Jernbaneverket
Norwegian High Speed Railway Assessment Project

Contract 6: Financial & Economic Analysis
Subject 1: Effects on Road and Aviation Sectors
Final Report

14/02/2011

Plan Design Enable

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Contract 6: Financial & Economic Analysis

Subject 1: Effects on Road and Aviation Sectors

Final Report

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Purpose of the Phase 2 study

The Norwegian National Rail Administration (Jernbaneverket - JBV) has been mandated by the Norwegian Ministry of Transport and Communications to assess the issue of High Speed Rail (HSR) in Norway. Atkins has been appointed by JBV to assist in Phase 2 of this HSR development project. The objective of the Phase 2 work is to identify a common basis to be used to assess a range of options for HSR development in Norway.

Purpose of this report

The objective of this report is to consider the range of impacts HSR could have on other modes of transport. The issues considered in this report are:

- The likely impact of HSR on the air and road sectors, in terms of financial and socio-economic effects;
- The extent to which improvements to airport terminal handling could improve the overall journey time associated with air travel, and hence pose a significant challenge to HSR in terms of inter-modal competition; and
- The potential impact on infrastructure development if there is more than one operator of HSR on a given route.

The conclusions reached in this report will provide input to the establishment of an appropriate approach to assess the economic impacts of HSR in relation to other modes.

The air sector (see Chapter 2)

The premise of the impact of HSR on the air sector is the potential abstraction of demand and revenue from the airlines and a resulting impact on Avinor, the airport operator. It is important that the demand and revenue challenge posed by HSR on the air sector is noted. There are a number of ways the air sector could respond to the challenge of HSR, which can be grouped into the following categories:

- Category 1 - Acceptance of revenue loss without changing services and therefore operating costs – for example, if the route is subsidised or the revenue loss is small in comparison to other markets served by the route such as the interlining market, or if higher profit services are provided by the same planes on connecting legs of their overall routing schedule;
- Category 2 - Reduction in operating costs to offset revenue loss but using measures that do not noticeably impact on air passengers – for example, the same level of service could be provided to the passengers, but savings could be derived from back-office / supply-chain optimisation, or the planes could be changed to suit post-HSR demand. These planes could be smaller and have lower operating costs;
- Category 3 – Introduction of measures to generate revenue or save operating costs that do not avoid an impact on the remaining air passengers. For example, fares could be increased for inelastic demand (in which case demand may be reduced further but the total revenue could increase) or fewer or no flights could be operated, which would make air travel less convenient and hence reduce demand and revenue but save operating costs. Where the response involves reducing the number of planes and/or landing slots in use, airlines could potentially use any released capacity as a basis for expanding into new markets, helping to compensate for lost demand and revenue; and
- Category 4 - Mitigation of revenue losses through competition with HSR, consequently resulting in a reduction in HSR demand and revenue – for example, the airlines could reduce

fares or they could make the service more attractive by increasing the number of flights, especially in peak periods, abstracting back demand from HSR as well as potentially generating new demand from people who would not otherwise be travelling. Coupled with this, airlines could attack new markets to compensate for lost revenue (although it is questionable whether there would be opportunities to do this beyond what airlines would do without the HSR improvements).

While four categories are discussed above, there are numerous potential response measures that fall under these categories. In addition the response measures, and indeed categories, are not all mutually exclusive – some can be bundled together to form packages of responses.

At this stage, it is unclear how the air sector may respond and the response will be different depending on the route and market. As a starting point, its response strategies would be heavily influenced by the level of demand abstracted to HSR. The establishment of a demand forecasting model forms part of the Phase 2 study. Using this model, HSR demand impact on the airlines will become more apparent in the Phase 3 study. As part of the Phase 3 study sensitivity tests varying responses from the air sector as well as the iterative impact on HSR and the impact on Avinor will be undertaken, based on the four broad categories discussed above.

In terms of the potential impact of HSR on airport investment, again, the response from the air sector needs to be considered in greater detail in Phase 3. Meanwhile, initial analysis (pre-demand forecasting) suggests that major airport investment is unlikely to be affected by HSR. This is due to a number of considerations, including the timing of HSR and the potentially limited impact on overall demand at airports, as well as the possible air sector responses already discussed.

Once the air sector responses have been tested in more detail in Phase 3, the estimation of socio-economic impacts, such as noise, pollution, emissions and accidents from the air sector, will be undertaken, primarily based on the reduction to the number of flights – an appropriate approach as currently used by Jernbaneverket in rail project assessments, following its guidance.

The road sector (see Chapter 3)

The premise of the impact of HSR on the road sector is the potential abstraction of demand from car traffic. The reduction to car traffic will result in a reduction to toll revenue – an adverse impact on the state income. However, with a reduced level of traffic on the roads, savings could be made from infrastructure spending – a positive impact on the state budget.

Because there would be fewer cars on the roads as result of HSR demand abstraction, there would be a range of socio-economic benefits, including reduced noise, pollution and emissions from cars and fewer car accidents, This is captured in the socio-economic analysis outlined in the Subject 4 Economic Analysis report and will be assessed for each option considered in Phase 3.

The bus and ferry sectors (see Chapter 4)

Compared to demand abstraction from the airlines and cars, it is envisaged that HSR's impact on buses, and inter-city ferries in particular, will be limited. Nevertheless, it is important to establish the demand and revenue challenge posed by HSR on the long-distance bus operators and to confirm the impact on ferry trips on relevant corridors using the demand forecasting outputs in Phase 3. As discussed with respect to the air sector, the initial challenge should not be interpreted as the final outcome there is a range of possible responses from the bus operators, which will be established as part of the Phase 3 study, when the magnitude of the challenge has become more apparent for each option on each corridor.

As with the air sector, the estimation of socio-economic impacts depends on the responses from the operators. For example, if fewer buses are operated, then cost savings can be derived, as well as reduced noise, pollution and accidents from buses. However, in this case, bus passengers will be worse off, as they face a reduced level of service.

Summary of approach to assess inter-model impacts

Based on the brief discussions above, the standard economic assessment outputs will:

- **Report the revenue challenge that could be faced by the operators of other modes** (for the road sector, this refers to the road toll collectors) with the introduction of HSR. The levels of revenue challenge are reported as "impact", without considering responses from the other modes / assuming no response from the other modes;
- **Report no cost savings and socio-economic impacts associated with air and bus travel**. This is based on the rationale that such impacts can only be established if the levels of service on these other modes can be established in detail as part of the response strategies; and
- **Report cost savings and socio-economic impacts associated with car traffic**, based on the unit rates per car kilometre recommended by the Guidance. The car kilometres removed by HSR can be estimated with a degree of confidence, based on HSR car demand abstraction and car occupancy rates.

Once the HSR demand impacts have become more apparent in Phase 3 sensitivity tests will be undertaken to show a range of possible impacts on other modes, broadly following the response strategy categories outlined above in the air section.

Airport terminal handling efficiency (see Chapter 5)

Improvements in terminal handling efficiency may be achieved in the future. However, it cannot be guaranteed that such improvements will translate to a reduced overall airport time allowance for passengers. Unreliability needs to be included where there are uncertainties and there is a variety of different processes included in the overall journey time, of which airport handling is only one. Also, the potential for improvements to be made depends on the commercial considerations of the air sector and the commercial benefits from them.

According to survey data, pre-departure times spent by air passengers at airports have increased since 2003. Typically, people spend more time at airports than the minimums advised by the air sector. However, it is likely that frequent flyers travelling on domestic routes spend far less time at airports than other passengers. Such passengers are likely to form a significant proportion of the HSR target market. Therefore, their behaviour is more important than average observations and advised times. The stated preference survey, which has been undertaken as part of the Market Analysis study, will provide information on existing average time spent at airports by people who belong to the target market of HSR. Therefore in Phase 3 it will be possible to show how much impact a reduction in terminal times will have on these passengers.

Through discussions with the air sector in Norway, it is understood that a reduction of five minutes in passenger terminal journey time could be achieved in the near future. Tests of a time reduction of five and ten minutes will be undertaken in Phase 3, to assess the extent to which HSR demand, revenue and benefits could be affected by improvements to terminal handling efficiency.

Multi-operator scenario (see Chapter 6)

Multiple operators of rail services can result in increased investment in infrastructure by generating competition on routes, in turn leading to increased innovation and a drive to match services to passenger needs. Operators may make small scale investments in ticketing and waiting facilities, but tend to be averse to large scale investments that may not return profit within a sufficient timeframe. The extent of operator's incentive to invest in infrastructure or provide input into its development will depend upon the contractual structure of the operating contracts. Some rail services will require subsidy to achieve desired socio-economic aspirations and if part-subsidised franchises are employed to provide this, profitable routes need to be protected to ensure revenue remains available for investment.

1 Introduction

1.1 Background

Jernbaneverket has been mandated by the Norwegian Ministry of Transport and Communications to assess the issue of High Speed Rail (HSR) lines in Norway. There is a National Transport Plan covering the period from 2010-2019 which includes relatively minor enhancements to the railway network. The ministry wishes to understand if going beyond this and implementing a step change in rail service provision in the form of higher speed concepts could “contribute to obtaining socio-economically efficient and sustainable solutions for a future transport system with increased transport capacity, improved passability and accessibility”.

Previous studies have been carried out looking into HSR in Norway and there are various conflicting views. The aim of this study is to provide a transparent, robust and evidence based assessment of the costs and benefits of HSR to support investment decisions.

The study has been divided into three phases.

- In Phase 1, which was completed in July 2010, the knowledge base that already existed in Norway was collated, including outputs from previous studies. This included the studies that already were conducted for the National Rail Administration and the Ministry of Transport and Communication, but also publicly available studies conducted by various stakeholders, such as Norsk bane AS, Høyhastighetsringen AS and Coinco North.
- The objective of Phase 2 is to identify a common basis to be used to assess a range of possible interventions on the main rail corridors in Norway, including links to Sweden. The work in Phase 2 will use and enhance existing information, models and data. New tools will be created where existing tools are not suitable for assessing high speed rail.
- In Phase 3 the tools and guiding principles established in Phase 2 will be used to test scenarios and options on the different corridors. This will provide assessments of options and enable recommendations for development and investment strategies in each corridor.

This report is a component of the Phase 2 work.

The principles established in Phase 2 are to be used to test four scenarios:

- Scenario A – reference case. This is a continuation of the current railway policy and planned improvements, with relatively minor works undertaken shown in the National Transport Plan from 2010-2019. This forms the ‘do minimum’ scenario to which the other scenarios will be compared;
- Scenario B – upgrade. A more offensive development of the current infrastructure, looking beyond the ‘InterCity’ area;
- Scenario C – major upgrades achieving high-speed concepts. This is to be based on an aggressive upgrade of the existing network to provide a step change in journey times; and
- Scenario D – new HSR. This involves the implementation of newly built, separate HSR lines.

The improvements are being considered on six corridors:

- Oslo – Bergen;
- Oslo – Trondheim;
- Oslo – Kristiansand and Stavanger;
- Bergen – Stavanger;
- Oslo – Stockholm (to Skotterud in Norway); and

- Oslo – Gothenburg (to Halden in Norway).

The scenarios will be considered in relation to the long distance travel market, for example for journeys over 100km in distance. Other studies, such as the InterCity Study will look at initiatives for shorter distance travel at a more regional level. Various route alignments, stop patterns, station designs, speed standards and fares will be tested. It will be necessary to assess conditions related to income and costs, environmental concerns, energy consumption, maintenance under winter conditions and the procurement and operational organisation of the services and infrastructure.

1.2 Overall Context of Contract 6 (Financial and Economic Analysis)

To achieve Phase 2 of the study, Jernbaneverket has commissioned 6 Contracts:

- Technical and Safety Analysis;
- Rail Planning and Development;
- Environmental Analysis;
- Commercial and Contract Strategies;
- Market Analysis; and
- Financial and Economic Analysis

WS Atkins International Ltd (Atkins) is assisting Jernbaneverket in two of the contracts: Market Analysis and Financial and Economic Analysis. This report is part of the Financial and Economic Analysis Contract.

The Financial and Economic Analysis Contract consists of five Subjects:

- Subject 1 Impact on Road and Aviation Sectors;
- Subject 2 Cost Estimation;
- Subject 3 Funding and Operating Structure Analysis;
- Subject 4 Financial and Economic Analysis; and
- Subject 5 Uncertainty Analysis

The purpose of the Financial and Economic Analysis Contract is to establish an assessment framework to use to evaluate potential HSR options against the objectives stated in the Ministry's mandate. Outputs of the assessment framework will show the financial impact and affordability of the interventions, including an evaluation of alternative financing options. Socio-economic impacts of the improvements will also be demonstrated and together with forecast generated revenue will be considered in relation to the expected costs. The uncertainty around the results will be assessed. Together the outputs will provide a basis for HSR investment decisions in Norway.

This report provides the outputs for Subject 1.

1.3 Purpose of Subject 1 (Effects on Road and Aviation Sectors) Report

Appendix 1 of the Contract 6 Invitation to Tender (ITT) requires this report to analyse:

- The extent to which HSR could reduce the future need for investment and maintenance spending on roads and airports, including the possibilities to avoid or postpone major investment at the largest airports;

- The potential impact on the air and bus industries;
- The extent to which HSR could have positive financial and socio-economic effects on other transport modes;
- The extent to which air could become more competitive against HSR by improving airport terminal handling; and
- The possible effects on the development of transport infrastructure if several private and public train operators operate on the same tracks.

We have interpreted the above and consolidated into three areas for reporting. This report:

- Establishes the likely relationship between reduction of demand in the air and road sectors and the implications on the state budget, as well the potential to reduce the socio-economic cost associated with travelling by air and road;
- Discusses the potential improvements to terminal handling efficiency at airports, which could reduce HSR competitiveness against air travel; and
- Identifies the likely effects of the development of HSR if more than one organisation operates services on the same routes.

JBV has a guidance document setting out how to carry out economic assessments of typical rail projects in Norway, including how the impacts on other modes are captured. As discussed in the Subject 4 Report (Economic Analysis), the guidance will be followed to produce the economic assessment of HSR but in addition some alterations will be made to produce an additional expanded assessment that better captures the impacts of HSR. This report contains many references to the Guidance: Methodenhåndbok JD 205, Samfunnsøkonomiske analyser for jernbanen, Version 2.0 – juni 2006. This document is referred to hereafter as “the Guidance”. A spreadsheet is attached to the Guidance, NKA 20 05 06.xls, which is discussed in the following chapters, referred to as “NKA” or “the NKA spreadsheet”. It provides important calculation methodologies and values which numerically explain the current Norwegian approach to socio-economic assessment.

1.4 Organisation of Report

This report contains the following chapters:

- Chapter 2 discusses the potential impact on the aviation sector, focusing on the state budget and socio-economic benefits;
- Chapter 3 discusses the potential impact on the road sector, focusing on the state budget and socio-economic benefits;
- Chapter 4 discusses whether other modes, such as coach and ferry, are likely to be affected by HSR;
- Chapter 5 reviews current terminal handling efficiencies and potential changes in the future;
- Chapter 6 discusses the potential implications for HSR development under a multi-operator scenario; and
- Chapter 7 concludes and recommends the approach to capturing HSR’s impact on the road and air sectors.

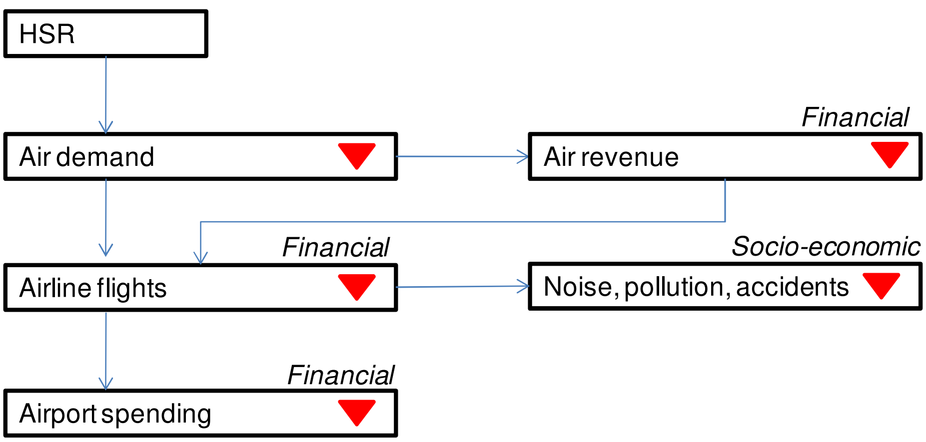
2 The Air Sector

2.1 Introduction

Following the requirement of the ITT, this section focuses on the potential impact on the air sector in terms of the requirement for airport investment and maintenance, as well as the air industry as a whole, including potential financial and socio-economic impacts.

The premise of HSR's impact on the air sector is that HSR is likely to abstract demand from air because it will provide an attractive alternative that competes in terms of time, convenience and quality of experience. Assuming a reduction in air demand, it is possible that airlines may choose to operate fewer flights, and, if fewer flights are operated, then there is less need for airports to implement expansion plans. If expansions are avoided or postponed, this would constitute savings. From a socio-economic point of view, fewer flights are associated with reduced noise, pollution and air accidents which are captured in the economic assessment of the scheme. This relationship is illustrated in the figure below:

Figure 2.1 – A simple illustration of HSR's potential impact on the air sector



This chapter is structured according the logic above and discusses HSR-Air interaction in terms of:

- Section 2.2 Current Norwegian economic assessment approach;
- Section 2.3 HSR and air demand;
- Section 2.4 Air demand and airline operations;
- Section 2.5 Airline and airport operations;
- Section 2.6 HSR's impact on airline associated noise, pollution and accidents; and
- Section 2.7 Recommendation for the treatment of HSR impact on the air sector in the alternative approach to assessment.

However, as will become apparent, the figure above describes a very simplistic relationship between HSR and the air sector when, in reality, the relationship is highly complicated, including many complex commercial considerations.

2.2 Current Norwegian assessment approach

The Phase 1 report provides information on how revenue and cost impacts have been treated in previous studies:

- The ECON study assumes that effects for operators can be ignored, since they will adapt to the new basis for traffic and income. This implies that changes to revenue and costs balance out in the long run, retaining profit for the air sector, with little net impact; and
- The VWI study concludes that society will save transport costs when traffic that would have gone by air without HSR would travel instead by HSR. The differences are included in the benefit of modal shift.

