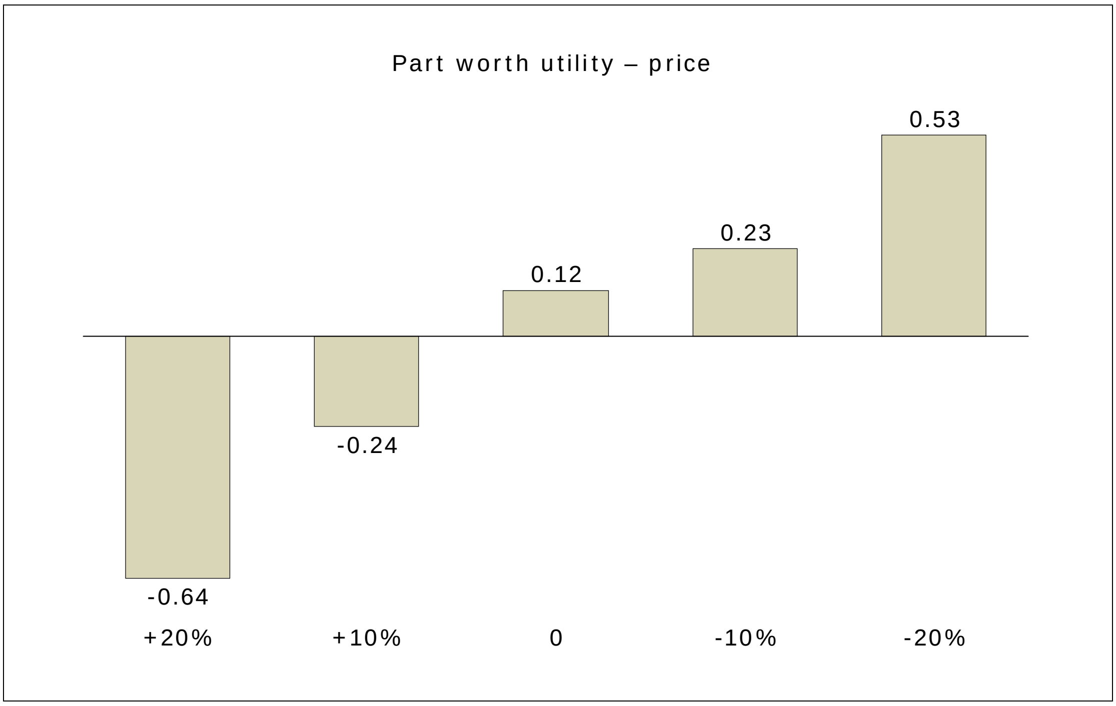


Figure 20: Part-worth utility - price

Punctuality is also important for a transport decision even if the price level dominates. The expectation to be more punctual achieves lower part worth utilities than part worth utilities for being delayed (Figure 21).

