HSR in UK- Should UK go for High Speed Rail?

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Abstract— UK got their first high speed rail, named HS1, between London St Pancras and Channel Tunnel, this has a line speed of 186mph. This line essentially connects Britain to the continent on high speed rail link. The high-speed rail came to Britain almost two decades later than France and elsewhere in the Europe. History says that the Britain was the leader of the industrial revolution. The HS1 was an initiative to run the train from the continent at same faster full speed in the UK. It was more of an external force. Now the situation has changed. The domestic market is growing. There is an exploration that what are the alternatives to meet the demands of the market. One alternative is high speed rail along with air, road networks. The question is that is high speed rail is the best solution?

Index Terms— Capacity of HSR, Cost of HSR, Environment Impact of HSR, High Speed Railway, HSR, Market of HSR, United Kingdom.

1 Introduction

IN November 2007, UK got their first high speed rail, named HS1, between London St Pancras and Channel Tunnel, this has a line speed of 186mph. This line essentially connects Britain to the continent on high speed rail link.

Since 1994, the Eurostar changed the way people travelled between London and Paris/Brussels when the channel tunnel became operational. Those trains used to slow down once they were at Dover in the UK, out of the channel tunnel on a journey from the continent. The rail track and signalling were not built to let the trains run at their full speed. The train ended at Waterloo station back then.

In 2007, the new line was opened which brought the trains even closer to the city centre to St. Pancras. This new line HS1 has increased the speed of the trains and has cut the journey time by 20 minutes. (Eurostar website, Feb 2008).

The high-speed rail came to Britain almost two decades later than France and elsewhere in the Europe. History says that the Britain was the leader of the industrial revolution. It made the world's first successful steam locomotive in the year 1829. Now it is catching up in the railway technology with the other parts of Europe.

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2 BRIEFS, Scope, Exclusion & Methodology

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2.1 Brief

The author had discussed the issue whether the UK should have high speed rail, if so what the considerations are?

2.2 Scope & Exclusion

The scope of this document was limited to academic study of feasibility of high speed rail in the UK. The discussions are limited to estimated cost, market and environment issues based on available public information.

This report excluded any commercial and political matters Copyright Form

2.3 Glossary of Terms

Term	Meaning / Definition
CfIT	UK Commission for Integrated Transport
DEMU	Diesel Electric Multiple Unit
DfT	Department for Transport
EMU	Electric Multiple Unit
GDP	Gross Domestic Product
HS1	The first UK High Speed Line from Kent to St. Pancras
ICE	Intercity Express, The German high-speed trains
IRJ	International Railway Journal
Km/h, kmph	Kilometre per hour
mph	Mile per hour
TGV	Train a Grande Vitesse, The French high speed trains
UN	United Nations

2.4 Methodology

Following method was used to prepare this report:

- Collection and study of public information;
- Analysis of the information
- Explanation of the analysis;
- Making choices;

3 SECTIONS

This document has following sections:

1. Introduction: A brief introduction of the assignment and its context;
2. Background: Background information of the subject and its history;
3. Analysis Information: author examined various issues for the high-speed rail;
4. Conclusions, Recommendation and Reviews: Conclusions were made and review points are detailed;
5. References: The lists of references are placed here.

4 BACKGROUNDS

Britain made the world's first successful steam locomotive in 1829, called the Rocket. It also invented vacuum brakes for the trains. London was the first city in the world to run railway underground in 1863. The fastest steam engine train from London to Scotland was with Mallard engine with the speed of 126mph in July 1938. Britain was always a leader in the railway technology.

In 1974, France unveiled faster trains called TGV, Train a Grande Vitesse. Ever since then they have ledhigh speed rail with the world fastest steel wheel and steel rail interface speed of 574.3 kmph in April 2007. The quest for high speed rail was followed by many other European countries. Germany has their own ICE, high speed trains.

Britain's first high speed rail, HS1, from the east coast to St. Pancras was an expansion of the high-speed rail connecting the island to the continent. This line has cut the journey time by 20 minutes. In addition, the terminal station has come closer to the city centre for the trains coming from the mainland Europe.

Now the domestic market is growing. The existing railways are running at nearly full capacity. Britain has to think of alternative ways of increasing the capacity for transport as a whole. Railways are high capital-intensive investment projects. They take long to build. The success of such investment is dependant on many factors like market, capacity of infrastructure, benefit to cost ratio, environment, safety etc. The author discussed the issue with its associated arguments in following sections.

5 ANALYSIS INFORMATION

Based on available public data following analysis was carried out.

The Market

There have been many market surveys for railways. Passenger rail travel has grown 50 percent since 1994. (Ben Webster, Times, Jun 2007). A recent report from department for transport (DfT, Delivering Sustainable Railways, July 2007, p41) states that passenger kilometres between London and the south east is expected to rise from the level of approximately 20 billion kilometres in 2005/06 to 26 billion kilometres in 2014/15. The growth in the report was expected to be 6.7% in July 2007, but in reality, today it has shown 10% growth in the last year alone (Ben Webster, Times, Jan 2008).