Overall, changes in the air sector's income are not considered in either ECON's or VWI's analysis.

JBV's economic assessment guidance provides a basis for assessing HSR's impact on the air sector. The attachment to the Guidance, the NKA spreadsheet, provides detailed calculation methodologies, relating to revenue, costs, and socio-economic benefits.

Having reviewed the details of the NKA spreadsheet, it is noted that the current Norwegian approach includes allowances for considering airline revenue and costs. Assumptions can be made on the treatment of these, but there are no recommended values. The JBV rail Guidance recommends values for a number of impacts, which can be used to assess the impact of HSR on the air sector, including:

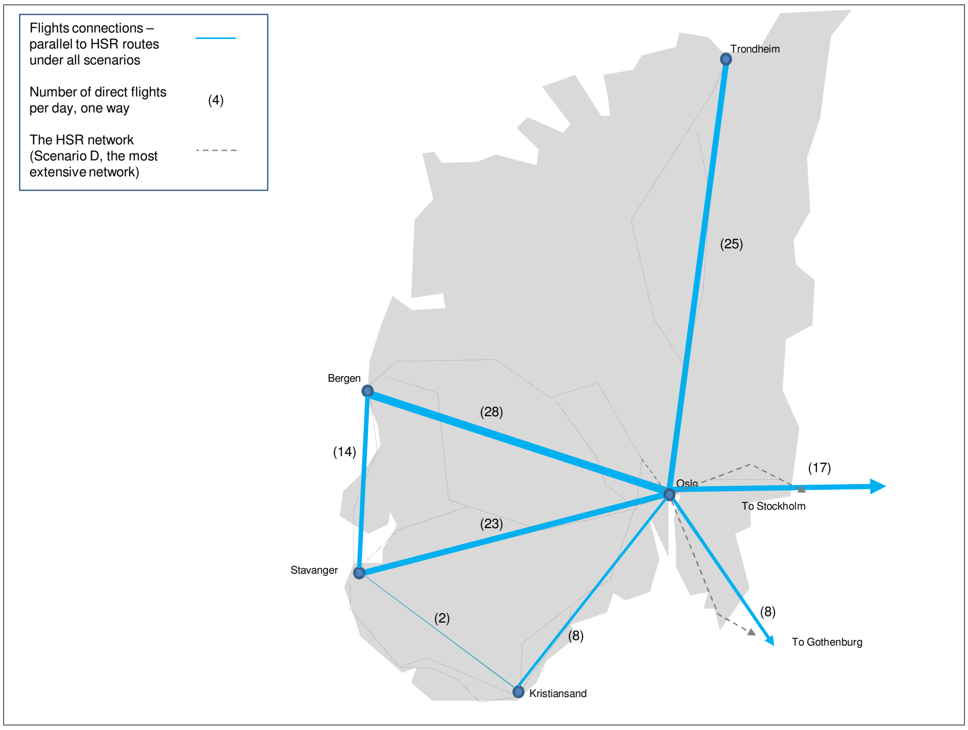
- Airport cost savings are valued at 3.51 NOK per plane kilometre removed (2006 prices);
- Accident cost is valued at 0.27 NOK per plane kilometre removed (2006 prices);
- Local level pollution is valued at 1.33 NOK per plane kilometre removed (2006 prices);
- Global level pollution is valued at 3.70 NOK per plane kilometre removed (2006 prices); and
- CO2 cost is valued at 8.48 NOK per plane kilometre removed (2006 prices).

It should be noted that the derivation of the magnitude of the impacts discussed above requires the establishment of the impact on air service levels. Plane kilometres can be used to determine this impact.

2.3 HSR and air demand

For HSR to compete against air for demand, it needs to operate services that are along existing air routes. The figure below illustrates the key air routes that are likely to be affected by HSR, with the approximate number of flights per day indicated.

Figure 2.2 – Air routes and flight frequencies, along HSR corridors



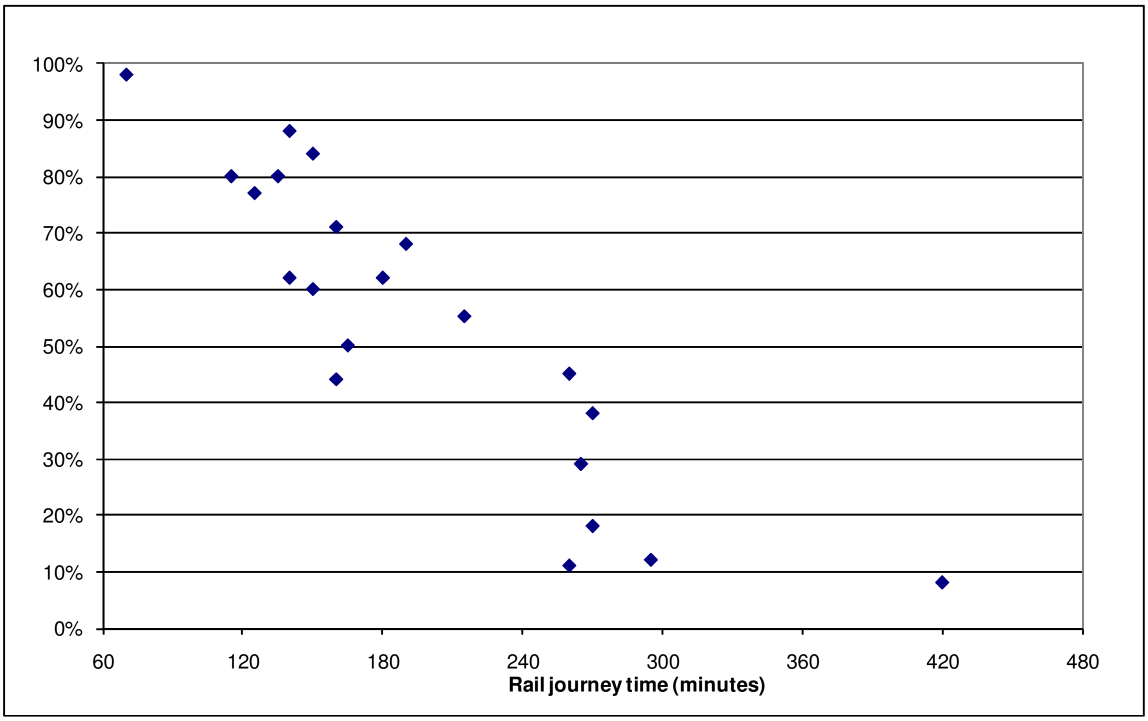
Experience from other countries, particularly in Europe, suggests that HSR can, in certain specific geographic contexts, pose a significant competitive threat to air travel, especially for trips less than 750 kilometres. It should be noted, however, that the factors that contribute to a switch of mode, from air to rail, are highly influenced by the nature of the traffic, passengers' origin and destination points, as well as the onward travel options. Typically, the city-centre to city-centre nature of HSR services does not always account for the total composition of demand that would be using the "equivalent" air service, i.e., on most flights, a proportion, however small, are transfer passengers. Nonetheless, it is the case that examples of significant mode shift from air to rail have occurred around the world and are highlighted below:

- In Sweden, the air-rail mode share for the Stockholm and Götenburg route shifted from 60%: 40% to 40%: 60% after the introduction of the X2000 trains with an top operating speed of just over 200 kilometres per hour, reducing rail travel time from four hours to a bit more than three hours (Source: *Nya Tåg i Sverige – affärsmässig analys*, final report on new rail systems in Sweden, July 2008).
- In France, the introduction of TGV trains across the country produced a number of significant shifts in demand from air to rail. On the Sud-Est network (Paris – Lyon), market share for air travel fell from 31% to 7%.
- In Spain, after the introduction of the AVE Madrid – Seville service, air market share dropped from 40% to 13% (Source: *Interaction between High Speed Rail and Air Passenger Transport*, European Commission Directorate General of Transport, 1998) and the impact of HSR on Madrid to Barcelona and Malaga air traffic has been significant, with Barcelona demand falling by 40% in two years and Malaga traffic dropping by 50% in a similar period.
- In the cross-Channel market, before the Channel Tunnel opened in late 1994, France was the second largest UK air travel market in Europe. Between London and Paris, passenger numbers peaked in 1994 at just fewer than four million. However, since the introduction of the high-speed Eurostar rail services, point-to-point air demand has decreased by about 50%.

While the examples above are based on the changes of rail and air demand through time – before and after the introduction of changes on the railways – it is also useful to compare rail and air demand on a range of routes, to see the size of the market rail captures based on its journey time.

Twenty-one European HSR and fast rail routes have been reviewed, relating rail journey times and rail demand shares against air. The figure below shows that the longer the rail journey time, the smaller the rail market share compared to air.

Figure 2.3 – Rail demand as a proportion of the rail-air market share



(Source: Atkins internal database)

As shown above, on routes where rail journey time is approximately one hour, almost all the demand is taken by rail. On routes where rail journey time is approximately two hours, rail takes approximately 80% of the demand, and air 20%. The market is split half and half on routes where the rail journey time is approximately three hours. Rail market shares are relatively modest on routes where journey times exceed four hours.

Therefore, all else being equal, the introduction of HSR in Norway, significantly shortening rail journey times, is likely to abstract substantial city-to-city demand from air, particularly where the rail journey becomes shorter than three hours. Contract 5 Market Analysis includes the building of a demand forecasting model which will be able to forecast the number of air passengers who are likely to switch to using HSR.

Depending on the station location and service patterns, HSR could also enhance air demand, by providing city-centre to airport connections. Such connections would benefit both HSR and the air sector, offering connections that do not typically exist. The Oslo Airport (Gardermoen) Rail Link is an example. Approximately a third of Gardermoen users take the Airport Express Train (Oslo Lufthavn, 1 September 2007), demonstrating how rail and air could complement each other. However, on the long distance routes, which are core to this study, the demand effect between HSR and air is mostly abstractive.

2.4 Air demand and airline operations

The simple logic illustrated in Figure 2.1 suggests that a reduction in air demand has a direct financial impact on the airlines. The impact is that, all else being equal, a reduction in air demand leads to a reduction in air fare revenue. If revenue decreases, in order to maintain profit, airlines may withdraw flights in light of post-HSR air demand. Following this logic illustrated in Figure 2.1, for example, a 50% reduction in air demand could lead to a 50% reduction in air revenue and potentially a reduction to the number of flights, and overall, in effect, airlines adjust their operating costs in light of the post-HSR air revenue.

The above logic is simplistic. While a pro-rata approach would suggest that an X% reduction in air demand would lead to an X% reduction in the number of flights, in reality the extent to which airlines may reduce the number of flights is highly complicated. It should not be assumed that there is a one-to-one relationship between demand and supply. For example, while there has been a 50% decrease in London – Paris city-to-city (point-to-point) air demand since the introduction of the Eurostar rail services, there has been a considerable market for transfer journeys, with Paris Charles de Gaulle being a busy hub for such traffic – from London via Paris to elsewhere around the world. In November 2010, three years after the completion of Section 2 of the HSR link to London St Pancras, British Airways has announced a new 12-times weekly London – Paris service, competing against Eurostar, but also in part a reaction to the siphoning effect of transfer passengers choosing to fly through Paris rather than from British Airways' hub at Heathrow. In Norway, on the air routes parallel with the proposed HSR network, approximately one third of air demand between the HSR-served city-pairs are for onward travel, i.e. transfers.

Table 2.1 – Transfer as a proportion of demand by air route to / from Oslo

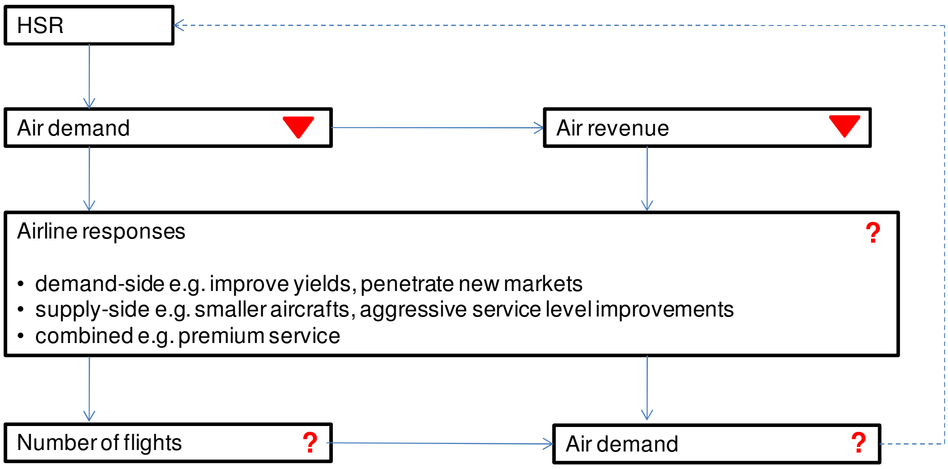
Oslo -	Transfer (% of total) (from 2009 data)
Trondheim	34%
Bergen	31%
Stavanger	32%
Kristiansand	49%
Gøteborg	4%
Stockholm	24%
All HSR corridors	**33%**

(Source: based on data in Innland transfer Togstrekninger.xls, Avinor)

For most airlines, maintaining their inter-lining capability is important, connecting spoke to hub airports and vice-versa. If flight frequencies are reduced because of HSR abstracting city-to-city (non-transfer) demand, then this would adversely affect the airlines' inter-lining offer, sacrificing traffic on their long-distance markets. Therefore, it should not be assumed, as a given, that flight numbers would be reduced following city-to-city demand reduction. Instead, there are a number of strategies which may mean that no fewer flights are operated.

The figure below illustrates that, when facing HSR competition, the airlines may not simply withdraw services but can implement a range of competitive responses.

Figure 2.4 – Illustration of airline responses to HSR demand abstraction



On the demand side, airlines could introduce initiatives to improve yields, i.e. extracting higher fares from passengers by adjusting the services offered, mostly by attracting a slightly different market segment. This could include changing the service offering to reflect different market economics and attract a different segment of demand. This means that while the number of air passengers will be lower compared to a "without HSR" scenario, there is no overall need to reduce the number of flights. If HSR reduces city-to-city (non-transfer) demand, airlines could use that "surplus" capacity for further inter-lining opportunities, i.e. bringing onboard new demand that is not between two HSR-connected cities but for onward journeys. The airlines may also adjust their fares to compete with HSR.

On the supply side, airlines may want to maintain market presence by keeping the same number of flights but operating with smaller aircraft. They may also aggressively improve their levels of service, competing with HSR directly. Alternatively, they could reduce aircraft size to reduce operating costs but retain the same frequency.

The above initiatives are not mutually exclusive. Airlines may combine a number of measures in reaction to HSR competition, for example by targeting new markets through the improvement to existing services and aircrafts, while introducing door-to-door services by aligning flight offers with services on other modes.

Depending on the response from the airlines, air demand may not necessarily fall. This means that there could be an iterative loop which affects HSR demand. Such iteration is highly complex because, while assessing HSR's own mode is relatively easy as most variables such as HSR service levels are "controllable" within this study, airlines' reactions are not "controlled variables". Predictions on airline behaviour are required. As discussed, such predictions cannot be readily second-guessed. The only certainty that exists is that, depending on the level of air demand abstraction estimated using the demand forecasting model developed under Contract 5 Market Analysis, there will be a revenue pressure placed on the airlines. This pressure is the product of demand abstracted and average fare.

Overall, while the previous studies by ECON and VWI have not reported the revenue challenge that is likely to be posed by HSR on the airlines, it is important that such a challenge is highlighted. However, in the longer term, such challenges should not be assumed as the final outcome, as depending on the responses from the airlines, the final outcome may not be as dramatic a revenue decrease as the challenge may first appear to suggest, as airlines may react to minimise the commercial impact on them. This issue is discussed further in the next section.

2.5 Airline and airport operations

Avinor operates the key airports that serve the cities to be connected by HSR. It is a limited company but is owned by the Department of Transport who sets its airport charges. The key airports are understood to be profitable, whilst Avinor cross-subsidises non-profitable airports. The government has an interest in keeping many non-profitable airports open, benefiting local people around these airports due to many socio-economic factors relevant to Norway. Avinor is considering expanding Olso Gardermoen and Bergen airports by adding new terminals and runways. The proposed expansion of Gardermoen has recently been approved by the ministry.

The simple logic illustrated in Figure 2.1 suggests that with the reduction of air demand, fewer flights are operated which, in turn, means that there is less need to expand and maintain airports, leading to cost savings to Avinor or the state. In addition, if fewer flights are operated between profitable airports, then the ability for Avinor to cross-subsidise unprofitable airports could be undermined. However, while HSR will place some adverse pressure on the air sector, it is not necessarily the case that the air sector is strictly passive. Instead, it can work to meet the challenges arising from the introduction of HSR. In any case, the real impact of HSR on airport expansions is likely to be modest. Oslo Gardermoen airport is used as an example below.

In 2009, almost one third of demand at Oslo Gardermoen was to and from cities that are proposed to be served by HSR. This is shown in the table below.