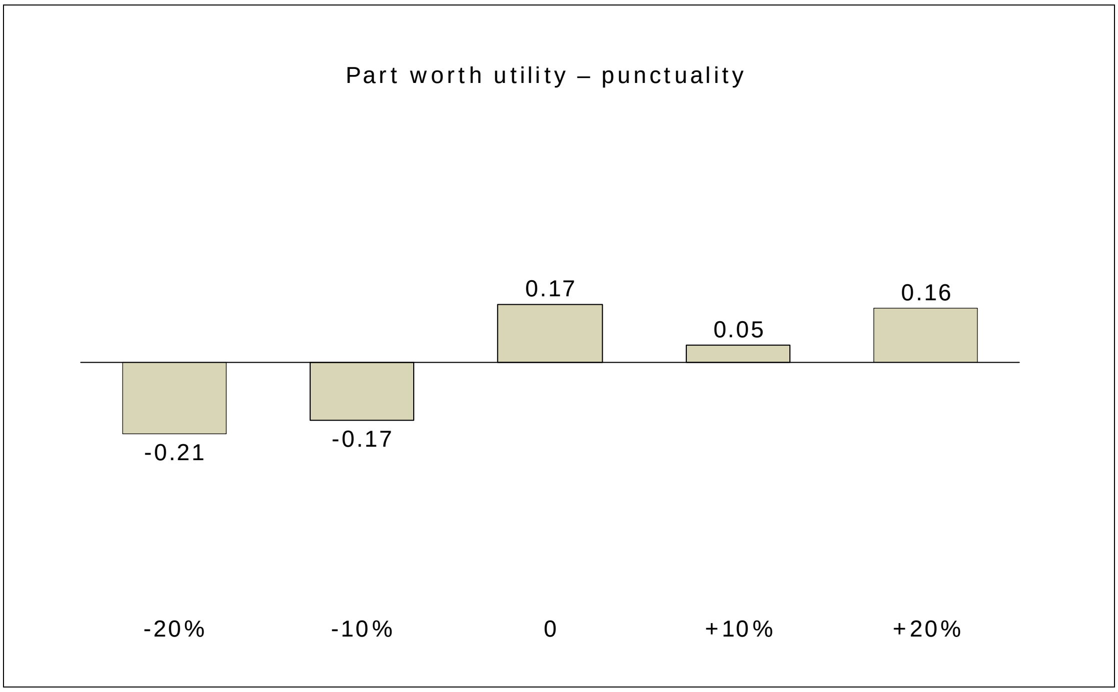


Figure 21: Part-worth utility - punctuality

The expectation to be +10% more punctual reveal a relatively low positive impact. Not until punctuality is improved by +20%, the part-worth utility climbs to 0.16. However, delays are not accepted at all. A -10% deterioration shows already a negative assessment of the part-worth utility of -0.17. With a further decrease to +20% the part-worth utility drops to -0.21. Thus, a -20% lower punctuality has a slightly higher impact on the decision than a +20% punctuality improvement.

The part worth utilities of the transport time are lower than the values of price and punctuality. Figure 22 indicates that an extension of the transport time of +10% with a part-worth utility of -0.05 is accepted to a certain degree. A worsening to +20% causes a rise to -0.12. An increasing transport time has therefore a low impact, but a reduction of the transport time reveal a marginal influence on the transport decision.

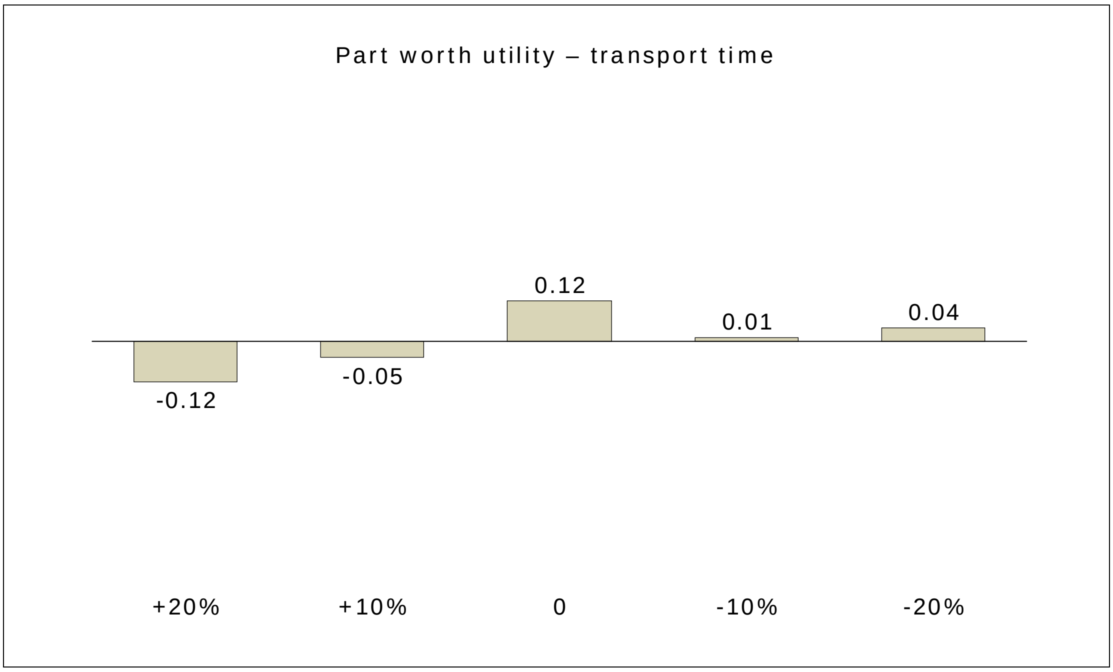


Figure 22: Part-worth utility – transport time

The part worth utilities for the type of transport mode show very low positive and negative values. Therefore, this parameter has only a low or no impact on the decision of a transport (Figure 23).

