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High Speed Railways, Development Period and Competitiveness with Other Transportation Modes

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Abstract

High speed railways can be considered as a new railway class which is provided by enhancing the criteria's like level of service parameters, infrastructure and capacity of conventional railways for more than forty years. A rapid entrance to high speed railway sector has been emerged in Turkey that important investments have been done and is done. Firstly, Ankara-Eskişehir High Speed Railway Line has been completed, then Ankara-Konya High Speed Railway Line was started to operate, after that Eskişehir-Konya High Speed Railway line connection has been opened. Objectives of the thesis are expressing the development period of the sector, evaluation of high speed railway definitions, researching on the perspectives of level of service parameters and capacity and making compares with other modes.

Keywords: Capacity, High Speed Railways, Intermodal Integration, Passenger Transportation, Velocity

1. INTRODUCTION

Shinkansen high-speed train service, which was opened in Japan between Tokyo and Osaka 40 years ago at a speed of 210 km/h, emphasizes the return of railways as significant passenger mode of transport. From this date onwards, high-speed train (HST) services have entered many countries, most of which are planned and railways have become the dominant modes of transport over many routes. In such researches, different high-speed train (HST) operating elements for the purpose of characterizing high-speed train operation and the best design and delivery included in this scope are summarized. The research concludes that high-speed trains (HST) can replace conventional train services in situations where higher capacity, less travel time, improved rail services (versus other modes), and modal stabilization are required on the same routes. However, the high investment rates for the high-speed train (HST) infrastructure cannot be justified based on economic development benefits due to their lack of certainty. As a result, it is advisable to define high-speed train (HST) services as follows: high capacity and frequent railway services with an average operating speed of over 200 km/h [1].

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2. TECHNOLOGICAL DEVELOPMENT OF TODAY'S HIGH-SPEED TRAINS (HST)

Traditionally, a speed of 200 km/h is seen as a threshold for 'high speed' and is a speed caught in the tests in Germany in 1903. In 1955, France broke a new record with 331 km/h, and at the same time, they also developed their record in 1990 on the French TGV high-speed train (HST) on steel rails with steel wheels at 515 km/h. The commercial speed that is caught with it, however, has a greater importance. The maximum operating speed of the Tokaido line is currently 270 km/h while the TGV Atlantic line trains operate at a top speed of 300 km/h. The standard for the new lines is higher, and at 350 km/h, this is the official maximum operating speed for new high-speed train (HST) lines such as Madrid-Barcelona. Higher operating speeds are not commercially feasible due to noise problems, high operating costs and other technical difficulties [2].

The modern high-speed train (HST) uses steel wheels-based technology on steel rails just as it was in the first trains that started in the 19th century. Nevertheless, many marginal engineering and technological improvements are needed at all stages of train operation to reach commercial transfer speeds above 200 km/h.

The main technical challenges in the development of commercial high-speed trains (HST) concern the development of a train and route that can maintain stability and comfort of passengers (while the train is traveling at high speeds), maintain safe stopping capability, prevent sharp increases in maintenance and operating costs, and prevent noise and vibration increase in areas adjacent to the line.

In many cases, the solution is to include: installing a line that prevents hard curbs, increasing the inter-axle distance in spark plug to help maintain stability, placing spark plug between wagons (not at the end of each cart) to reduce weight by reducing the number of spark plug required to move wagons, improving stability by preventing vehicles from turning from one to the other, making aerodynamic design to reduce friction and to shape the train in a way to reduce noise and vibration which can be achieved by using lighter and more robust material.

Also, high speeds require changes such as the development of signaling systems, the transition to automatic braking/speed-cutting systems to increase safety, in the case of train operations, for instance at high speeds, the driver must move the roadside signals to the controller's cabinet because the driver is passing too fast to see the roadside signals.

3. DEVELOPMENT OF HIGH-SPEED TRAIN (HST) NETWORK

Despite the success of the Tokaido line in Japan, the spread of high-speed train (HST) lines around the world are relatively slow. Whereas the worlds third high-speed train (HST) operation was only started in Italy. Today, the high-speed train (HST) operation spans more than Japan and Europe and is beginning to enter the Far East. The United States is behind in this regard.