Table 2.2 – Demand at Oslo Gardermoen airport, 2009

To / from Oslo Gardermoen	Demand (million passengers, transfers and non-transfers)	% of total
Trondheim	1.54	9%
Bergen	1.52	8%
Stavanger	1.25	7%
Stockholm	0.97	5%
Kristiansand	0.45	2%
Sum of the above	5.73	**31%**
Total at Oslo Gardermoen	18.09	100%

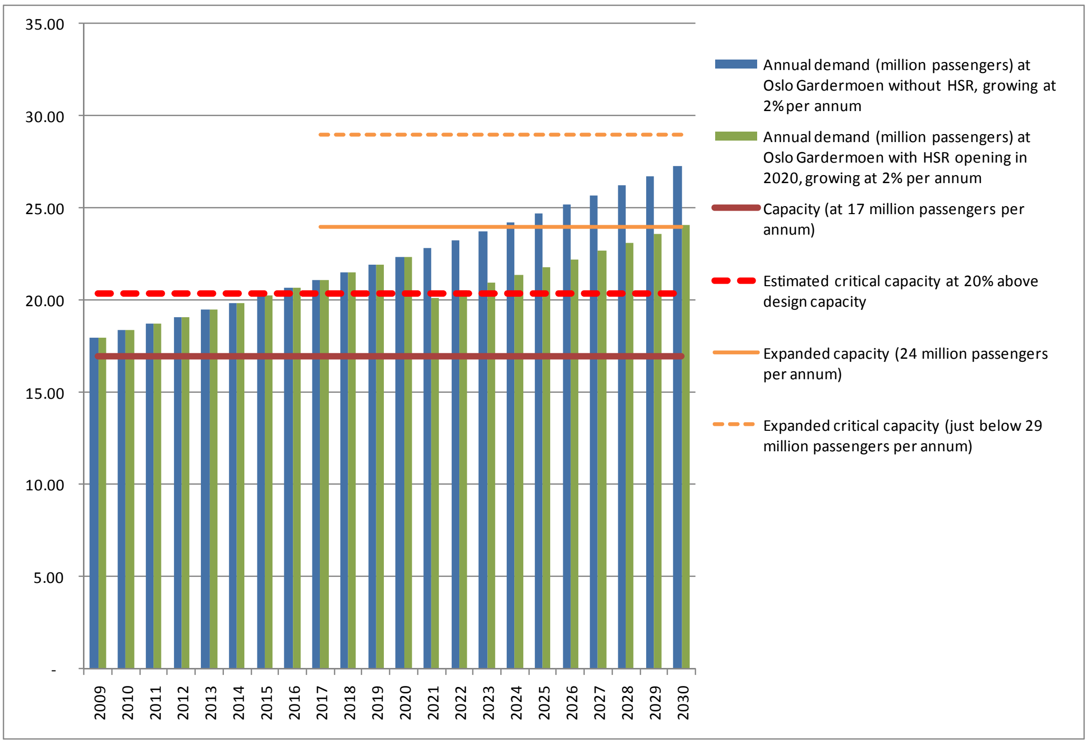
(Source: Oslo Gardermoen Airport website)

As shown in Table 2.1 approximately one third of air demand between cities to be served by HSR is for transfers – 66% are non-transfers, based on the data from the table above, this means 20% (31% x 66%) of demand at Oslo Gardermoen is available for HSR to abstract. If HSR abstracted 50% of this available demand (detailed abstraction forecasts will be produced by the demand forecasting model to be built under Contract 5 Market Analysis), then this would in effect reduce demand at the airport by 10% (20% x 50%). If the underlying growth is 2% per annum (based on Avinor's advice), for simplicity's sake and hence ignoring compounding, then it would take approximately five years before demand reaches its without-HSR level. However, it should be noted that the domestic aviation market has been relatively stagnant.

Demand from HSR-served cities as a proportion of the overall demand at Oslo Gardermoen airport		31%
Approximately 1/3rd of demand are transfers i.e. 2/3rd of demand are between HS-served cities and Oslo	x)	66%
Maximum proportion of demand at Oslo Gardermoen that could be captured by HSR		20%
Suppose ½ of all demand that could be captured by HSR will be abstracted from Oslo Gardermoen	x)	50%
Then demand at Oslo Gardermoen falls by		10%
If demand at Oslo Gardermoen increase by 2% per annum	÷)	2%
Then (without compounding for simplification), this level of reduction to airport demand could delay airport expansion by 5 years		5 years

The figure below illustrates demand at Oslo Gardermoen without and with HSR, assuming that HSR becomes operational in 2020, and it could abstract 50% from the available market from its first year of operation (i.e. assuming no build-up). It is understood that the design capacity of the airport is 17 million passengers per annum (*Annual Report 2009*, Avinor).

Figure 2.5 – Demand at Oslo Gardermoen airport, without and with HSR



As shown in the figure above, currently, Oslo Gardermoen airport is operating at above design capacity. It is likely that demand will increase to above critical capacity level before 2017. The government has recently given approval for the airport to expand. This expansion is planned to be in place by 2017, increasing the design capacity to 24 million passengers per annum, with a critical capacity of just below 29 million (as advised by SAS, January 2011).

This expansion addresses the issue of over-capacity at the airport in 2017. HSR is not due to become operational until at least 2020. Its effect on air demand at Oslo Gardermoen would come too late to resolve the issue of demand being over critical capacity before 2017.

If HSR could potentially reduce demand at Oslo Gardermoen airport by 10%, then it may proportionally reduce more demand at other airports such as Bergen, Stavanger, Trondheim and Kristiansand, with implications on their capacity requirements. The table below shows that if (as an illustrative example) 50% of the available market (non-transfer passengers to / from Oslo) can be captured by HSR, then the demand reduction at these airports is between 11% and 15%. Therefore, HSR's impact on airport terminal capacity requirement may be limited. It could however, delay the need for expansion.

Table 2.3 – Potential demand reduction at airports

Airport	Demand to / from Oslo Gardermoen (non-transfer) million journeys (2009)	Total demand (all routes) million journeys (2009)	% of demand at airport that could be open to HSR competition	% reduction to demand at airport if 50% of the available demand is abstracted by HSR
Bergen	1.02	4.48	23%	11%
Stavanger	0.83	3.42	24%	12%
Trondheim	1.01	3.42	30%	15%
Kristiansand	0.23	0.84	27%	14%

Having illustrated the potential impact on airport terminal capacities from HSR, it should be remembered that such impact is "initial" – the issue of how the air sector (the airlines and the airports) may react to this downward demand pressure, or upward capacity release by alternative interpretation, has not so far been discussed. The issue of air sector response to the HSR challenge is discussed later in this section. Meanwhile, this issue of interactive relationship between HSR and air should be kept in mind.

Moving away from terminal capacity, the need for runway expansion is determined by the number of flights taking off and landing at an airport during peak periods and by the airspace capacity that sits above the airport. Whilst there are a number of complex reasons why different airports have different numbers of runways, the proposal for a third runway at Oslo Gardermoen has been subject to some criticism (*Navarsete satser på Gardermoen*, Dagen Næringsliv, 24 February 2007), citing that much larger and busier airports, such as London Heathrow, only have two runways.

A quick sample analysis suggests that the busiest periods at Oslo Gardermoen are between 08:00 and 09:59 and between 16:00 and 17:59, when there are 60 flight departures per two-hour period (live departure information on Oslo Gardermoen airport website, Wednesday 26th January 2011). Comparatively, at London Heathrow, between 16:00 and 17:59, there are 211 flight departures (life departure information on London Heathrow website, Friday 21st January 2011). On a time slot basis, within the 09:00 five-minute slot, there are 10 departures from Oslo Gardermoen, whereas at London Heathrow, within the 16:00 five-minute slot, there are 20 departures. Of course there are some differences between the airports in terms of aircraft take-off speeds and Oslo Gardermoen can be more seasonal in terms of its demand; the analysis here is at a high level. The table below shows a sample of airports with different combinations of runways and total numbers of passengers.

Table 2.4 – Sample of airport by passenger demand, aircraft movements and the number of runways

Airport	Passengers (millions, 2009)	Aircraft movements (thousands, 2009)	Number of runways
Oslo Gardermoen	18	211	2
Bergen	4	97	1
London Gatwick	32	252	1
London Heathrow	66	466	2
Stockholm Arlanda	16	193	3
Copenhagen Kastrup	21	245	3
Beijing Capital	65	488	3
Paris Charles de Gaulle	58	525	4

(Source: Airport Council International)

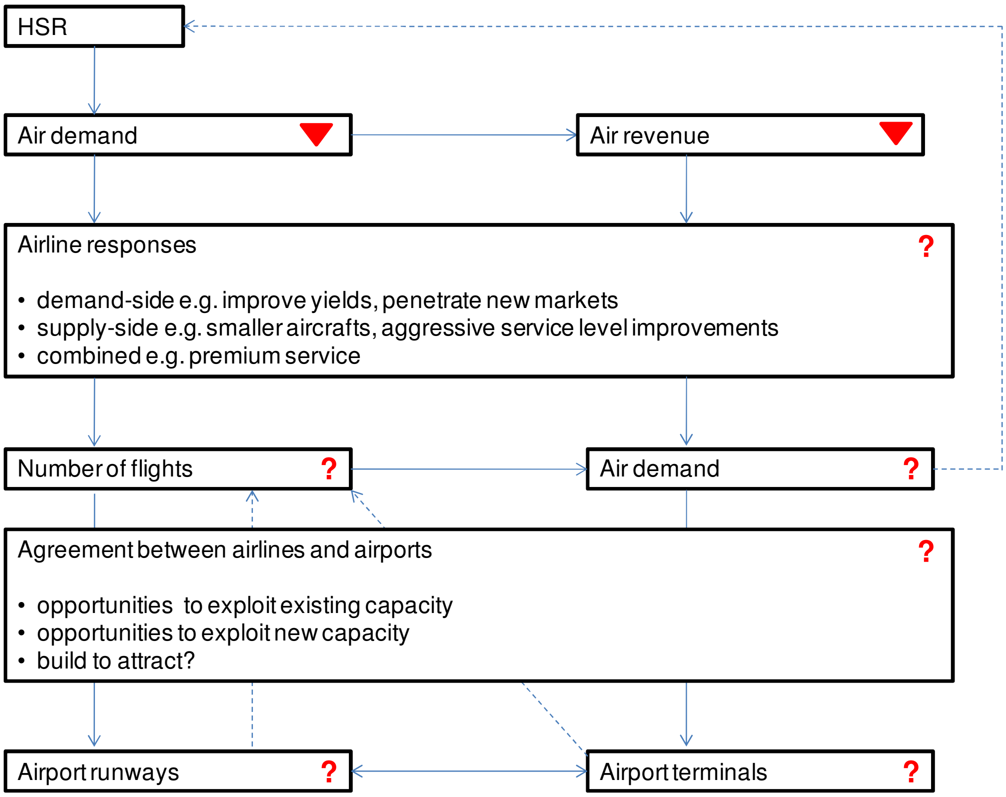
While Stockholm Arlanda and Copenhagen Kastrup airports have similar levels of passenger demand and aircraft movements as Olso Gardermoen but have three runways each, there are busier airports with fewer runways and that some airports with more than one runway are busier than Oslo.

As with the issue of airline demand and revenue, and airport terminal capacity, whether the building of additional runways can be avoided or delayed as a result of HSR depends not only on the HSR's forecast potential for demand abstraction, but crucially on the response from the air sector and on the responses and policy from the Government. Overall, it is argued that HSR should not be viewed as a first direct substitute to airport capacity expansion, and improvement in airport operational efficiency should be emphasised.

As noted with the example of Oslo Gardermoen, an airport's physical capacity is determined mainly by runway and terminal capacity. Investments in physical capacity are taken in large steps (e.g. a single runway airport cannot build half a runway in response to demand increase of 50%). Projects often take a very long time to implement. Therefore, the extent to which airport capacity could match perfectly with demand is questionable, and often it would be more feasible to implement expansion plans when they are ready than to fine-tune the investment timing. This is because airports, and the airlines that they serve, are not static entities. Even if a flight were to be terminated due to competition from HSR, it is not the case that the airport and airlines are victims to the loss of traffic to HSR. The airport and airline can actively pursue to use the capacity in their respective systems – runway slots and facilities for the airports and aircraft utilisation for the airlines – in order to balance any loss to HSR-affected routes. The same logic is applicable to Bergen where terminal and runway expansions are also being considered.

The figure below illustrates that it would be dubious to second-guess airline responses which, in turn, makes the second-guessing of airport responses even more problematic.

Figure 2.6 – Illustration of airline responses to HSR and the interaction between airports and airlines



As illustrated above, the airlines and the airports can introduce a number of counter-measures to maintain and improve their businesses. This may have knock-on implications on HSR demand.

On the issue of airport income and cross-subsidies between airports, one key income-stream is landing charges. Landing charges are affected by the number and type of aircrafts landing and taking off at a given airport. Unless it is clear how the airlines intend to behave it would be difficult to second-guess a likely change to airport income such as in terms of landing charges. In addition, given airports, like airlines, are not static organisations, whose only position would be to accept the changes from external conditions such as the introduction of HSR, the airports can actively seek business opportunities together with the airlines. Depending on their actions, there could be further, iterative, impacts on HSR demand as illustrated in Figure 2.6.

If the ability of the airlines and the airports to cross-subsidise is challenged by HSR through the abstraction of income on profitable routes, then, there may be greater pressure on the state to start providing subsidies or increasing its subsidies.

While it has been discussed that there are numerous potential responses from the air sector, it is useful to establish, at a high level, what these responses could be in terms of their knock-on impacts on HSR and on the state. The tables below present some of the potential responses from the airlines, airports and the state. It should be noted that some of the measures set out below can be combined into packages of measures for the airlines to implement.

Table 2.5 – Examples of potential responses from the airlines and knock-on impacts

Airline response	Impact on airports	Implications on the state	Impact on HSR
No change on HSR-competing routes – same number of flights, with fewer passengers Loss of revenue Little change in costs	Loss of retail revenue from reduced passenger levels Potentially less pressure on terminal expansion – elements that are directed at accommodating passenger through-put, but expansion plans may still be implemented to attract new business	Modest pressure on subsidy	No change from forecast levels of HSR demand
Withdrawal of services partially or completely on routes under HSR-competition. This could have a knock on effect on services offered to international destinations Loss of revenue Cost savings from withdrawals	Fewer or no flights on these routes leading to reduced landing charges Reduced retail revenue from fewer passengers Potentially less pressure on airport expansion Potentially less requirement on routine spending Possible to use freed up capacity for other uses	Potential reduced pressure on expansion investments Might lead to greater subsidy payments depending on airport-state negotiations	Greater HSR demand as travelling by air becomes less convenient or not possible if services are completely withdrawn
Competing head-on through fare changes, attempting to attract "back" the demand lost to HSR, accepting a lower yield Potential for recouping revenue Modest change in costs	Depending on the level of success, if the same number of passengers and planes use the airports as "without HSR", then no significant impact	Depending on the level of success of the airlines' measure. Potentially no impact	Because airlines could attract "back" demand, HSR demand could be lower than forecast levels
Competing head-on through frequency improvements, attempting to attract "back" the demand lost to HSR This includes the option for increasing peak-time frequencies, with airline capacity off-peak used elsewhere Potential for recouping revenue More costs to be incurred	If more flights than "without HSR" are operated, then more landing charge income can be earned However, this will place additional pressure on runway slots, leading to greater pressure on runway expansions Depending on the level of success, if the same number of passengers use the airports as "without HSR", then no impact on retail revenue	Potentially greater pressure on airport investment	Because airlines could attract "back" demand, HSR demand could be lower than forecast levels
Attract new demand that is less likely to be abstracted by HSR, e.g. improving interlining demand, new markets, perhaps to other international destinations (although there may be a limit to what airlines would do beyond what they would have done without HSR) Potential for recouping revenue Some changes to costs depending on the measure	Depending on the level of success and what measures are to be implemented by the airlines, if the same number of flights are operated with the same number of passengers going through the airports as "without HSR", then no significant impact on retail revenue	Potentially no significant impact	Because airlines would be attracting a different market which HSR was not set out to abstract in the first place, there would be no impact on the level of HSR demand originally estimated.
Maintain the same level of service but reduce operating cost through the	Fewer passengers and smaller planes lead to a loss of income	Potentially greater pressure on subsidies but less pressure for terminal	The use of smaller planes to accommodate reduced demand is unlikely to affect

Airline response	Impact on airports	Implications on the state	Impact on HSR
use of smaller aircrafts on HSR-competing routes Loss of revenue Some cost savings potentially	Fewer passengers lead to reduced pressure for terminal expansion	investment	forecast levels of HSR demand
Maintain the same level of service but reduce operating cost through supporting function optimisation i.e. no change to the services offered to passengers Loss of revenue Some cost savings	If the airlines operate the same number of flights, using the same planes, and provide just as many passengers to the airports as "without HSR", then no impact	Potentially no impact	Given this airline response is to reduce their costs rather than increasing their demand, it is unlikely to affect forecast levels of HSR demand

In generic terms, the example responses shown in the table above can be grouped into four broad categories on the basis of their impacts on costs and revenue:

- Category 1 - Acceptance of revenue loss without changing services and therefore operating costs – for example, if the route is subsidised or the revenue loss is small in comparison to other markets served by the route such as the interlining market, or if higher profit services are provided by the same planes on connecting legs of their overall routing schedule;
- Category 2 - Reduction in operating costs to offset revenue loss but using measures that do not noticeably impact on air passengers – for example, the same level of service could be provided to the passengers, but savings could be derived from back-office / supply-chain optimisation, or the planes could be changed to suit post-HSR demand. These planes could be smaller and have lower operating costs;
- Category 3 – Introduction of measures to generate revenue or save operating costs that do not avoid an impact on the remaining air passengers. For example, fares could be increased for inelastic demand (in which case demand may be reduced further but the total revenue could increase) or fewer or no flights could be operated, which would make air travel less convenient and hence reduce demand and revenue but save operating costs. Where the response involves reducing the number of planes and/or landing slots in use, airlines could potentially use any released capacity as a basis for expanding into new markets, helping to compensate for lost demand and revenue; and
- Category 4 - Mitigation of revenue losses through competition with HSR, consequently resulting in a reduction in HSR demand and revenue – for example, the airlines could reduce fares or they could make the service more attractive by increasing the number of flights, especially in peak periods, abstracting back demand from HSR as well as potentially generating new demand from people who would not otherwise be travelling. Coupled with this, airlines could attack new markets to compensate for lost revenue (although it is questionable whether there would be opportunities to do this beyond what airlines would do without the HSR improvements).

While the above table provides some examples of the potential impacts as result of responses from the airlines when facing HSR competition, it is not only the airlines who could respond – airports could also take the initiative. Their response strategies could influence the behaviour of the airlines, with implications on the state budget as well as HSR demand. For example, airports could lower their landing charges (with agreement from the Department for Transport who set their charges) to attract new airline business, subject to available runway slots. If the airlines do not operate any more services, then for the airports, this would mean a loss of revenue, with further implication on state subsidies. For the airlines, meanwhile, this reduced cost could help them to maintain their services without having to introduce any measures listed in the table above.