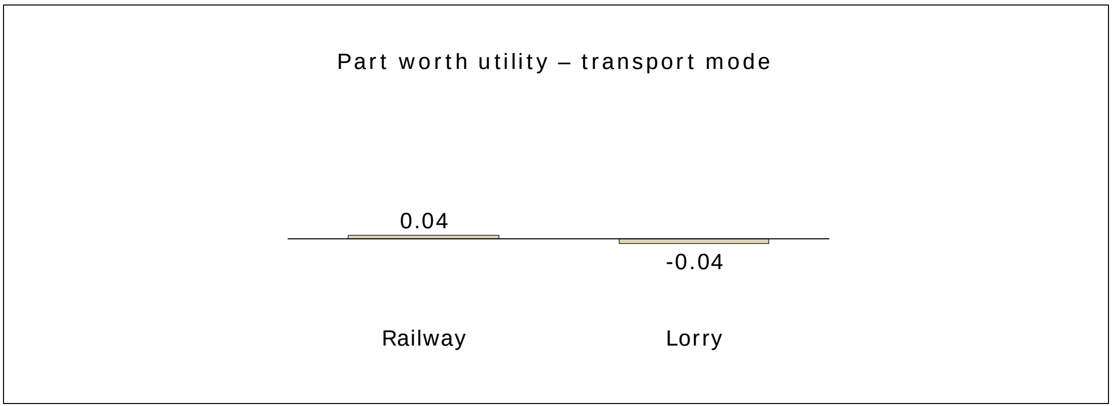


Figure 23: Part-worth utility – transport mode

The total utility for different scenarios will be calculated by adding the individual part worth utilities of the overview in figure 24. The higher the total utility the higher is the preference of a transport alternative.

Specification	Price	Punctuality	Transport time	Transport mode
-20%	+0.53	-0.21	+0.04	
-10%	+0.23	-0.17	+0.01	
0%	+0.12	+0.17	+0.12	
+10%	-0.24	+0.05	-0.05	
+20%	-0.64	+0.16	-0.12	
Railway				+0.04
Lorry				-0.04

Figure 24: Overview part worth utilities

An example in figure 25 illustrates the calculation of total utilities. A transport carried out by railway instead of lorry with a +20% higher punctuality reveal an increased total utility of +0.44 compared to the lorry one with +0.37. If the same transport would be carried out with a price decrease of -10% the total utility would rise to +0.56. This relation also shows that the price has a higher impact on a transport decision than the punctuality.

	Lorry		Railway		Railway	
	Specification	Part worth utility	Specification	Part worth utility	Specification	Part worth utility
Transport mode		-0.04		+0.04		+0.04
Price	0%	+0.12	0%	+0.12	-10%	+0.23
Punctuality	0%	+0.17	+20%	+0.16	0%	+0.17
Transport time	0%	+0.12	0%	+0.12	0%	+0.12
Total untility		+0.37		+0.44		+0.56

Figure 25: Total utility

These examples reveal that punctuality indeed has an impact on the transport decision but the price's impact is much higher.

3.3 Qualitative Interviews

Next to the survey by questionnaire several qualitative interviews were carried out with transport and logistics experts from e.g. Deutsche Bahn, Rail Cargo Austria, Association of German transport companies, Rail Freight Group (U.K.), Forschungsgemeinschaft für Logistik (research community) and New Opera (Operating network for a European Rail Freight Network).