A report from the UK commission for integrated transport 'High-Speed Rail' (CfIT, HSR, Jan 2008) states that the case is dependent on a number of market factors as below:

- The highest market for high speed rail is where the journey length is around 200-800km, preferably in the range of 300-600 km. Air travel is a preferred for journeys more than 800 km. high speed rail has shown no benefit for shorter journeys of 150-200km;
- The demography of the country should be such that a large population is spread across the route so that effective capacity utilisation of the railway is achieved. At the same time, a significant population can easily access the railway.
- It is easier to build railways (including conventional railways) in sparsely populated countries like France, but railways through cities with high population can serve the market more effectively.
- The economical case for high speed rail becomes less beneficial for shorter distances when there is an existing good conventional railway. It is possible to use the existing railways for final approaches to major cities. Thus, the costs of high speed rail could be lower.

Britain has highly populated cities spread across the country, distances approximate from London are 90 miles to Birmingham, 185 miles Manchester, 300 miles to Newcastle, 400 to Glasgow and 480 miles to Edinburgh. This has a mean distance of around 96 miles between stations. It complies with the requirements stated above.

The report (CfIT, HSR, Jan 2008) further states that the case for high speed railway was stronger in 1980 for France than Britain for above reasons. Now it is a stronger case in Britain. Many other European countries are building or planning their high-speed rail on the same basis. There was previously spare capacity on British national rail, it would have been very difficult to justify the construction of high speed rail. Now due to growing capacity constraints, it is required to have a solution to serve the growth in the market.

Capacity

In the report to the parliament from DfT, delivering a Sustainable Railway (DfT, 2007, p61), it states that the London to Birmingham line will have utilisation in excess of 100% of the capacity level for 3 hours during morning peak by the year 2030. Some part of the line is already operating at 80%-100% level today.

The high-speed rail report (CfIT, HSR Jan 2008) states that the high-speed rail would have additional 50% seating capacity than conventional railway. It also states that it has 50% higher capacity than that of a three-lane motorway with a train journey time at 1/3rd of the equivalent road journey.

The French TGV has seat capacity of 1000 per train, while Japanese bullet trains have 1600 seats capacity. A high-speed rail could provide 220 trains a day, currently there are about 98 trains per day on west coast main line after the recent upgrade to run 'Virgin Pendolino' trains at 125 mph speed. There government has set aside £30 million to refurbish/replace the roll-

ing stock to improve capacity and meet passenger expectations. (DfT, 2007, p54)

The growth trend and the increasing demand of intercity travel would support the realisation of maximum benefit of the investment in high speed rail.

The existing rail network is already saturated and running at full capacity. Any further capacity expansion on existing lines is not feasible at the present speed limits of the trains.

The report 'Delivering Sustainable Railways' (DfT, 2007, p84) states that the freight train requirement is likely to increase by 30% over next ten years. The route between Liverpool and London has maximum freight train traffic of over 50 trains per day, (DfT, 2007, p85). This is the same route where the passenger carrying capacity is nearly saturated.

There are route capacity and passenger train capacity issues. These can be resolved by a high-speed rail corridor. The report (CfIT, HSR Jan 2008) states that many countries have invested in high speed rail to improve capacity. The high-speed line not only carries more passengers but it frees the resources on the conventional railway to serve regional passenger traffic, including freight. The high-speed rail not only increases capacity but it also reduces journey time, which is very welcome to the passenger.

Costs of high speed rail

In a recent interview with The Times news paper, Mr. Ian Coucher, Chief of Network Rail, was proposing three new lines operating at 200mph (Ben Webster, The Times, January 25, 2008):

- From London to Glasgow via Birmingham and Manchester;
- London to Edinburgh via Leeds and Newcastle upon Tyne;
- London to Cardiff via Bristol.

He estimated that it will cost more than £50 billion to complete. Network Rail has decided to take the lead.

The report, 'The vision for HSL' (Atkins, Oct 29, 2004) has stated that the benefit to cost ratio is between 1.9 and 2.8 to 1. It discusses many options for a high-speed line, including one from London to Edinburgh and Glasgow. The report doesn't include any line to Cardiff as pointed out by Mr. Coucher in the interview.

The high-speed line from the north of St. Pancras to Birmingham is estimated at £11 billion in the news report in The Times (Ben Webster, June 19, 2007). There is an assumption that this option has part of the journey at 125 mph on the existing lines. This will enable the trains from Paris to directly travel to Birmingham at high speed.

The report (CfIT, HSR Jan 2008) suggests thinking a little further. It states that the cost in the UK for high speed rail construction appears to be much higher than other European countries. The cost could be lower by 20-30%, if construction is undertaken in several stages between London and Scotland. However, some cost can never be reduced e.g. land and labour. It does recommend that efficiency gains may be possible through more effective use of resources and to examine those areas where there is a scope of cost reductions.

The report also points out that safety regulations are highly demanding in the UK. The regulations often become counter-productive in spite of the railways are being the safest and least polluting mode of transport. Secondly environmental regulation also adds significantly to the cost. A balanced approach to environmental, social and economic benefit could help to mitigate environmental impact.