The state can plan its response to the introduction of HSR. It could follow the air sector and be passive in its actions, for example, by paying subsidies to keep existing airports open if they are no longer cross-subsidised. It could act and introduce new requirements on the air sector to push them to explore commercial opportunities to the fullest extent, although it should be acknowledged that the air sector is already a competitive industry. The state could also, should it be acceptable to the public, close down unprofitable air routes and airports, instead of offering subsidies to the air sector.

In conclusion, airports and airlines are commercial entities, which are capable of putting in a range of measures to maintain and improve their profitability. They should not be viewed as static entities, simply falling victims to HSR competition. While it is certain that there will be a first direct impact on airline revenue due to HSR competition, depending on how the air sector responds, the overall profitability of this sector may be maintained.

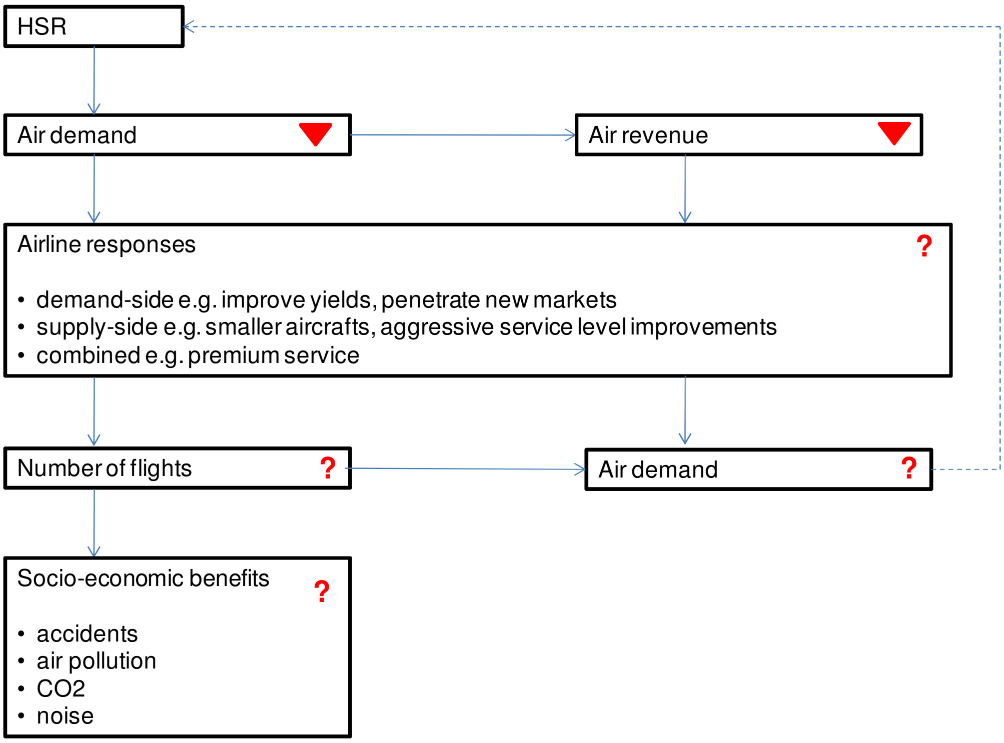
On the issue of subsidies to unprofitable airports, if the assumption is that HSR will permanently reduce the number of flights to profitable airports, then this would undermine Avinor's ability to cross-subsidise non-profitable airports. Further, this would support Avinor's request for subsidies from the state in order to keep these non-profitable airports open. However, as discussed above, while HSR will place some revenue pressure on the airlines, initially, the actual flights to be provided by the airlines, generating income for the airports, are not certain. Also, it may be possible for Avinor to respond by changing its charges for example, although it should be noted that any changes in charges would have to be agreed by the Department of Transport who sets the charges. Overall, there is a range of possible outcomes, with some being more likely than others. It could be the case that the Avinor will require some additional subsidies, but this is not necessarily the only possible conclusion. In conclusion, it would require a large and substantial study, separate to this HSR study, to establish the likely behaviour of the airlines and the airports. Meanwhile, without this large separate study, generic high-level sensitivity tests based on the four categories of potential responses already discussed, such as air fare and flight frequency changes, can be undertaken at Phase 3 of the study, to establish the potential impact on HSR from the air sector's actions.

HSR competes with the air sector for long distance travel but over shorter distances HSR and air may complement each other e.g. HSR providing new airport access, making the investment in both modes more effective. The Association of Norwegian Airports indicated, through discussions in January 2011, that they expect the potential for such links is limited given the location of airports such as Bergen and Trondheim. However, the latest version of the corridors being considered shows a link to Trondheim airport. Although the emphasis of this study is long distance travel, such links will be tested and analysed further in Phase 3 using the demand forecasting and economic models.

2.6 Socio-economic benefits

As discussed in Section 2.2, the socio-economic costs associated with air travel are estimated on a "per plane kilometre" basis. To utilise the unit costs provided in the Guidance, it is essential for the reduction of flights to be established first. As discussed in Section 2.4, a pro-rata (to revenue loss) approach is inappropriate, as it is uncertain whether the airlines will reduce the number of flights in reaction to HSR's competition. The figure below illustrates this point.

Figure 2.7 – Illustration of HSR and socio-economic benefits in the air sector

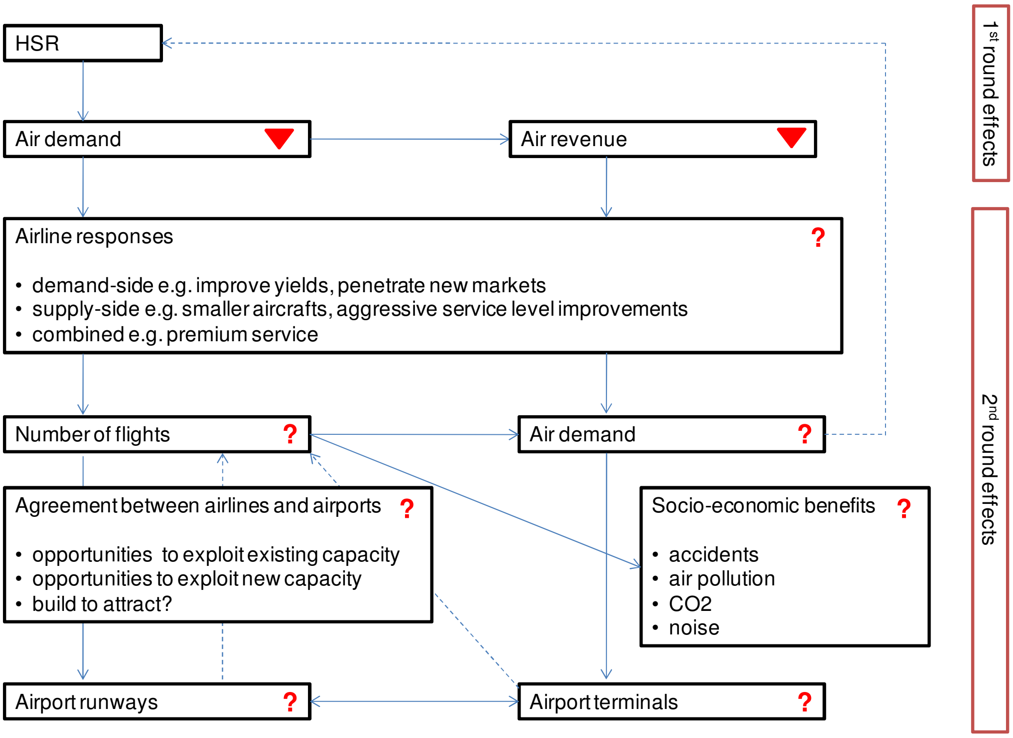


As shown in the figure above, given it is not necessarily the case that fewer flights would be operated due to HSR competition, it is not possible to state the level of socio-economic benefits to be derived in the air sector due to HSR at this stage. The tests to be undertaken in Phase 3 based on the four broad categories of possible air sector responses, will include options for reduced flights. For these options, the socio-economic benefits can be estimated.

2.7 Recommendation on the treatment of the air sector

Given HSR represents a step-change in rail travel, with frequencies much higher than currently provided by the existing rail service, and with journey times that are competitive with air, the primary target market for HSR is likely to be the same as the air market. Therefore, it is envisaged that there are likely to be substantial interactions between the two modes. The figure below agglomerates previous flowcharts on the complex relationship between HSR, the airlines and the airports.

Figure 2.8 – Illustration of first and second round effects of HSR on the air sector



As shown, the effects are grouped into first and second round. The first round effect is HSR's impact on air demand and revenue, which can be established with a degree of confidence. Depending on the response from the airlines, together with the airports, the impacts associated in the second round are far more difficult to confirm. Indeed, if such impacts can be established with a degree of confidence, then they need to feed back into HSR demand forecasting, resulting in a complex iterative loop.

Given HSR's direct challenge to the airlines, it is envisaged that substantial demand will be abstracted from air, and with that demand, revenue. It would be inappropriate to ignore the assessment of the impact on the airlines, as the previous ECON and VWI have done, given the strong substitution relationship between the two modes. Therefore, it is recommended that air revenue impact is reported as HSR's first round impact.

In reaction to the introduction of HSR, the airlines may respond through a number of ways. It is not feasible to second-guess all these possibilities. It is sufficient to say that given the level of inter-lining demand (approximately one in three passengers are not getting off at the airports where they first land, but connecting at the hubs for their onward journey), and the commercial nature of airlines, it should not be assumed that flights will be reduced on a pro-rata basis with demand.

Given it is not feasible to second-guess airlines' reactions, it is also not feasible to predict the second-round demand effect on HSR. If flights are reduced, then arguably, there should be further increases to HSR demand, revenue and benefits. If the airlines react aggressively, then HSR demand, revenue and benefits may fall.

Initially and simplistically, it may be reasonable to think that if air demand falls then investments in airports can also be reduced or significantly delayed. In reality, given the commercial interactions between the airlines and the airports, the air sector does not have to accept demand reduction as the only eventuality. The air sector can actively pursue strategies to meet the challenges from HSR. Therefore, the requirement for airport capacity may not be reduced in reality.

Although HSR could abstract substantial demand from air on a route-by-route basis, its overall impact on any given airport may be more limited. A better understanding can be established once the demand forecasts are produced, including disaggregating the responses of business and leisure passengers separately given their differing characteristics and potential response.

Meanwhile, to give a rough indication, if a 50% abstraction of non-transfer (interlining) demand between the key cities and Oslo is assumed, the initial impact on airport demand is a reduction of between 10% and 15% - such levels of impact, of course, do not consider the response strategies from the air sector.

The planning and implementation of expansions take a long period of time, instead of delaying the programme, the airports and the airlines may work together to make the best use of any new infrastructure, as part of their response strategies when facing a potential reduction in demand. This may have further implications on flight services, and hence HSR demand.

The socio-economic costs such as accidents, pollution and noise associated with air travel are based on plane kilometres. Given it is not feasible to second-guess flight reductions, it is not feasible to establish the extent such benefits can be realised. In terms of air passengers, depending on the responses, they may be affected, for example, if fewer flights are operated or fares are increased. In such cases, their cost of travel (represented by monetary fare and ease of journey-making) would change, and these impacts will need to be captured.

As already discussed, it is not possible to second-guess air sector response at this stage, therefore assessment of HSR's direct impact on the air sector is restricted to the revenue pressure (first round effect as shown in Figure 2.8). This 'default' position of only capturing the revenue pressure can be amended once more detailed analysis on the second round effects has taken place in Phase 3, if it is possible to reach agreement on an alternative most likely default position.

At Phase 3 of the study, generic air sector responses can be tested to establish the likely knock-on impact on HSR, and the wider implications for passengers and the economy. These can be based on the four broad response categories described in Section 2.5 above:

- Category 1 - Acceptance of revenue loss without changing services and therefore operating costs;
- Category 2 - Reduction in operating costs to offset revenue loss but using measures that do not noticeably impact on air passengers;
- Category 3 - Introduction of measures to generate revenue or save operating costs that do not avoid an impact on the remaining air passengers; and
- Category 4 - Mitigation of revenue losses through competition with HSR, consequently resulting in a reduction in HSR demand and revenue and / or entering into new markets.

HSR impact on the **air** sector:

- Potentially large impact on the non-transfer air demand on HSR routes;
- Demand abstraction leads to revenue pressure on the airlines and Avinor;
- There are many ways the air sector could respond to the challenges posed by HSR and the exact response is not certain;
- Depending on the possible responses of the air sector, sensitivity tests will be undertaken in Phase 3, with the immediate outputs being changes in air revenue and costs, as well as the iterative impact on HSR demand, revenue and benefits. The demand forecasting tool will be ready for use in this analysis in Phase 3 and will show the initial size of the impact on the air sector by route as a starting point;
- The estimate of socio-economic benefits will be undertaken for the tests, with issues including noise, air pollution and emissions, and accidents based on the changes to plane kilometres operated. In addition, changes to air passengers' cost of travel will also be estimated;
- At this stage, it appears that HSR should not be viewed as a direct alternative to airport expansion;
- The need for increased subsidies to the air sector should not be interpreted as the only possible outcome following HSR competition as airlines and Avinor may be able to respond and re-gain some of the lost income or the Government could consider other money saving strategies; and
- The air sector is not a static but a dynamic and commercial entity, and therefore while HSR will pose a challenge on its revenue, such a challenge should not be equated to final outcome as the air sector's response should be captured.

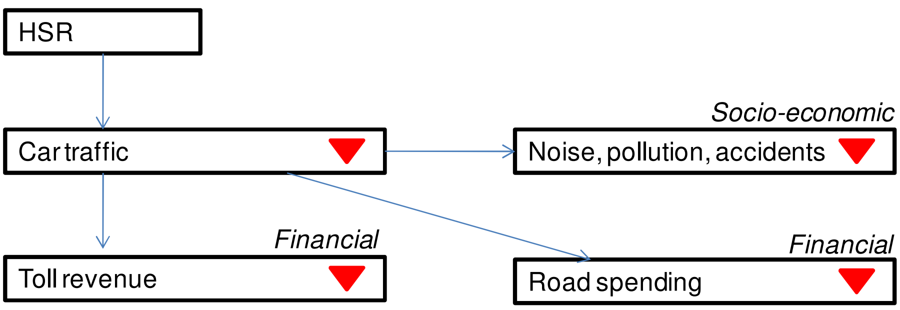
3 The Road Sector

3.1 Introduction

Following the requirements of the ITT, this section focuses on the potential impact of HSR on the road sector in terms of the requirement for road investment and maintenance, as well as potential financial and socio-economic impacts.

The premise of HSR's impact on the road sector is that HSR is likely to abstract demand from car traffic. With reduced car traffic, it is possible that spending on the roads can be reduced, generating savings to the state. On the other hand, road toll revenue would also decrease. From a socio-economic point of view, fewer cars on the roads are associated with reduced noise, pollution and road accidents. This relation is illustrated in the figure below:

Figure 3.1 – Illustration of HSR's potential impact on the road sector



This chapter is structured according to the logic above, and discusses HSR impacts in terms of:

- Section 3.2 current Norwegian economic assessment approach;
- Section 3.2 HSR and car traffic;
- Section 3.3 car traffic and toll revenue;
- Section 3.4 car traffic and road spending;
- Section 3.5 HSR's impact on car traffic associated noise, pollution and accidents; and
- Section 3.6 recommendation for the treatment of HSR impact on the road sector in the alternative approach to assessment.

3.2 Current Norwegian approach

Currently, the Guidance already contains important calculations and values with respect to the estimation of cost savings and socio-economic benefits:

- Road cost savings are valued at 0.33 NOK per car kilometre removed (2006 prices). This includes both investment and maintenance costs;
- Accident cost is valued at 0.26 NOK per car kilometre removed (2006 prices);
- CO2 cost is valued at 0.11 NOK per car kilometre removed (2006 prices);
- Noise is valued at 0.22 NOK per car kilometre removed (2006 prices) outside sparsely populated areas;

- Congestion cost is valued at 1.03 NOK per car kilometre removed (2006 prices) in large cities; and
- Air pollution costs are valued according to the table below (2006 prices).

Table 3.1 – Unit values in the JBV Rail Guidance for road-related air pollution

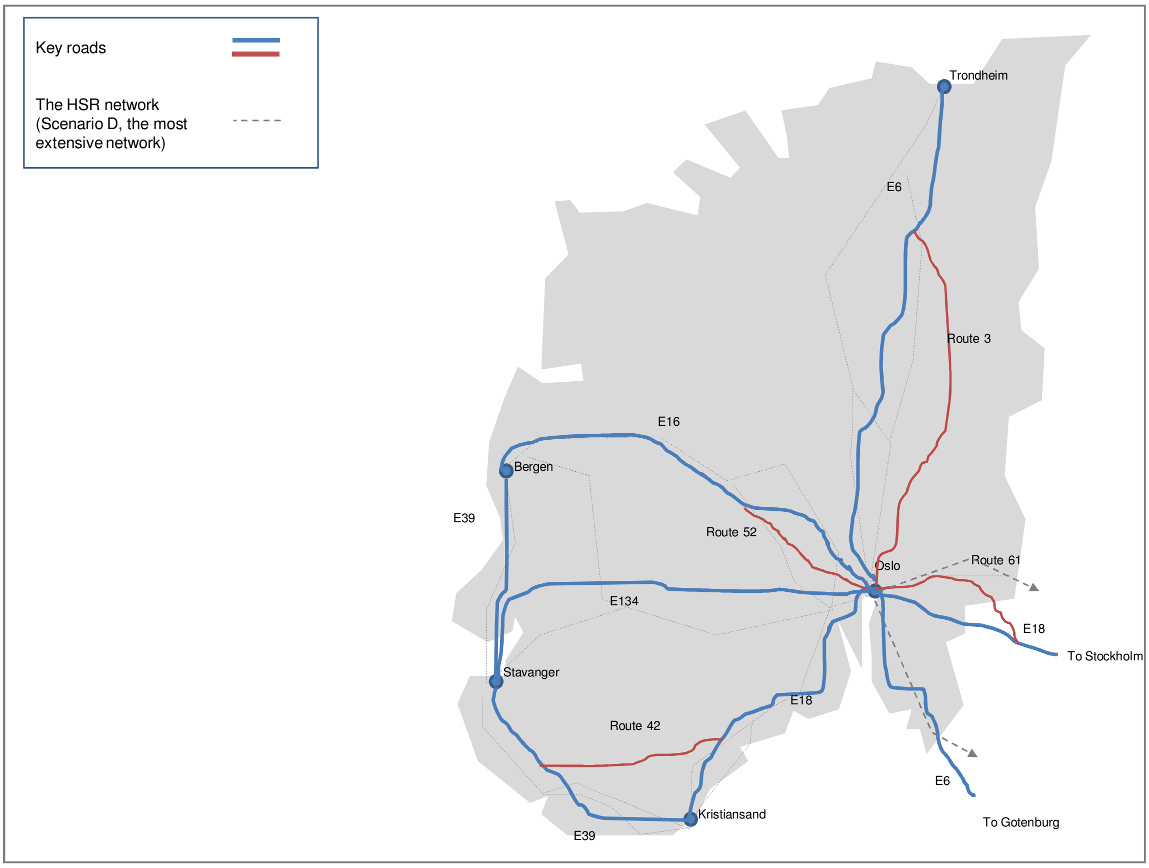
	City		Other urban areas		Sparsely populated areas	
	Local	*Global*	Local	*Global*	Local	*Global*
Car	0.07	*0.05*	0.03	*0.05*	0.01	*0.05*

As recommended in the Phase 1 report, change in road toll income is one of the monetised effects that should be considered. The previous studies by ECON and VWI do not appear to have considered this potential loss of income to the state, as the impacts on non-HSR operators are omitted.