The results of the expert's interviews mainly sustain the findings of the market survey. Reliability is also from the expert's view an important parameter but in some cases more a precondition for staying in the market. In some branches relevant potentials are seen for new and further demands on rail freight services. This especially concerns branches that can offer a reliable transport due to well-linked logistical chains as well as branches that require low transportation times due to high costs of capital of the transported goods (e.g. half-finished and finished goods).

And it is not sure whether you can achieve higher prices because there is a huge price pressure in the market at present. On a midterm or long-term basis, perspectives for a higher price differentiation are seen that also include higher prices for notably reliable transportation. An improved reliability of the rail freight traffic can be realised significantly through operational measures to foster capacity management e.g. by improved timetabling, train running, loading, dispatching and reception. Chapter 2.2 already described the importance and possibilities of operational improvement measures. And also the market survey's results show that operational problems are one of the main reasons for perturbations and related delays.

A reliability improvement on the basis of the current infrastructure conditions is regarded as very difficult. Especially problems in border crossing transports due to inadequate interoperability and missing standardisation and a discrimination of freight against passenger transport are hindrances. In order to cope with the rising prospected transport volume and to guarantee a high level of punctuality new infrastructure is needed. Some of the interview partners see the only relevant input to increase reliability of rail freight transport and the according increase of the railway in the modal split.

But the necessary enlargement of network capacities cannot be financed by increasing turnovers. Public funding is still essential but is often spent on prestige-projects instead of the amelioration of infrastructure bottlenecks.

By the participants several approaches for better reliability were named, e.g.

- Realisation of dedicated freight lines
- Revitalisation of shut down lines
- Longer trains
- Up to date train controlling technology
- Improved access to shunting locations
- Increased storage possibilities
- Optimised train running

Next to the operational and infrastructure capacity problems, the availability of rolling stock is becoming more and more scarce leading to rising prices and bottlenecks.

3.4 Conclusions of the market survey

In order to interpret the results it has to be kept in mind that the survey pictures a specific part of the freight market especially against the background of the small sample. The calculated values of the conjoint analysis provide important indications but they have to be regarded relatively i.e. there are further parameters and more specifications defining the transport decision.

Choice of a transport mode

The general part of the questionnaire as well as the conjoint analysis identify punctuality as an important parameter in the decision process but the price is the dominating factor in the freight sector. Punctuality is regarded more as a precondition for the participants. This ranking is also supported by the interviews with the logistic experts.

A reduction of the transport time seems to have no significant impact on the transport decision but a longer transport time is valued slightly negatively. Also the expert questioning reveals that the reliability is crucial and not a higher speed in most cases.

It does not affect the transport decision a priori whether the transport is operated by railway or lorry.

Next to cheaper prices and a higher reliability also a higher flexibility and availability of rail transports are regarded as necessary for successful freight services.

Punctuality hindrances

The main reasons of an insufficient punctuality from the participant's point of view are traffic congestions caused by scarce infrastructure capacities, operational problems e.g. during the loading and reloading processes as well as rolling stock and especially wagon shortages.

The expert's interviews added further problems in terms of punctual freight services:

- Shunting capacities are scarce
- Storage space is inadequately
- Passenger trains are prioritised
- Insufficient interoperability and standardisation

Some experts are of the opinion that without a significant enlargement of the infrastructure a reliability improvement is in a medium term not possible. Dedicated freight lines, a revitalisation of shut down routes and state-of-the-art train control technology are necessary to cope with rising transport volumes and to ensure reliable transports.

All experts are aware that infrastructure is expensive. They see only low chances that infrastructure can be financed privately e.g. by public private partnerships (PPP) due to small expected returns caused by the low track access charge levels. Furthermore, public infrastructure companies can benefit from better interest rates than private companies in some cases. One of the experts is convinced that in some cases a lean infrastructure is completely sufficient and could be build more cost effective.

4. Implications and recommendations

The following chapter explains the implications and advices on actions classified according to their relevant groups.

- Rail freight companies: Focus on operating
- Infrastructure companies: Focus on infrastructure
- Political authorities: Focus on funding

Rail freight companies

Rail freight companies should put effort into the improvement of reliability to develop their market position. Reliability is an important parameter even if the price is the dominating factor in the freight market.