There is a socioeconomic benefit with high speed rail. It helps by improving GDP of the country. It allows skills to be utilised across the country, giving an opportunity to commute from a distant city to where needed. Secondly the reduced time to travel increases the availability of productive time. These parameters can not be measured directly, but they do have an impact.

The Maglev trains are considered twice as expensive to construct. Shanghai has recently shelved the project on the cost factor (web eriksrailnews.com accessed on Feb 21, 2008).

Environmental Impact

As stated earlier the environmental regulation is onerous in the UK. The report 'Delivering Sustainable Railways' (DfT, 2007, P18) shows that the CO_2 emission from transport is 23% of total emission in the UK and conventional rail account less than 1% of the total. The rail industry can make significant contribution by promoting a 'greener' travel mode compared to road use, which is 16% of the total emission.

In another study by University of Lancaster called 'Environmental Impact of High speed rail' (Prof. Kemp, April 21, 2004) shows a comparison of high speed rail with the other modes of transports such as car and air.

The study states that the energy consumption linearly rises with the speed of the train for a journey between London to Edinburgh, but the fall of journey time is not linear. The journey time benefit reduces for speeds beyond 300 kmph. For all the three modes of transport Prof. Kemp suggest that it requires 20-22 litres of fuel, with an assumption that the power is generated from fossil fuel for the high -speed trains. He gave an example that France has reduced the emission by using a nuclear power station with a question can UK do so?

The study (Prof. Kemp, April 21, 2004) makes following partial recommendations:

- A modest speed, 200-250 kmph;
- Low carbon energy source: renewable, nuclear;
- High capacity, wide bodied double deck EMUs;
- Discourage travel growth such as long commuting distances;
- Provide capacity for parcels, mail (freight);
- Free up other lines to allow modal transfer of freight.

The author of this report disagrees with some of the recommendations above especially speed of the trains and discouragement for long commuting distances. One of the reasons for GDP growth is to share the skills across the cities; a 300 kmph service would be favourable.

The metro system in New Delhi, India is the first railway in the world to claim carbon credit from the UN (IRJ, Feb 2008, p12), which they can sell and generate revenue.

Safety

The railways are overall safest mode of transport in the UK

and Europe. It is further improving in that the fatalities rate have fallen from 2.5 per billion passenger kilometres in 1972 to less than 0.5 per billion passenger kilometres. The UK had a few peaks in recent years due to Ladbroke Grove and Hatfield incidents.

The high-speed rail would have its own safety implication because of its speed. The line side signalling is simply not workable as the signals would not be sighted by the drivers, they have to be in cab signals. The 20 minutes journey time reduction between London and Paris was because of the improved signals in the UK for the first high speed line.

France has taken a decision to isolate the high-speed lines from conventional railways. This is a safety approach as defence in depth. To run mixed traffic on the same line is very difficult to manage and maintain safe distances between the trains. There should not be any level crossing on the line. The entire line has to be fenced to keep trespassers away. This will increase the cost to some extent but safety benefits are increased.

Energy source

High speed rail can only work on electric traction (EMU). The regenerative brakes, if any, would help only if it can feed back power to the traction supply. Diesel trains (DEMU) would be heavier and not be energy efficient.

Prof. Kemp has already cautioned in his study (Prof. Kemp, April 21, 2004) that the energy source should be either renewable or nuclear type.

The author of this thinks that this should be a pre-condition for high speed rail.

Train Technology

Maglevs are wheel-less magnetically levitated trains. They offer a significantly reduced friction has and have a very smooth, fast journey. The construction cost is almost double that of steel wheel – rail interface infrastructure. The biggest disadvantage is that it can not run over existing conventional infrastructure. The inter modal operation is very difficult to manage, as such maglev is not preferred solution.

6 Conclusions and Reviews

Conclusions

The analysis has made the following conclusions:

- Britain has a case now for high speed rail using steel wheel – rail interface with speeds not more than 300 kmph;
- The domestic market continues to grow;
- The benefit to cost ratio is between 1.9 and 2.8 to 1;
- There are severe capacity issues to meet demand. They can be met with high speed line;
- The demography and distances between the cities is favourable to have 100-mile gap between the stops, which is desired for a high-speed rail.

The Network Rail has already taken lead to construct high speed line at the cost of £50 billion over 15-30 years. Through high speed rail, Britain has an opportunity to be on par with the world in railway technology and operation.

Recommendations

Based on the above conclusions the following recommendations are made:

- Build high speed rail in stages as proposed by Network Rail;
- Explore reduction of cost through efficient management and multiple staged plan;
- Explore the increase of revenue through a carbon credit from the UN;
- Consider relaxation of safety and environment regulation, which may assist in cost reduction;
- Promote high speed rail journey to reduce car/air journeys;
- The energy source has to be of renewable type or nuclear type.

Reviews

Following reviews are required from this report:

- Review the safety and environmental regulations;
- Review approval process and its costs;
- Evaluate energy efficient rolling stock.

7 References

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