3.3 HSR and car traffic

For HSR to compete against cars for demand, it needs to operate services that are along existing major roads. The figure below illustrates the key roads that are likely to be affected by HSR.

Figure 3.2 – Major highways along planned HSR corridors



Compared to the impact on air travel, experiences from other parts of the world suggest that HSR's impact on road traffic is typically more modest, as shown in the table below:

Table 3.2 – Changes in market share, air and road, before and after HSR

	Air			Road		
	Before	After	*Change*	Before	After	*Change*
TGV Sud-East (France)	31%	7%	*-23%*	29%	21%	*-8%*
AVE Madrid – Seville (Spain)	40%	13%	*-27%*	44%	36%	*-8%*

(Source: *Interaction between High Speed Rail and Air Passenger Transport*, European Commission Directorate General of Transport, 1998).

While the above changes provide a useful background, it should not be assumed that demand changes will be the same in Norway. To illustrate, ignoring all other factors and considering the issue of speed only, road speeds are substantially higher in France than in Norway. Compared to modal switch in France, a person may save more time if s/he switches from driving on Norwegian roads to taking a Norwegian HSR train. If so, then compared to France, more car traffic could be reduced in Norway. Of course, there are many elements to mode choice, with speed being one of them. The important elements are considered under Contract 5 Market Analysis.

Contract 5 Market Analysis includes the building of a demand forecasting model, which will be able to forecast the number of car users who are likely to switch to using HSR. Using car occupancy rate contained in the spreadsheet attachment (NKA 20 05 06.xls) to the Guidance, the number of cars removed from the road can be estimated, and any revenue and benefit impacts can be estimated accordingly.

It is likely that a proportion of HSR passengers will access and egress the stations by car. Therefore, there may be more traffic on local roads around HSR stations. However, local access issues are not core to the study objectives, and are best discussed in later-stage studies on local road layout and potential improvement measures in view of HSR station development, including the local analysis of socio-economic impacts such as noise, pollution and accidents. At the aggregate level, considering HSR's overall corridor-based impact, such local variations are likely to be very modest in magnitude.

3.4 Car traffic and tolls

A system of tolls operates around major cities such as Oslo, charging cars as they enter the cities. The tolls are operated by non-profit companies on a day-to-day basis. The charges and discount systems are approved by the Ministry of Transport and Communications. All tolls are approved by the Parliament. The state receives the money from tolls to invest in the transport infrastructure and public transport projects.

According to the National Transport Plan 2010 – 2019, road tolls generate as much as NOK 60 billion for the state. If HSR abstracts substantial demand from road traffic, then it is foreseeable that it will also reduce state revenue collected from road tolls.

The toll charges (NOK) for driving into the city centres directly relevant to HSR are:

- Oslo: 26;
- Bergen: 15; and

- Kristiansand: 10.

There is a toll at Trondheim, with a charge of between 10 and 40 NOK depending on vehicle type and the time of the day. However, this toll is targeted at Trondheim airport traffic instead of highway access from other cities such as Oslo by road.

Unlike the airlines, which operate on a highly commercial basis, especially on busier routes between HSR-served cities, the road tolls are more controlled by the state and are operated on a not-for-profit basis. Also, compared to the airlines, there is far less flexibility for tolls to devise response strategies. Therefore, while it would involve significant second-guessing to establish what would happen in the air sector, it is relatively simple for the toll collectors. One of the key measures that the toll collectors could introduce, theoretically, is a reduction of charges, in order to induce more car demand and hence revenue (depending on the elasticity response, the overall revenue may or may not be greater than before the price change). However, given the primary purpose of the tolls is to reduce congestion and its related adverse effects in the cities, it should not be imagined that the tolls are a commercial entity, aimed at maximising their profit, or revenue to the state. Therefore, it is assumed that the charges would stay the same, with or without HSR, and that toll revenue would decrease due to HSR demand abstraction. The loss of toll revenue will be reported in the proposed alternative assessment.

3.5 Car traffic and road spending

The state has a direct involvement in the investment, operations and maintenance of major roads in the country. As of January 2010, more than half of the national highways are transferred to the county municipal authorities (National Transport Plan 2010 – 2019).

The National Transport Plan sets out a comprehensive programme of works for until 2019, aiming to, among others:

- Upgrade 350 km of national roads; and
- Convert 230 km of national roads to four-lane roads.

According to the Plan, about 40 major road projects, all costing in excess of NOK 200 million each, would be undertaken. These include:

- Substantial upgrading works on
    - E6 highway from north to south,
    - E16 Oslo-Bergen highway,
    - E39 coastal trunk road;
- Substantial investment and operating resources will be spent on the E16 highway between Oslo and Bergen in order to secure a trunk road between east and west that is open throughout winter.

As a result of these investments, it is estimated that travel times will be reduced by about 30 to 35 minutes on the following routes:

- E6/E136 highway between Oslo and Ålesund;
- E39 highway between Bergen and Ålesund;
- National road 80 and the E6/E8 highway between Bodø and Tromsø;
- E6 highway between Oslo and Trondheim.

If HSR abstracts some demand from road traffic, then the impacts on state spending on roads are (1) reduced need for spending on maintenance and (2) reduced need for investment in new road assets.

Operating and maintenance costs generally include:

- Winter maintenance;
- Pavement routine maintenance e.g. for sealing cracks;
- Pavement heavy maintenance and renewal e.g. overlays; and
- Structure maintenance.

In terms of road pavement surface damage, this occurs due to action of tyres when turning, braking or accelerating, which leads to a reduction in skid resistance and surface grip. During the winter, the use of studded tyres or snow chains on dry roads increases the rate of surface wear. This type of damage is mainly from heavier vehicles and the effect from cars is relatively small.

In terms of pavement structural damage, again, this is mostly caused by heavier vehicles. In the UK, wear factor associated with cars is zero, while it is 2.6 for coaches.

Ignoring other types of road-based traffic, if there are no cars on the road because of public transport abstracting all car demand, then there is little need to maintain as well as enhance the road network. Therefore, the reduction of car traffic reduces the need to spend on roads.

Road improvements benefit many people – those who travel the entire section of an improved road and those who only travel a small section of that road. For example the upgrading of the E16 Oslo – Bergen highway would not only benefit those who travel between these two cities but all those who use this road. Therefore, the need for road investment is less directly inter-tradable with rail. However, HSR is likely to have some impacts on spending in the road sector, even though no whole-sale replacement of road investment is entailed.

3.6 Socio-economic benefits

The reduction to road traffic is likely to generate a range of socio-economic benefits, namely fewer road accidents, less air pollution, reduced noise and road decongestion. Unlike in the air sector where the final impact is highly dependent on the responses from the airlines and the airports, the forecasting of these benefits associated with car traffic can be estimated with a larger degree of confidence – based on HSR passenger kilometres forecast to come from cars, divided by car occupancy rate, and multiplied by the benefit unit rate per car kilometre removed.

3.7 Recommendation on the treatment of the road sector

The impact of HSR on the road sector is direct and far less complicated than its interactions with the air sector, as unlike the air sector, there is no organised commercial response from individual car users.

With fewer cars on the road, cost savings can be made and socio-economic benefits can be gained, such as reduced noise, air pollution and emissions, few car accidents and lower levels of road congestion. These impacts can be estimated using the unit rate per car kilometres removed as per the Guidance approach.

On the other hand, fewer car trips can lead to less toll revenue, and this impact on the state budget will need to be captured.

HSR impact on the **road** sector:

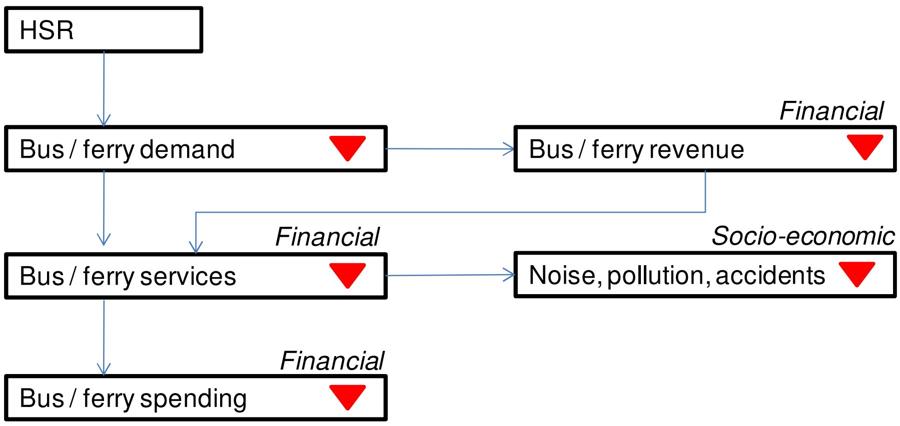
- Potentially sizeable abstraction of demand from cars to HSR;
- Fewer car trips lead to less road toll revenue;
- Fewer car trips lead to less requirement for spending on the roads;
- Fewer car trips also generates socio-economic benefits such as reduced noise, air pollution and emissions, as well as fewer car accidents;
- In addition, the roads in large cities can become less congested; and
- The above impact can be estimated based on the unit rate approach of the Guidance.

4 Other Modes

4.1 Introduction

The ITT requires an assessment of the extent to which HSR is likely to have financial and socio-economic impact on the bus and ferry sectors. The most straightforward logic is that if HSR abstracts substantial demand from buses and ferries, then there would be a loss of revenue for these modes. In turn, services could be withdrawn leading to a reduced need for spending and reduction of socio-economic costs such as noise, pollution and accidents.

Figure 4.1 – Illustration of HSR's potential impact on buses and ferries



This chapter discusses such impacts and also includes a discussion on the potential impact on the ferries:

- Section 4.2 Current Norwegian economic assessment approach;
- Section 4.3 HSR and demand for bus and ferries;
- Section 4.4 Bus and ferry demand and operations;
- Section 4.5 Operations, spending and socio-economic impacts; and
- Section 4.6 Recommendation on the treatment of impacts.

Similar to the discussions in Chapter 2 on the air sector, the simple logic illustrated in Figure 4.1 is open to challenge, as the real considerations for service withdrawal are unlikely to be as straightforward as a pro-rata reduction in line with demand. Therefore, the treatment of spending and socio-economic costs is more complicated than Figure 4.1 suggests.

4.2 Current Norwegian approach

Currently, the Jernbaneverket Guidance provides important calculation methodologies and values for assessing the potential impacts on bus services. The principle method for estimating cost savings and socio-economic benefit is based on bus kilometres withdrawn multiplied by unit rates. The rates are provided below (2006 prices):

- Maintenance: 3.09 NOK;
- Accident cost: 0.58 NOK;
- Local air pollution: 4.11 NOK (in cities);

- Global air pollution: 0.17 NOK;
- CO2: 0.39 NOK;
- Noise: 2.54 NOK; and
- Decongestion: 2.07 NOK.

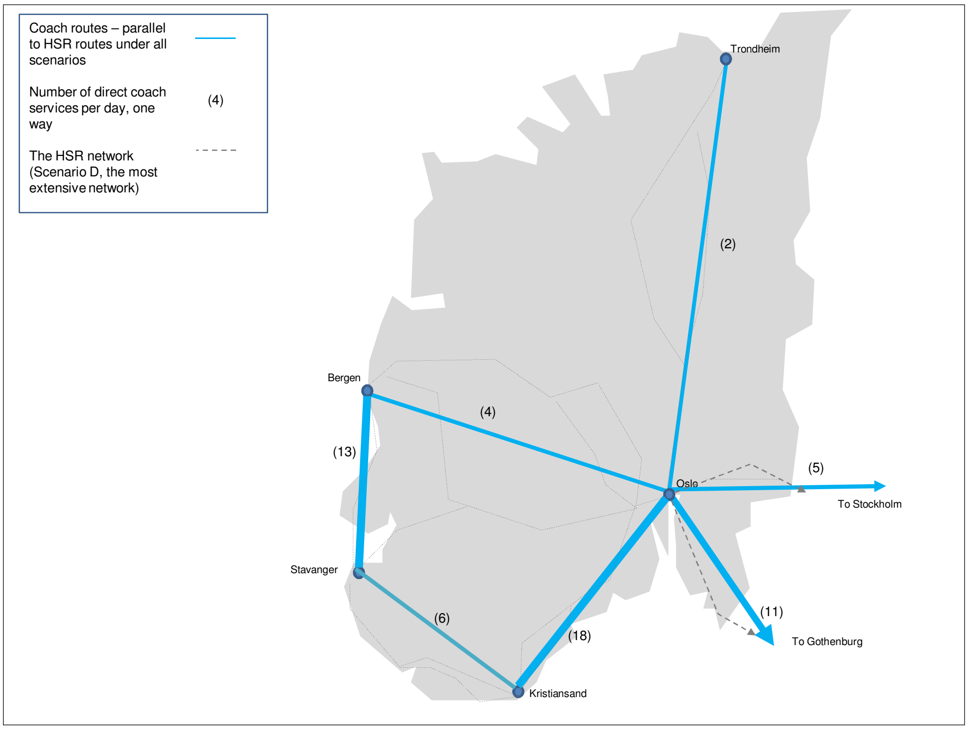
The previous studies by ECON and VWI omit the impacts on bus / ferry operators from their analysis.

4.3 HSR and demand for bus and ferry

If there is to be any spending savings and reductions to socio-economic costs associated with buses and ferries, then the starting point to analyse the extent to which HSR is likely to abstract high levels of demand from these modes.

The proposed HSR corridors are along existing long-distance bus routes, as illustrated below, with bus service frequency (per day) noted in brackets:

Figure 4.2 – Bus services along planned HSR corridors



There are two types of ferry services – those that connect sections of roads which are considered as part of the road sector, and those that operate inter-city services. It is the inter-city services that are considered in this chapter. While most HSR corridors are between cities that are not served by inter-city ferry services, there is a ferry connection between Stavanger and Bergen.

While most of HSR's demand is likely to be abstracted from air and cars, there may be a small abstraction from long-distance bus and ferry services. This section argues that, overall, the travel market segment for HSR services is likely to be substantially different from that for bus and ferry services.

Inter-city bus services operate between the key cities in the proposed corridors for HSR. The table below provides a comparison of fares and service levels between bus and existing rail.

Table 4.1 – Comparisons between bus and existing rail services

Route	Bus			Existing rail		
	Cost NOK (max fare - 'on-the-day')	Time	Daily frequency	Cost NOK (max fare - 'on-the-day')	Time	Daily frequency
Oslo – Gothenburg	243	03:35	11	484	03:54	3
Oslo – Stockholm	455	07:30	5	562	06:05	4
Oslo – Trondheim	299	08:30	2	856	06:36	4
Oslo – Bergen	805	10:25	4	788	06:28	5
Oslo – Kristiansand	350	05:30	18	636	04:25	5
Oslo – Stavanger	860	09:10	6	886	07:42	4
Stavanger - Bergen	490	05:00	13	1135	16:32	3

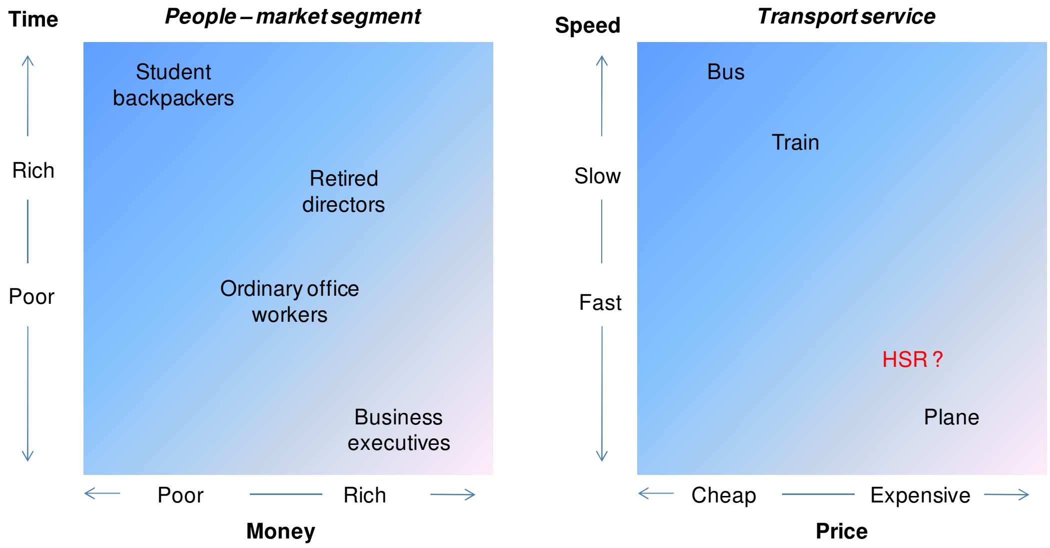
As shown, it is generally significantly cheaper to travel by bus than existing rail. In terms of journey time, typically, it is slower travelling by bus. The Stavanger – Bergen bus service is an exception, as currently there is no direct rail link between these two cities.