Over the last years several activities have been approached to enhance the rail freight products. But there still is a selected market segment of the freight market, where rail freight companies are active and competitive. Currently, rail transports mainly bulk cargo like coal or textiles and rather rarely high qualitative technology products. If the railways want to enhance business also to more sophisticated market segments they have to assure first of all the punctuality. This is the precondition and only thereafter a price differentiation for products can take place. The following figure describes possible ways of business developments. The freight railways are going to have a steady development of products, quality differentiation and further services to meet customer requirements, both in new and in changing markets. At present rail freight companies are focussing on the fields (1) and in some cases (2).

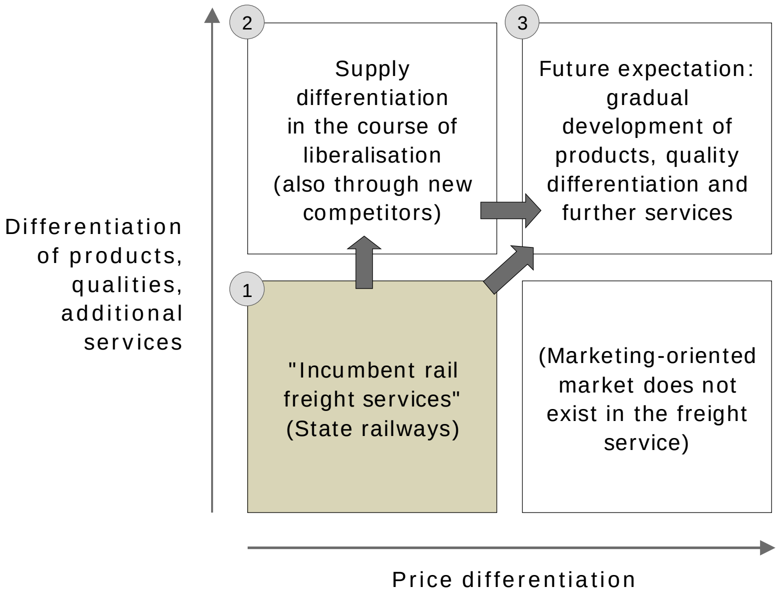


Figure 26: Strategy portfolio

In this context, they will presumably offer more customised high quality products with different standards in reliability in order to gain higher prices (3). On the other hand, efficiency growth due to e.g. advanced process flows should be used to offer more attractive prices to the clients. Bimodal traffic concepts might be one strategy to combine the advantages of rail and road transport and to ensure high quality and tailor-made services for the clients. The offer of an optimal transport chain with a one-stop-shop for the customers is a promising basis for a successful business.

Nevertheless, a high reliability is a precondition for a successful rail freight business. According to the judgement of experts the current level of reliability in many branches of the rail freight business currently lays below the according minimum requirements. By increasing the reliability and to some extent by reducing transport times a notable increase of demand in these branches is to be expected. A lower punctuality will not be tolerated by customers and will lead to decreasing market shares.

Irrespective of the political and infrastructure framework, rail freight companies can improve reliability by operational measures e.g. by improved timetabling or train running. Operational measures have two important advantages for railway companies: The measures can be implemented at short term and are often possible without massive investments. The establishment of incentives (Bonus/malus, penalties) to increase pressure from the network operator might be useful to force railway companies to improve operations.

Higher reliability is one important aspect, because it forces the competitiveness of freight railways and also leads to lower costs in terms of better utilisation of the resources and more potential traffic volume.

Large infrastructure investments are rarely possible without public funding because track access charges cannot finance the necessary investments in the railway infrastructure. Political decisions are needed to prioritise infrastructure projects.

Infrastructure companies

A higher transport growth comes along with a better network utilization and a higher cost recovery rate (s. figure 12). But it does not significantly foster an improved financial situation because the parallel rising maintenance and renewal costs partly "eat up" the additional earnings. In order to really enhance the financial scope the track access charges have to be increased, which could be done according to a better network performance.