Although bus service frequencies are higher than existing rail, with daily frequencies mostly in single figures, passengers typically plan their trips accordingly, and hence their waiting times are broadly unaffected by such low service frequencies, i.e. passengers would not turn up at the stations, at random, and wait for the next service. An exception may be the Stavanger – Bergen bus service, where coaches are mostly operated at one service per hour throughout the day (05:45 to 18:45). However, even here, it is unlikely that many passengers would turn up at random and wait for the next service.

A paper by Leiren and Fearnley (Institute of Transport Economics, University of Oslo) suggests that the evolution of new bus services has had little impact in the volume of passengers using rail, with most users preferring rail where there is a rail alternative for the whole journey. Hence it might be expected that HSR's overall impact on the bus network might be quite modest.

In terms of the market segment for transport, people can be distributed along the dimensions of time and money – some have a lot of time but very little money, while some are "cash rich, time poor". Different modes can be imagined along the dimensions of speed (time) and fare (money) – some are slow and cheap while some are fast but expensive. These concepts are illustrated in the figure below (with the Stavanger – Bergen route being an exception).

Figure 4.3 – Market segment and transport service, differentiated by time and money



Given the services offered by bus and existing rail, the market segments (in terms of the type of people and their preference between time and money) for these two modes are likely to be relatively similar to each other, with rail users being more time sensitive and less money sensitive. The market segment for plane travel is substantially different with the typical air passenger likely to be more "cash rich, time poor" compared to bus passengers. Offering a fast service, HSR's primary target market segment is similar to that of the air market segment, rather than bus. Those passengers who use buses instead of the faster trains today, have already revealed their preference for money saving rather than time saving. Therefore, it is unlikely that many of them would be attracted to using HSR, which is likely to be more expensive to use than existing trains.

Given the high-level discussion above, it is not surprising that any forecast for HSR abstraction of bus demand is low. According to Phase 1 report Table 3.3, Urbanet Analyse (2008) forecasts that the market share for bus will decrease from 6% to 4% or 5% along HSR corridors, representing a decrease in demand for coach of only 5% or 6%. Indeed, most international studies on HSR demand composition do not discuss bus in any great detail, and analysis is typically combined with car traffic.

In reality, it is possible that HSR will abstract some demand from bus, possibly by the magnitude according to Urbanet Analyse forecasts. On the Stavanger – Bergen route, under Scenario D, there will be a direct HSR link between the cities. Given currently bus is the most convenient public transport, it may be the case that a "more than typical level" of demand could be abstracted from bus on this route.

It should be noted that while HSR is likely to have only a few intermediate stops between two large cities, and hence mostly serving demand between end-to-end stations, there are many local stops on bus routes, serving the local areas. For example, on the Oslo – Kristiansand route, there are 34 stops. Therefore, while HSR's market segment is long-distance journeys between large cities, in comparison, the market for bus travel has a significant local element – this local focus is, to a certain extent, also reflected in the stopping pattern of current "classic" rail. For example, the 07:11 service stops at 14 stations between Oslo and Kristiansand.

In terms of potential demand impact on the ferries, the only possible direct competition between HSR and the ferries is between Stavanger and Bergen. HSR Scenario D (separate HSR lines) proposes a direct link between the two cities.

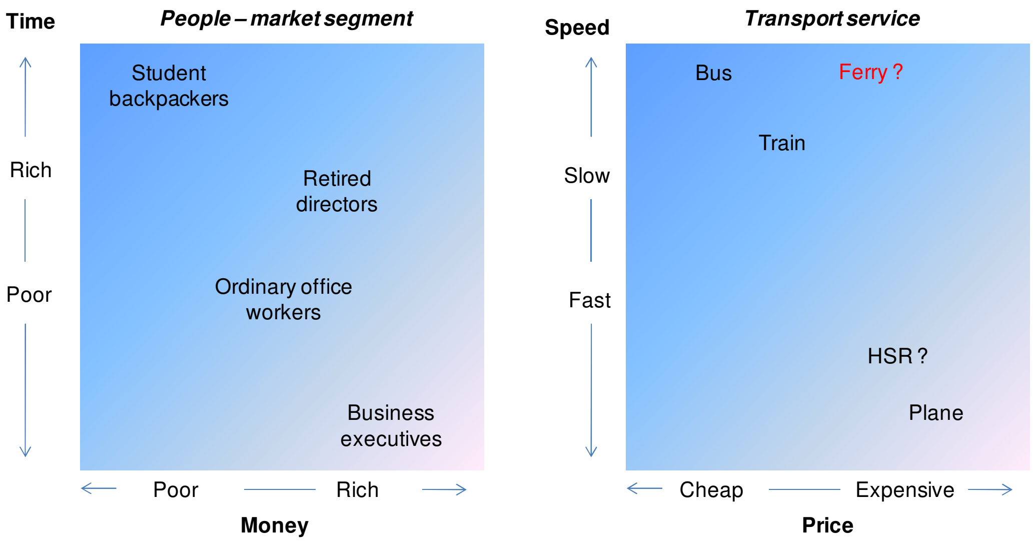
The table below shows that ferry is not particularly fast compared to bus, and is not cheap either.

Table 4.2 – Comparisons of journey options on the Stavanger – Bergen route

Stavanger - Bergen	Frequency	Journey time	Fare (NOK)
Ferry (tide Express Boat)	On a weekday from Bergen: 07:30, 16:05	4.5 hours	750 (regular)
Bus	13 buses a day	4.5 ~ 5 hours	490
Plane	14 direct flights a day	35 ~ 40 minutes	549 (low) ~ 1159 (full)
HSR Scenario D	Every 2 hours	01:35	?

Given the “not fast, not frequent and not cheap” service offered by the ferries, the market for this mode is likely to be relatively niche, and is not likely to be the same segment as HSR. The figure below uses the high-level analysis framework, introduced under the analysis on bus, in relation to the market for ferry services.

Figure 4.4 – Comparing ferry to other modes in terms of market segment



As shown in the figure above, if the market segments for bus and HSR are substantially different, then the segment for ferry is also substantially different. Therefore, it is highly unlikely that HSR would abstract any notable demand from ferries.

4.4 Bus and ferry operations

The previous section has established that it is unlikely that substantial demand would be abstracted from bus and ferry services to HSR. This will be confirmed by the forecasts generated by the demand model developed under Contract 5 Market Analysis (which will be available at the end of Phase 2 for use in testing in Phase 3 of this study). Given it is likely that the demand and revenue impact from HSR on these other modes are likely to be modest, the pressure on the operators of these modes to adjust their operations may be also modest. It is unclear that ferry services would change between Stavanger and Bergen (given there are currently only two services a day). However, the potential impact on the bus operators should be considered.

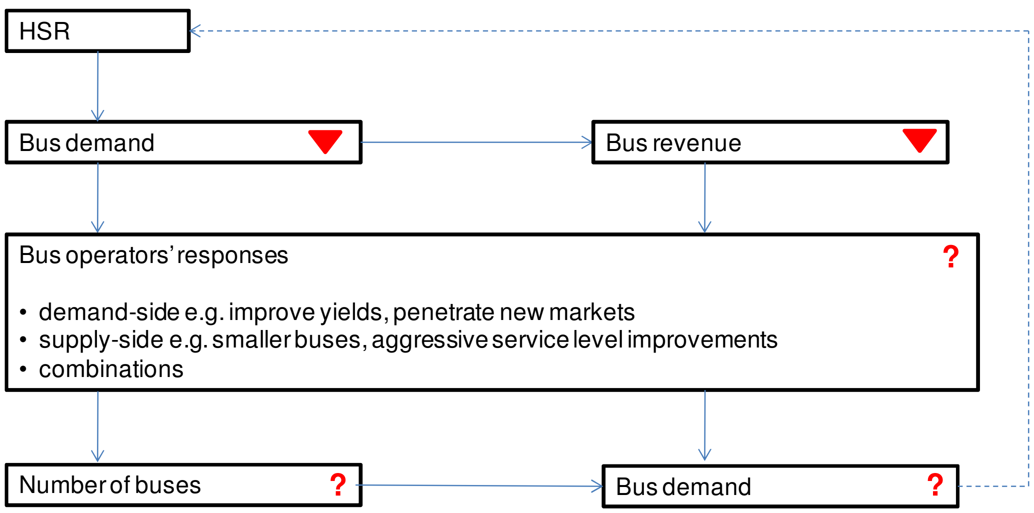
NOR-WAY Bussekspress operates the key routes. It is a marketing company for approximately 40 companies that are its owners. The operating companies hold the concessions to provide the bus services, responsible for timetables, fares and discounts. The state is involved in granting concessions in return for agreements by the operators to fulfil a set of obligations, in particular social functions.

Potential demand and revenue challenges from HSR may be modest on most corridors apart from the Stavanger – Bergen route. However, the bus operators may react in a number of ways, just as the airlines might do so under commercial considerations. For example, the bus operators may:

- accept the demand loss, and operate with the same number of buses to maintain market presence;
- try to improve yield by innovative marketing and penetrating new market segments of people who may be happy to pay higher fares;
- operate with smaller buses; or
- ask for subsidy from the state.

These are just some of the potential response measures the bus operators may choose, and such measures could be implemented in combination. As a result, it is highly dubious to claim that the only possible outcome, in light of a potentially very small demand reduction, would be the withdrawal of bus services. Indeed, depending on the overall strategy, the bus operators may choose to enhance their service frequencies to compete directly with HSR. Depending on the response from the bus operators, there could be an iterative impact on HSR demand, revenue and benefits, as illustrated in the figure below:

Figure 4.5 – Illustration of bus operators' responses to HSR demand abstraction



The iteration illustrated in the figure above is complex because while assessing HSR's own mode is relatively easy as most variables such as a HSR service levels are "controllable", bus operators' reactions are not "controlled variables". Given this "uncontrollability", bus operators' response strategies are cannot be readily second-guessed. The only certainty that exists is that depending on the level of bus demand abstraction estimated using the demand forecasting model developed under Contract 5 Market Analysis, there will be a revenue pressure placed on the bus operators. This pressure is the product of demand abstracted and average fare.

On the short-distance market, there may be a degree of competition in terms of airport access, for example if the Flybussen network provides bus-based airport access and HSR begins to operate along the same route. However, this competition is likely to be limited and is not analysed in this study which focuses on the long-distance effects of HSR.

While HSR could abstract airport-access bus market, it can provide additional demand on local buses that serve HSR stations. There could be an equivalent Flybussen network for HSR stations, possibly based on the adjustments to the Flybussen network in conjunction with adjustments to the local bus network. Therefore, HSR could provide more impetus for local bus development, including investments in bus vehicles and associated infrastructure. Given the local nature of such developments, they are not analysed further in this long-distance study of HSR.

4.5 Operations, spending and socio-economic impacts

The Guidance recommends a unit rate per bus kilometre removed to calculate the potential savings from reduced bus operations. However, unless the changes to bus operations can be modelled, it may be highly dubious to claim that such savings on the bus sector could materialise. In any case, given the different market segments that buses and HSR are likely to attract, the potential interaction between the modes are likely to be modest.

Even if service withdrawal is the only option available to the bus operators, the number of withdrawals is likely to be only one or two services per day, given the already low service frequencies on the bus routes.

Therefore, overall, the savings are unlikely to be materialised or substantial. The same logic applies to the materialisation of socio-economic impacts, such as reductions to noise, pollution and accidents, which are all based on bus kilometres removed. As for ferries, HSR is highly unlikely to affect their operations, spending and associated socio-economic impacts.

4.6 Recommendation on the treatment of bus and ferry in the assessment

While HSR’s demand impact on the bus sector is likely to be modest, there could still be some impact, especially in terms of the forecast revenue pressure. As with the air sector, the initial revenue challenge should not be interpreted as the final outcome; bus operators can respond to the HSR challenge. Depending on their response strategies, which will be established in Phase 3, more realistic final revenue and cost impacts can be estimated. The response strategies will be considered in line with the four broad categories already discussed with respect to the air sector, namely:

- Accept revenue loss without changing the operating costs;
- Reduce operating cost to offset revenue loss through measures that do not significantly impact on the bus passengers, such as operating smaller and more fuel efficient buses;
- Mitigate revenue losses through measures could adverse affect the bus passengers, such as fare increases and service frequency reductions; and
- Mitigate revenue loss through direct competition with HSR, such as fare reductions and frequency enhancements.

Depending on the response, revenue and cost changes can be estimated for buses as well as iterative impacts on HSR. In addition, socio-economic benefits can be estimated. In terms of noise, air pollution and emissions, as well as accidents, the magnitude of these benefits depends on the bus kilometres withdrawn as result of HSR competition. Bus passengers' benefits are also affected by certain responses, for example if bus frequency is reduced or the fares are decreased.

It should be noted that as discussed in terms of market segments in Section 4.3, existing rail services are competitors of the bus sector, given they are both relatively slow and infrequent. However, HSR is different. It represents a step-change in rail travel, with frequencies much higher than that are currently provided, and with journey times that are competitive with air. The primary target market for HSR is likely to be the same as the air market. The interaction between HSR and the bus sector is likely to be modest, and even more so for the ferry services. Therefore, the overall pressure on the bus and ferry sector to change their services is likely to be limited. In fact, the ferry services can be ignored all together as the only inter-city operation is between Stavanger and Bergen, with two services a day, targeted at a niche market that is highly differentiated with the HSR market.

HSR impact on the **bus** / **ferry** sector:

- Impact is likely to be limited (if any for ferry);
- Demand abstraction leads to revenue pressure on the operators;
- There are many ways the bus operators could respond (ignoring the ferries who operate in a niche market) to the challenges posed by HSR, at this early stage of the study, the exact response is not certain;
- Sensitivity tests will be undertaken in Phase 3 to show the outcome of possible operator responses, with the immediate outputs being changes in bus revenue and costs, as well as the iterative impact on HSR demand, revenue and benefits;
- The estimation of socio-economic benefits will be undertaken for the tests, with issues including noise, air pollution and emissions, and accidents based on the changes to bus kilometres operated. In addition, changes to bus passengers' cost of travel will also be estimated.

5 Airport Handling Efficiencies

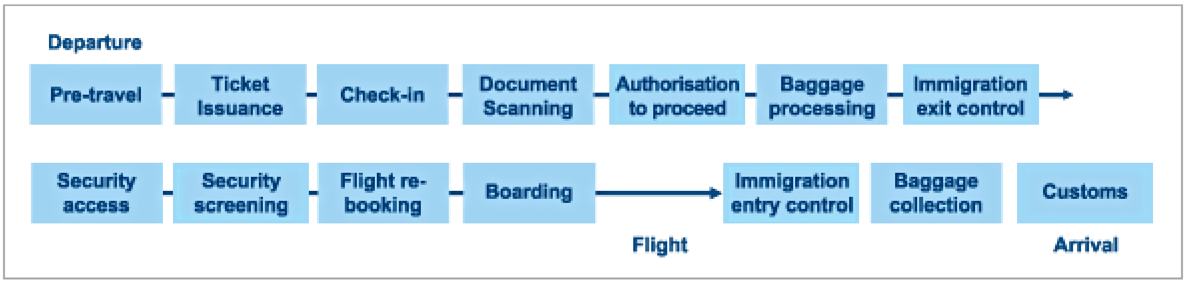
5.1 Introduction

Experiences from different HSR networks around the world indicate that the success of a new HSR system will significantly depend on its ability to compete with, and gain demand from, airlines that are serving the same city pairs, or combinations of cities along the HSR route. A key factor on which HSR competes with air travel is journey time. When deciding on which mode to use, people do not simply consider the in-vehicle (or in-flight) time; they also consider other components of their journey. For flights, a key component is the time spent before and after the flight, getting into and out of the airport. This chapter discusses whether improvement to airport terminal handling could lead to significant shortening of the overall journey time associated with air travel, and hence pose a substantial challenge to HSR.

5.2 The elements of airport transit time

There are a number of elements in the overall journey between origin and destination airports. This is illustrated in the figure below.

Figure 5.1 – Elements of airport transit time



(courtesy IATA)

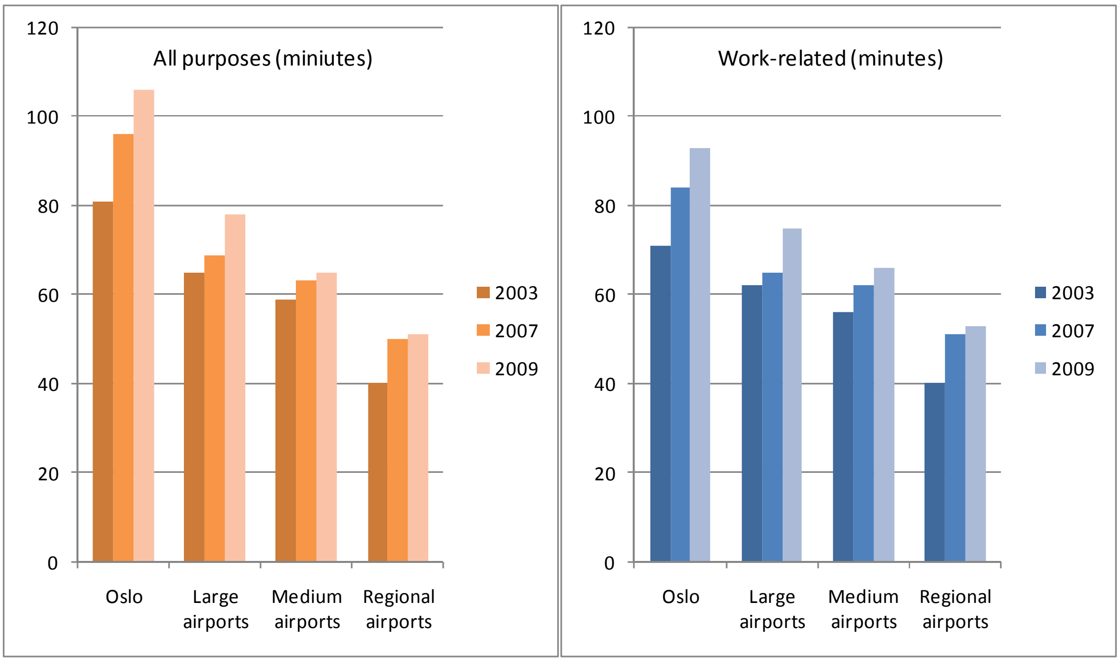
Each of the elements has a target time. Real time spent at each of the elements is subject to variability. There are a number of factors which could influence both target times and variability, including:

- Facility provision e.g. the number of check-in desks for baggage drops, the number of security gates, the provisions at the boarding gates, the technologies used all facilities;
- Staffing e.g. the number of staff from airlines at check-in desks, the number of personnel at the boarding gates, the extent to which the same staff perform a number of roles;
- Airport size and layout e.g. distance between the places where each element of the transit time takes place, the provision of travelators, the ease of navigation;
- Regulation e.g. the requirement on issues such as security;
- Passenger levels and behaviour e.g. the queue time at each element of the transit process is a function of both provision and demand levels; and of course
- Unforeseen disturbances e.g. equipment failure, boarding gate changes.

Overall, to ensure that passengers have sufficient time to get on their flights, airports and airlines advise the passengers to be at the airport far in advance of their scheduled departure times. For example, Oslo Gardermoen Airport, on its website, advises passengers to arrive at the airport at least an hour before their domestic flights. The same amount of time is recommended for passengers using Bergen, Trondheim, and Stavanger airports (Source: Avinor website). For international flights, typically passengers are advised to arrive at the airports earlier, about 90 minutes before departure.

The advised times can be different from how much time people actually spend at airports. According to air travel survey 2009, the average time people spend at airports before their flights has increased in Norway since 2003, as illustrated in the figure below.

Figure 5.2 – Average passenger arrival time in minutes before departure



(Source: Norwegian Air Travel Survey 2009)

The data from the survey does not differentiate between international and domestic travel. It is understandable that frequent flyers on domestic routes arrive at the airport closer to their scheduled departure times compared to the lengths of time suggested in the figure above. While the latest check-in time is 40 minutes before departure at Stockholm Arlanda Airport, at Oslo airport it is 30 minutes (Source: Swiss International Air Lines website), people with no bags to check in (according to SAS only 10% of passengers check in bags on work days in the peak hour) can arrive closer to their departure times, particularly business travellers who are less likely to travel with baggage. Currently, a minimum of 20 minutes is required for arrival at the gate before departure (as advised by SAS, January 2011). Some time has to be allowed for the transit between airport entrance and the gates. Currently, the service level agreement provided by Avinor is that 95% of passengers should wait for no more five minutes before security checks (as advised by SAS).

5.3 Theoretical improvements

Theoretically, if the time required to be spent at airport is reduced, then the Generalised Journey Time (GJT) of air travel will also be reduced. GJT includes in-vehicle (in-flight), waiting, access, and other elements of time which together represent the overall time experienced by passengers. All others being equal, reducing GJTs of air travel should increase air demand, which could have an adverse impact on HSR demand. Also it is expected that if airport-style check-in / security procedures had to be introduced on HSR there would be a negative impact on HSR demand (although this may be a result of the existence of the checks as much as the time they take).

It is theoretically possible that target times of completing each element of the transit process could be improved, for example:

- Increase facility provision e.g. having more check-in desks and baggage drops, providing more security gates, all with more advanced technology that reduces passenger transactions times. For example, check-in technology is developing, through the increasing use of digital technology – 2D bar-cades, new mobile applications, the internet and biometrics;
- Increase staffing e.g. more airline staff at check-in/bag drop desks, more security staff helping passengers to get through the screening process;
- Improve speed and ease of navigation through the airport, e.g. provide more travellators, control passenger "call to gate" times more proactively, improved signage for passenger navigation;
- Reduce time-impacting regulations, e.g. reduce/remove the no-liquid rule, and rigorously assess new security requirements before they are imposed by national governments;
- Adoption of more advanced technologies at security screening points, reducing the need for slower, staff-based, interventions and checks; and
- Relocate functions out of airports, with the creation of "virtual" airports moving away from the traditional airport campus, where parking, bag drop-off, validation of travel documents and authorisation can take place, and bypassing the traditional check-in halls and security points.

5.4 The issues with improvements

While improvements are theoretically possible, there are a number of critical considerations, which may mean that, in reality, it is difficult to improve transit times. For example:

- The costs of provisions – facilities and staffing costs the airports and the airlines. The question is if the improvements discussed in the previous section would make commercial sense to the air sector. The reduction of a few minutes may not translate to any significant increase to passenger demand for air travel, while the cost of providing that guaranteed level of shorter transit time (improving both transaction times and reliability) may cost a substantial amount;
- The commercial interest of the airports – airports have an interest in passenger dwell time in their terminals, allowing time for passengers to use the retail facilities, generating income to the airports, although it is understood that a substantial proportion of the non-aeronautical income to Avinor from domestic flights is from car parking, with retail being of limited interest (Source: SAS, January 2011);
- Regulatory environment – changes to regulations could add to, as well as reduce, transaction times and variability, especially on the security issue. This important aspect is mostly beyond the direct control of the airports, a point which was highlighted during discussions with Avinor. It can take substantial time for new procedures and technologies to be accepted by the government security agencies;
- Potential trade off between transaction times and reliability – ambitious improvements can also be associated with greater unreliability, while steady routine can be associated with less risk. Passenger service quality satisfaction surveys for airports suggest that predictability is the most important feature, rather than simple speed. Therefore, while improvements to transaction times are important, the actual performance of each handling element within the passenger journey is equally important to passengers' perception of a reliable time through

the airport. In other words, if transaction times are improved, but reliability issues are not resolved or even become worse, then passengers will continue to perceive the same amount of time would be required in air travel as in the pre-improvement scenario;

- Time buffer - quite often, the potential saving in transit times, through technology and system improvements, have been "diverted" to reducing costs for the air sector, allowing more time for passenger "dwell time", and building in "head-room" or "lax" in view of potential unreliability. As such, over the past decade or more, while technologies and systems have improved, real transit times as advised to the air passengers have not changed substantially; and
- The physical aspects of the airport – the size of airports has an immediate impact in that walking distances can still be long, leading to unavoidable elements of time that will not change as part of the passenger journey.

Based on the above discussion, while it is theoretically possible to improve transaction times, the extent to which the airports and the airlines could improve these times is not certain. Therefore, unless the air sector is sure of the predictable shortening of these times and that it makes commercial sense to do so, it would continue to advise its passengers to arrive at the airports far in advance of their scheduled departure times. The worst case would be:

1. To be over confident about the amount of time required for transit;
2. Inform passenger to allow less time for transit;
3. Substantial costs have been incurred by the air sector to improve the target times;
4. But the reliability issues often associated with new systems could not be resolved;
5. Resulting in people missing their flights;
6. While the airport retail facilities gain less revenue, and hence placing pressure on reduced income;
7. And the air sector's reputation is damaged, leading to less air demand and revenue.

Although there are some challenges to improving passenger transit times in airports through improving terminal handling efficiencies, there have been some positive changes and initiatives in this area:

- Air sector as a whole – some major improvements in processes have occurred in recent years with the advent of ticketless travel and the simplification of the information exchange between passengers and airlines. There are a number of initiatives that exist exploring opportunities for improvements. The International Air Transport Association's (IATA) Fast Travel Programme is examining self-service options across five areas of a passengers' airport journey, taking advantage of, or developing new, uniform standards and recommended practices;
- In Norway – some advanced processes are already in place, supported by technology, including the use of check-in machines and foot scanner at security points (no need to take off shoes);
- On baggage handling – for passengers with bags to check-in, as yet, the process there is not as sophisticated as the passenger ticketing process, and the conveyance of baggage to the aircraft is still largely a manual exercise and there are risks inherent in the process. There are a number of initiatives that exist in air sector that are exploring opportunities for improvements in passenger and baggage facilitation, and therefore the ease and speed with which they are handled. It is understood from discussions with Avinor that it is seeking to improve baggage handling process times. Given the latest check-in times are partly determined by the time required to transport bags onto the planes, any improvement here

could potentially shorten the latest check-in times from typically 30 minutes for domestic flights in Norway.

Whether or not the above positive initiatives result in actual decreases to the average time passengers need to spend at airports depends on a range of considerations, as already discussed at the start of the section. Improvement in efficiency could translate into shorter times for passengers, or cost reductions for the air sector, or a combination of the two. Greater check-in automation allows passengers to proceed quicker, and allows airlines to provide fewer staff for this function. Quicker security procedures benefit the passengers, and could also benefit the operators with fewer security gates required. How the benefit of technological and procedural advances spread between the passengers and the operators cannot be guaranteed, but at least, there is the potential for shorter airport transit times for passengers.

5.5 Implication on HSR

The sections above have discussed that while it is possible to improve terminal handling efficiency, there are a number of challenges to be considered, such as the cost of such improvements and if it would make commercial sense to pass time savings to passengers via shorter advised pre-departure in-airport time allowance. Overall, it should not be assumed that target time improvements to one or even more of the elements in the transit process would automatically lead to a dramatic reduction in the overall journey time people allow for air travel. For the forecasting of HSR demand, in the central case, it is assumed that people do not allow shorter times for air travel.

Although it is unlikely that dramatic changes would take place with respect to the amount of time people spend at airports, it is understood from SAS that before the security alerts arising from the September 2011 terrorist attacks in the USA using planes, it operated with allowance for passengers with no check-in luggage to go directly to gate until 10 minutes before departure time. Due to all the new security measures, this was changed to 20 minutes. The airline hopes to reduce this 20 minutes to 15 minutes in the near future – a reduction of five minutes. The impact of this will be tested using the demand forecasting model in sensitivity analysis in Phase 3.

A stated preference (SP) survey has been completed to provide information for this HSR study. Part of the stated preference study revealed the amount of time people spend at airports, especially those people who belong to the target market for HSR. The SP revealed times will form the basis on which reductions to times spent at airports can be tested in Phase 3.

Based on the advice from SAS, a five-minute reduction to pre-flight time will be tested in sensitivity analysis. Given five minutes appears to be a relatively short period of time, a ten-minute reduction sensitivity test will also be undertaken. The impact on business and leisure markets will be considered separately given their different characteristics, for example business travellers are less likely to check in baggage and spend less time at the airports and potential responsiveness to the introduction of HSR and changes in aviation journey times.

6 Multi-Operator Scenario

6.1 Introduction

A railway can perform a range of roles. It can serve as a revenue generator if operated on a purely commercial basis. It can also provide a socio-economic function. The state can decide on the services the railway should provide, and if such services are not commercially viable, then subsidies are paid to the operator.

Purely commercial railways are rare. The large initial investment, substantial risk, and potentially slow investment recuperation often means that public funds are required. At an operating level, purely commercially operated railways are unlikely to meet the public requirements which are decided upon politically, and therefore on-going subsidies (to meet the shortfall between revenue income and operating expenditure) are required for the operator to provide certain services.

Many networks are entirely operated by one publicly owned body. On certain services, premiums are generated (where revenue exceeds operating costs) and on other services, subsidies are required. On other networks, the operator of a certain route is decided upon by the government under competitive bidding, with the winner often being the bidder that promises the largest premium or the smallest subsidy. On certain networks, in principle at least, the whole operation is provided on a price-per-path basis by different operators.

The commercial and socio-economic function of the railway needs to be balanced when considering under what form it should be operated, in particular if the infrastructure could develop differently under a scenario where multiple operators run passenger services on the same route. The key questions are the provision of necessary and satisfactory service and the delivery of good value for public money.

Jernbaneverket has recognised the possibility for HSR services to be provided by more than one operator and requires this commission to review implications on HSR development under a multi-operator scenario. This chapter provides an analysis of the effects of multiple HSR operators on the development of transport infrastructure. It considers the following:

- Section 6.2 introduces multi-operator models: how multiple public and private operators operate services on the same tracks, including European comparisons;
- Section 6.3 introduces the existing operational structure in Norway and exiting multi-operator arrangements;
- Section 6.4 describes scenarios under which open-access operation can occur, and alternative open-access offerings;
- Section 6.5 discusses the potential transport infrastructure investment impact of open access offerings; and
- Section 6.6 provides conclusions for Norwegian HSR case.

6.2 Multi-operator models

Throughout Europe the last two decades have seen a restoration of market driven rail operation that aims to enhance innovation and deliver better value for money. This has been driven by EU directive 91/440, which requires member states to allow open access operation on national railways. The high speed market has been complicated by the internationalisation of rail services, cabotage of services in places, and the need to find a fair means to deliver a multi-national multi-operator trans-European network. These issues are evidently in abundance in the future Norwegian HSR system, but it has its own complications:

- Two of the five high speed corridors are international (Sweden) and will be subject to the market conditions and regulations in both countries;
- The Norwegian network will serve relatively low demand destinations (when compared with Northern and Central Europe) - each corridor is terminated by a large rail market but inevitably passes through smaller regions which may not attract service in pure market conditions therefore requiring some kind of subsidy to realise socio-economic benefits; and
- A significant potential air interlining market may complicate service quality and timetabling requirements e.g. air-train links may attract an operator for that purpose.

In Europe the approach to market access for high speed rail has varied across a spectrum broadly defined by three market access concepts:

- Open market;
- Single network concession; and
- Tendered concessions.

Table 6.1 considers the characteristics and performance of these models.

Table 6.1 – Characteristics of market access models

	Open Market	Single Network Concession	Multiple tendered concessions
Description	Open access. Track access paths are sold in a competitive market.	Rail services dominated by one operator at arm's length from the state	Particular routes tendered.
Examples	Germany – although is de facto single network concession as Deutsche Bahn dominates	France: SNCF	UK – various franchised train operating companies and some open access.
Type of network	Mix of routes some of which have distinctive service requirements	Highly interconnected network	Generally distinct routes and type of service
Innovation of operators	High – operator determines route, frequency, facilities and quality seeking to maximise profit. Responds to demand.	Lower innovation than open market, but concession will seek to develop new services if demand requires	Low although depends upon flexibility of concession. In the UK franchises have traditionally been highly prescriptive, reducing opportunity to innovate. Some franchises are now being given more scope to innovate e.g. Chiltern developing new infrastructure – Evergreen 3.
Socio-economic benefit	Low-profit services endangered – may need to remove from open market and offer subsidy.	Concession generally obliged to offer low value services. High socio-economic benefit.	Franchises prescribe service frequency, capacity, and quality. Timetable performance is largely prescribed ensuring low value markets are served. Fair allocation of subsidy.

	Open Market	Single Network Concession	Multiple tendered concessions
Competition	Intense competition on high value routes - could deliver better value for money. However, experience has shown that there are often very few bidders for paths reducing effectiveness of market.	Competition to win concession.	Competition for each sub-network. However, market benefits require enough initial bidders.
Political	Most liberal. However, open to criticisms of privatisation.	Operates most closely to a state run railway.	Franchise specification prescribed by government – could be open to bias. Privatisation criticisms.

As shown in the table above, the more open market the railway is operated, the more intense the competition there could be, driving the need for greater innovation. At the same time, such market-orientated approach often leads to low-profit services being endangered, questioning the railway's socio-economic function.

On an operational level, timetable management is a key to success. Mixing trains of different speeds and stopping patterns, particularly if operated by different companies, can have a detrimental impact on capacity and reliability. This is a particular issue for open market operations, where train paths are bid for by companies. The timetable manager needs to be flexible enough to accommodate such open access paths within his/her strategic considerations, with respect to the commercial and socio-economic functions of the railway.

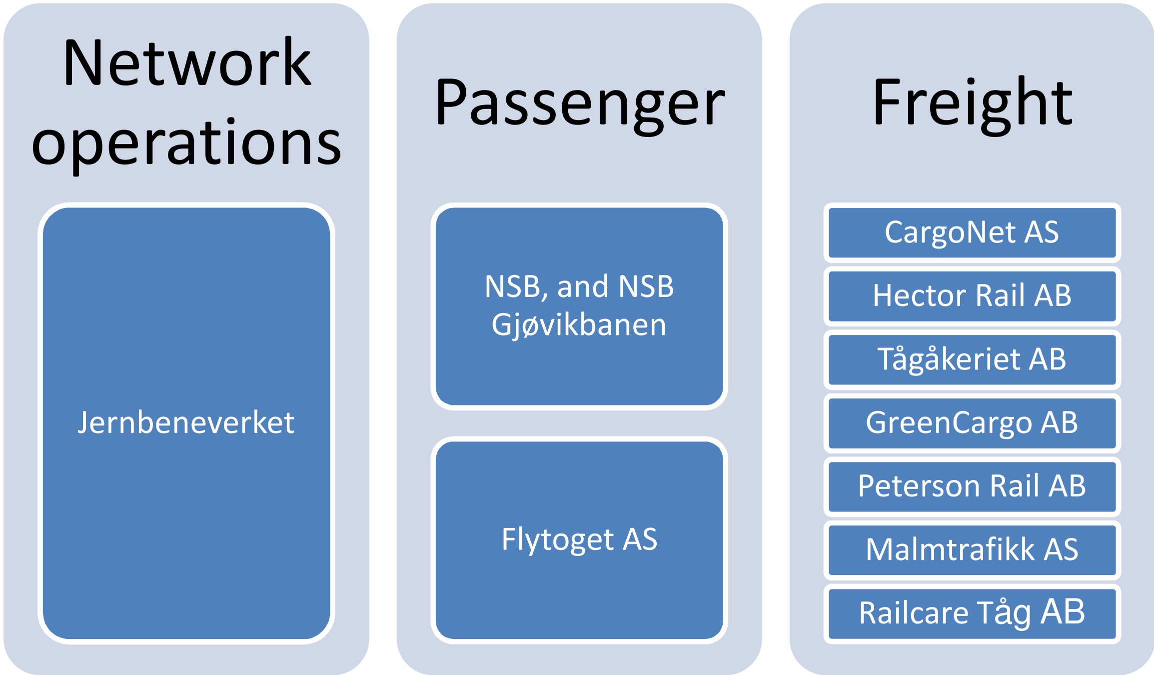
The number of bidders for multi-operator railways is important. If there are too few bidders, then this undermines the competition. In addition, the openness to new entrants is also important to ensure that competition is vibrant and meaningful.