However, merely track access charges cannot finance the necessary investments in the railway infrastructure. The possibility to generate by growing turnover higher investment funds is limited because of the financial relations between railway and infrastructure companies. Up to 30% and approximately 10% - 15% in average of the turnover of railway companies are paid as track access charges to infrastructure companies. In an optimistic scenario 5% of the track access charges can be reinvested by the infrastructure companies. The investment funds based on track access charges could finance only 1% of annual depreciation of the total network asset value in the European Union. Infrastructure companies will still need public subsidies.

Track access charges are very different in Europe and partly leading to a distorted competition. In a growing together of the European economic area the track access system could be further optimised and adjusted.

Infrastructure companies should be responsible to ensure a defined infrastructure quality as described above to realise the necessary standards for a reliable traffic by:

- Preventive maintenance
- Faster perturbation repair
- Optimal planning of civil works
- Quality management

- Infrastructure extension (highly depends on public funding)

The implementation of infrastructure improvements can only be realised in medium term, infrastructure extensions in the long term.

Infrastructure companies are strongly influenced by political authorities. A stand-alone strategy deduction without taking into account the strategy of political authorities is not practicable.

Political authorities

Political authorities and railways underwent big changes over the last decade due to the reforms of the national railway sectors in Western Europe. One of the consequences of these reforms are railways with the ambition to act more economically and self-determined in terms of decision making.

Due to the insufficient cost-recovery of the existing infrastructure from user fees and the demand of high infrastructure investments to enlarge network capacities and to cope with prospected rising transport volumes in the future, a funding of the network from political authorities will be still necessary in the long-run. To assure both - the autonomy of the infrastructure managers and the influence/controlling by the political authorities - new ways of cooperation have to be developed.

The most successful approach to serve the requirements of the political authorities and the railways seems to be service level and funding agreements. To assure reliability of long-term planning for railways political authorities should agree to long-term or at least mid-term (3-4 years) funding agreements. The budget funded by the authorities should be provided unrestricted as far as possible (e.g. not "*renewal of 5 switches in the area Y*"). To assure the optimal allocation of resources, the railways need to be controlled by the political authorities via output oriented key performance indicators (e.g. availability of the network, number of perturbations etc.). This would also be an important way to ensure network conditions that support the requirements for reliable transports.

Some European authorities and railways have already developed such agreements over the last couple of years and are now working on improving and detailing these agreements. Pioneers in Europe are The Netherlands (ProRail), Switzerland (SBB), Great Britain (Network Rail) but discussions are going on in Germany (Deutsche Bahn AG) and Austria (Österreichische Bundesbahnen).

International transports are growing strongly and have to be supported particularly. In order to simplify and to cheapen international transports the countries have to standardise traffic controls, power supply systems and regulations in terms of rolling stock and staff requirements. The interoperability along the north-south corridor from the Netherlands and Germany to Austria, Switzerland and

Italy already reveal positive harmonisation approaches. On corridors from West- to East-Europe interoperability is hardly implemented.

An implementation and extension of road charges for freight traffic is a suitable instrument to internalise external cost of the road sector and cause cost advantages of rail transports.

Outlook

This study identifies the relevance of reliability and punctuality on demand and willingness to pay. The relevance will even increase in the future because in a close interwoven economy with a high division of labour the reliability requirements will rise. In this context, short, medium and long term measures of railway companies, political authorities and infrastructure companies are elaborated to improve punctuality.

The core question especially for political authorities is to decide about the scope of financial subsidies. How much money do they want to spend on what kind of infrastructure projects for rail freight transports?

Various experts mentioned in this connection the implementation of dedicated freight lines as a solution in order to increase significantly the attractiveness and competitiveness of rail freight market. Successful examples from the US or Canada reveal that with an infrastructure used exclusively by freight traffic noticeable positive effects can be realised:

- Lower investment and maintenance costs compared to mixed lines
- Increased utilisation with a higher train frequency and longer trains leading to a higher profitability
- Increased reliability due to a lower vulnerability of infrastructure only used for freight transports
- Higher rail modal split
- Higher cost recovery rates for infrastructure investments

Decision maker should be open minded to discuss new business models for rail freight transports. An analysis of advantages and disadvantages of existing models from other countries might be a good starting point to identify suitable ways for a comprehensive European rail strategy.

5. Appendix - see enclosed document