6.3 Multi-operator scenario for Norwegian HSR

6.3.1 Existing operational model

Jernbaneverket is the government agency responsible for the maintenance of track, stations and freight transfer yards. Jernbaneverket may also assume responsibility of the HSR network in Norway once completed, and would act as the timetabling authority on the future network. Passenger operations are presently almost exclusively provided by NSB. NSB Gjøvikbanen is a subsidiary of NSB, responsible for the regional and local traffic on Gjøvikbanen. An independent state-owned company is responsible for the airport express train – Flytoget. Flytoget and NSB are controlled by two different ministries. Figure 6.1 summarises the operators involved in the existing Norwegian rail network. Whilst a market has developed for freight services, there appears to be limited competition with respect to passenger demand.

Figure 6.1 – Organisations involved in the present Norwegian rail network



6.3.2 Flytoget

In 1992 NSB Gardermoen was founded to build a new double-tracked high speed line between Oslo and Gardermoen airport and to provide a high quality, frequent rail service between Oslo and the airport. In 2000 the infrastructure was transferred to Jernbaneverket and Flytoget was established as the airport express train operator.

NSB competes directly with Flytoget on services between Drammen and Gardermoen airport station, with hourly commuter rail services to Eidsvoll, an hourly regional train to Lillehammar and six daily trains to Trondheim.

Flytoget and NSB tickets are not accepted on each other’s services and usually Flytoget tickets are more expensive (although students can receive a greater discount on Flytoget). Flytoget trains are given path priority around Oslo and boast 96% punctuality.

There has been an investment in separate ticket machines to sell Flytoget tickets. This could be seen as an infrastructure enhancement brought about by competition (more ticket machines), or an unnecessary confusion for customers.

The Drammen - Gardermoen corridor is the only existing example of on track competition in Norway. So far there is no evidence that this on-track competition has resulted in any fixed infrastructure investment, as the line was upgraded prior to the arrangement commencing.

6.3.3 Tickets to Sweden

The Swedish state-owned passenger operator Statens Järnvägar (SJ) operates the trains between Oslo and Karlstad / Stockholm. SJ has separate ticket machines at Oslo station. Tickets between Oslo and Swedish station on this line are sold via SJ machines but not NSB machines). However, on the other line to Sweden, NSB operates the trains between Oslo and Göteborg, Tickets on this line are sold via NSB machines but not SJ machines. While such a vending arrangement may not be confusing for frequent travellers, it may appear odd that depending on which city one wants to travel to, different machines have to be used.

6.3.4 Lynx

An international open access operator existed (2001-2004), which operated across Scandinavia including between Oslo and Gothenburg. However this service proved unprofitable as it could not compete with air for journey times. The introduction of a high speed route along this corridor would raise the prospect of a Scandinavian operator attempting this route again.

6.3.5 Potential future multi-operator scenario in Norway

The question of the potential for Norway HSR to be operated by a number of companies needs to be considered in view of the intended role this railway is envisaged to play – in terms of its commerciality and socio-economic function.

It is unlikely (at least initially) that a pure open market model will achieve adequate coverage to deliver all the socio-economic aims of a railway (providing agglomeration benefits, access to labour markets, and improved access to communities) some of which are not supported by large revenues and low operating costs. However, there may be opportunity for open-access operators to provide certain specific services, in addition to a concession which runs the majority of services and stations on each route. Track access, the interface between network and timetable management, is the critical constraint to open access, and requires an independent agency to assign paths. The availability and cost of paths is a major driver of what open access models might appear, and offer a means to recoup some of the scheme costs. Track access charges may be free, set at a specific rate for each path, or tendered commercially.

The possibility of multiple operators on the same tracks presents a number of issues:

- Which company is responsible for station management? In general the main concession holder should operate stations – but there may be specific stations served by open access operators such as airports or stations primarily for tourism.
- Public service obligations need to be provided for – how will franchises be awarded?
- Is it desirable to generate genuine competition on some corridors? Therefore open-access may well abstract from concession.
- In order to provide unified face of the railway, an independent unified ticketing system is desirable;
- If international high speed services require subsidy they are governed by European regulation (EC 1008/2008) and must be offered for tender in the Official Journal of the European Union and be open to any transport operator registered in an EU member state. The result may be a transfer of revenue out of Norway;
- Swedish Rail may play a significant role of some routes particularly in the East of Norway, resulting in significant revenue benefit to Swedish companies.

The following section considers the role open-access operators could play on a railway with certain paths sold privately.

6.4 Alternatives provided by open-access operators

High speed infrastructure may be used by a variety of service offerings, which aim to attract a certain segment of the market.

Potential service offerings include:

- **Premium long distance -** Business passengers require a high quality working environment which includes train accommodation with tables, electrical power sockets and Wi-Fi internet. A high quality catering service is expected. At stations a waiting lounge with these services would be expected. Premium long distance operators may also target the high-end leisure market – passengers who desire spacious carriages and on-board dining.

  Example: Deutsche Bahn Sprinter ICE 1st Class

  In Norway this could consist of a business express non-stop Oslo-Bergen service, designed to capture the high-end business market currently served by air. Investment in high-quality trains and facilities required.

- **Revenue maximisation** – open access operator deliberately chooses train paths with highest demand to maximise revenue. This will have a detrimental impact on franchised services.

  Examples: Grand Central on UK's East Coast Mainline

  Busiest lines in the Oslo commuter belt may attract such an operator, where large revenues can be guaranteed without much investment.

- **Under served market –** operator chooses a stopping pattern which serves markets that are currently not served particularly well. This may result in less distance to travel to reach a station.

  Examples: Hull Trains on UK's East Coast Mainline

  In Norway most of the HSR corridors include lower value destinations e.g. on the Oslo-Trondheim corridor and open-access operator of this type may choose to call at smaller markets such as Otta and Lillehammer.

- **International –** Operator provides international services including international marketing. On board staff are multi-lingual, multiple currencies may be used.

  Example: Thalys on the Brussels – Paris route

  This could include services from Northern Europe e.g. Deutsche Bahn may run a Hamburg-Oslo service. Likely to be significant Swedish Rail influence.

- **Airport express –** Airport operator or airline may decide to invest in a premium service from city centre to airport. This service will be fast and rolling stock will have additional luggage capacity. There is unlikely to be catering provision because of the short distance. The operator may invest in additional waiting facilities at the city centre, and in local bus links.

  Example: Heathrow Express, London – funded and operated by airport operator BAA

  As already seen at Gardermoen, airport express operators could develop at other locations if served by HSR e.g. Bergen Airport or another Oslo Airport i.e. Rygge, Torp.

- **Tourist –** Specific tourist attractions may attract an operator possibly on a seasonal basis. The operator will adapt its offering to match the market. For instance, a ski service may operate only in season, and provide capacious luggage storage. An operator serving a theme park may provide family discounts on tickets. An operator serving a scenic railway line could use slower trains and would offer high quality catering.

  Example: Bayerische Oberlandbahn – connects Munich with ski resorts and historical attractions in Bavaria. Offers combi tickets with bus transfers and ski passes.

  It is possible an operator may serve ski resorts such as Geilo and Lillehammer if the HSR network serves such locations.

- **Sleeper** – Overnight train provides very specific rolling stock and hospitality (although this service requires a subsidy to operate).

Example: Caledonian Sleeper, First

Long distance services to Northern Europe would be suitable for sleeping facilties.

6.5 Impact of open-access on investment in transport infrastructure

The open access models described in the previous section may have some impact on investment in transport infrastructure. This section describes the specific investments relating to each service offering, and then describes some of the multi-modal investments that can emerge. Finally it discusses potential decrements to future investment that could emerge.

6.5.1 Potential immediate investment from alternative open-access operations

The open access model discussed can result initially in generally small scale investments in the rail infrastructure, as operators provide the equipment needed to provide their unique offering. Table 6.2 outlines the possible open access models described above, their requirements and the resulting investments.

Table 6.2 – Alternative open access models and resultant investment impact

Open Access Offer	Passenger Market Requirement	Impact upon investment
Premium Long Distance	Very high quality train accommodation with tables and wi-fi internet High quality on-board catering and entertainment Spacious waiting facilities at station with catering, entertainment, wi-fi etc. Business market – train accommodation needs to be enabled for working Expectation of easy interchange to reach central business districts	Rolling stock refurbishment or procurement to necessary standards Operator invests in waiting facilities at stations including catering and wi-fi Investment in interchange facilities, such as bus/taxi waiting areas or provision or extra bus services provided by operator. Investment in high quality ticket sales including online and smartcard ticketing.
Revenue maximisation	Operator aims to maximise passenger trips (possibly maximising abstracting from franchised operator)	Minimal investment. May offer cheaper tickets undermining subsidised service revenues, to the detriment of overall investment.
Under-served market	Presently under-used station is served by high quality long distance trains	Investment in station facilities such as waiting areas and ticket offices. Car parking has a large role to play – as railheading distance may be reduced and a good parking facilities

Open Access Offer	Passenger Market Requirement	Impact upon investment
International	European operators provide service to Norwegian locations. High quality carriage accommodation	Revenue abstraction from Norwegian rail network may reduce funds available for investment – revenue could go overseas. Potential investment in station facilities to cater for the very long distance markets such as high quality waiting facilities and travelling shops (Foreign exchange etc.) Investment in information facilities at stations to provide international information in multiple languages.
Airline	Airport express service designed to provide rapid access to airport from city centre Focus on business trips with high values of time – good accommodation standard Frequent connection Space in rolling stock for luggage Good terminal facilities for handling onward journeys and luggage Interfaces with flight connection times	Investment in airport rail station facilities to improve writing and boarding conditions. Investment in rolling stock to allow more space for luggage. Investment in onward connections at the airport or city centre end. Potential investment in information at stations, including flight information. Potential investment in railway track and station e.g. BAA Heathrow Express.
Tourist	Ticketing interfaces with tourist attractions May be seasonal – e.g. ski	Potential investment in station facilities at attraction locations where facilities would otherwise be small scale. Potential investment in station on existing line to serve particular tourist attraction.
Sleeper	Sleeping carriages Catering	Investment in facilities associated with overnight accommodation. At stations additional toilet/shower facilities would be provided. On trains investment in sleeper rolling stock.

Most of the investments described in Table 6.2 are small scale in nature and tend to relate to improved information, demand specific rolling stock and small scale station investments (toilets, waiting rooms, shops). These investments are valuable but can only contribute a small amount to the overall investment. Open access operators are reluctant to provide major investment because of the associated risk and the short re-coup window due to the limited length of track access agreements. Longer track access agreements could encourage larger investments.

Case Study: Quality market driven investments - Arenaways, Italy

Arenaways started passenger railway services between Milan and Turin in November 2010 and directly competes with national operator Trenitalia. It has had its intermediate stops regulated to reduce abstraction from the monopolistic operator. The service has made a number of novel small scale investments to attract certain passengers which include:

- On board shopping
- Dry cleaning and shoe polishing service
- News and entertainment screens
- Free newspapers

This operator has made typical investments of an open access operator – small scale service quality investments on the train and at the station.

In some cases airport operators have committed to major infrastructure investment. An example is the Heathrow Express financed by BAA. Much would depend upon the balance between HSR competition with air and the integration benefits of them working in tandem. If a particular airport had limited capacity, and there was a desire not to expand, HSR could relieve some pressure. At Trondheim for instance an HSR extension to Værnes could transport interlining passengers from Nordland and Finnmark.

Case Study: Major infrastructure investment at airport - BAA Heathrow Express, UK

The Heathrow Express is a high speed premium service link which offers journey times of 16 minutes between London Heathrow Airport and the city centre. The trains run on national rail infrastructure for the majority of the distance (18km), but then diverge from Airport Junction into and 8km tunnel to the airport. The service is wholly owned and operated by Heathrow Express Ltd, a subsidiary of BAA (Ferrovial consortium). Heathrow Express Ltd is responsible for the 8km tunnel section and the stations beneath the terminals.

The operator shares tracks with the franchised operator for the region (First Great Western). The open-access operator has a 25 year track access agreement.

As well as investment in this major infrastructure by the open-access operator there were further soft investments at the Paddington national rail station including:

- Dedicated platforms at Paddington
- Airline passenger and luggage check-in facilities; and
- Ticket machines, with multi lingual and through-ticket purchase

In this example the large investment was justified by the private operator because of enormous demand from London's main airport and because a long term (25 year) track access agreement with Network Rail ensured a long term investment was viable.

6.5.2 Long term investment

In the longer term open access can generate funds for further rail investment but this depends upon appropriate track access charges and the success of the overall multi-operator system. If the system, including open-access satisfies a greater spectrum of transport needs the following benefits accrue:

- Generation of new demand due to improved services;
- Abstraction from competing modes;
- Rail heading changes (which station passengers choose);
- Reduced crowding (where relevant); and
- Economic benefits due to reduced generalised journey costs/ times.

Together these impacts will help the railway revenue as a whole grow, which in the long term will result in further investment.

6.5.3 Potential disadvantages to transport investment

On a heavily subsidised railway it is difficult to envisage a situation where open access would not abstract revenue from franchised services. If the franchise was designed to pay a premium to the rail administration or government, any abstraction would be to the detriment of transport investment. There is a particular danger with international operators that revenue could leave the country.

The price of paths needs to be carefully considered to ensure that the price is competitive but not too low. Experience in Sweden has shown a lack of bidders for paths drives down value with only two bids seen in places by SJ and Tågkompaniet. At least three bids are needed for genuine competition – there is little point in losing revenue if competition benefits are not realised.

Case Study: Revenue abstraction on the UKs East Coast Main Line

The 1993 UK Railways Act enables operators to apply for open access on the UK rail network, which is otherwise subject to tendered concessions. The East Coast Main Line, one of the most important rail lines in the UK (linking London and Edinburgh via a much of its route is considered highly profitable.

Long distance services on this route are provided by a franchised operator (currently however managed by the state). The operator

Grand Central has been accused of abstracting from high earning East Coast stations without providing much extra capacity (as these stations are already well served) e.g. Northallaton, York, Doncaster.

The UK Office of Rail Regulation (ORR) approves or rejects open access proposals and applies a “not primarily abstractive” test on proposed open access. This test considers ratio of generated to abstracted revenue as well as other economic and quality factors. Although open access operators on the East Coast Mainline have supposedly passed this test, track access charges have resulted in disputes including the test case GNER vs. ORR (2006)

6.6 Conclusions for Norway

It is conceivable that several private and public train operators will compete and operate on the Norwegian HSR network, particularly given its international connections. The resulting ongoing transport infrastructure investment will depend largely on how this multi-operator scenario is managed. Revenue needs to be maximised and captured to reinvest in infrastructure or to contribute towards its initial cost. Providing track access to open-operators is one means by which some of the investment funds can be recouped. If HSR is not operated on a purely commercial basis, and a socio-economic function needs to be performed under public service requirements, then it is unlikely that open access operation alone can provide much of the initial large-scale investment required to develop the HSR network, and provide the aspired socio-economic benefits. Experience across Europe has shown that open-access operators usually only provide small investments, such as investments in waiting and ticketing facilities. However there are some specific open-access offers, which might be suitable for the Norwegian markets, and deliver small investment benefits:

- Limited stop – slower serves serving smaller markets, which could result in upgrades of stations;
- Seasonal ski operator – specialising in calling at ski resorts (Geilo, Lillehammer), that do not attract sufficient demand to attract regular stopping of long distance services. May result in upgrades to stations and rolling stock;
- Airport Express – already exists for Gardermoen –could possibly be a case at Bergen or Trondheim. Could result in investments at stations and airports in ticketing, check-in and waiting facilities; and
- International – It is highly likely that an international operator from Northern Europe would run trains to Oslo. This would result in investment in improved waiting facilities.

However, it is important to consider the dangers of selling the most profitable paths to revenue maximising operations. If the long term objective is to fund reinvestment in the railways, high value routes should be operated by the national rail operator or the path price should be set to ensure a good return. It is important that as much revenue as possible is generated by providing the range of services that passengers need.

However, if the priority is to reduce dependence on public sector investment and increase innovation in revenue increases, then there may be a case for encouraging competition between operators.

7 Conclusions

The ITT requests the following analysis:

- The extent to which HSR could reduce the future need for investment and maintenance spending on roads and airports, including the possibilities to avoid or postpone major investment at the largest airports;
- The potential impact on the air and bus industries;
- The extent to which HSR could have positive financial and socio-economic effects on other transport modes;
- The extent to which air could become more competitive against HSR by improving airport terminal handling; and
- The possible effects on the development of transport infrastructure if several private and public train operators operate on the same tracks.

This report concludes that:

- The extent to which future spending on other modes if affected by HSR depends on the response strategies of the operators of these other modes, apart from the road sector where reduction to car traffic as result of HSR can be estimated with a degree of certainty;
- The airlines and bus operators are likely to face a revenue pressure from HSR competition. The way they may react to such a pressure cannot be easily second-guessed. However, in generic terms, we have categorised responses into four broad categories:
  - Category 1 - Acceptance of revenue loss without changing services and therefore operating costs;
  - Category 2 - Reduction in operating costs to offset revenue loss but using measures that do not noticeably impact on air/bus passengers;
  - Category 3 - Introduction of measures to generate revenue or save operating costs that do not avoid an impact on the remaining air/bus passengers; and
  - Category 4 - Mitigation of revenue losses through competition with HSR, consequently resulting in a reduction in HSR demand and revenue and / or entering into new markets.
- Based on these categories, in Phase 3, sensitivity tests will be undertaken to assess the impacts of inter-modal effects, including impacts on operator revenue and costs, as well as socio-economic impacts such as noise, air pollution and emissions, accidents, decongestion, and cost of travel (which includes both fare and time elements). The resulting impact on HSR demand will also be assessed to capture the full effect.
- The potential for significant reductions in airport terminal handling times are limited. Sensitivity tests of reductions of five and ten minutes will be undertaken in Phase 3 to assess the extent to which shorter average time required for airport transit could affect HSR demand, revenue and benefits.
- If HSR is operated by more than one organisation, then this has several implications, including the types of services that could be offered. In terms of major infrastructure investments, it is unlikely that the operators would commit such large spending.

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