The development of high-speed train (HST) services, as well as Japan and Europe, has a significant place in the Far East. KTX, which is the national high-speed train (HST) line that adopts the South Korean TGV model, has achieved the eighth country position with the operation of 300 km/h since its operation in April 2004. In 2005, Taiwan completed the 345 km/h high-speed train (HST) line between Taipei and Kaohsiung, making it the first country to implement the Shinkansen model outside of Japan. As mentioned above, China has taken its place among the countries that provide high-speed train service (HST) with the opening of the high-speed railway line between Beijing and Shanghai [3].

In the United States, there is a high-speed train (HST) line operation: Acela Express, which is a horizontal high-speed train (HST) that serves the Northeast Corridor between Boston and Washington DC. Today in the United States (USA), ten corridors were designed for high-speed rail operation and had not yet been built. The California high-speed train (HST) line connecting the San Francisco Bay area with Los Angeles and San Diego has the corridor that is at the most advanced planning stage. The current debate in the United States is the future of the US National Railway Passenger Company (AMTRAK), and discussions about the level of subsidy cause suspicions about the possibility of operating a high-speed train (HST) in the country. The lack of funding for intercity rail services makes funding a challenge for high-speed train (HST) operators, which suggests that the fate of the proposed high-speed train (HST) projects is largely dependent on state funds and administrators rather than federal funds. Various studies have been conducted on the scenarios of high-speed trains not being available in the United States and being widely available.

A project on the east coast high-speed train (HST) network is being carried out in Australia which aims to connect the cities of Melbourne, Canberra, Sydney, and Brisbane with a line of 2000 km long, however, the government decided in 2002 to suspend the process due to the completion of this work, which resulted in a high cost, and 80% of this would be met from the public.

Compared to the Maglev lines, Chuo Shinkansen between Tokyo and Osaka is in an advanced stage of planning and still expects a confirmation from the government. It does not exist in a Maglev plan that turns into tangible in the present situation.

The observations made within the relevant studies show that cars have the highest modal share in relatively short routes and the proportion of automobiles in the modal distribution is 82% in the Madrid-Zaragoza and Zaragoza-Barcelona routes at an average distance of 300 km before switching to high-speed train (HST) service. In this case, if there is a transition at a similar rate to that of airline and high-speed train (HST) services from the car, it means that there are certainly more passengers at the numerical level. Moreover, in these observations, it is noted that in Spain experience, the social benefit of travelers from the transition from automobiles to high-speed trains (HST) is greater than the interests of the airline to high-speed train (HST) transit [4].

In summary, all high-speed trains (HST) lines can be defined as fulfilling the objectives of increasing route capacity and reducing travel time. Higher capacity and traveling speeds lead to a change in modal distribution, an increase in the share of trains from airway and road, passengers transition from conventional trains to high-speed trains (HST). Also, the transition to high-speed train (HST) services is also causing the new demand on the route. The sum of all these is the transportation effects of the high-speed train (HST) services. More detailed evaluations of the transportation effects of high-speed trains (HST) are made mainly in Europe.

4. CAN HIGH-SPEED TRAIN (HST) SERVICES TAKE THE PLACE OF AIRLINES?

Although airline transport is not the main reason for the transition to high-speed train (HST) services in a substitute transport network, more attention has been given to high-speed train (HST) services instead of airlines as a solution to airline transport industry congestion and environmental problems.

Depending on the high-speed train (HST) stations being located in the city center and their high speeds, a high-speed train (HST) can be substituted for the airline with comparable or lower travel times on various routes. Since trains do not have to follow a direct route, the average travel speeds of high-speed train (HST) services and the travel distances of high-speed trains (HST) can be an advantage, depending on the travel distances required for each mode of transport. For instance; on a journey between London and Paris, the airline travels 380 km while the high-speed train (HST) travels almost 500 km. In most of the routes, which are about 300 km away, the indicators show that airline services have been disabled by switching to high-speed train (HST) services (for instance as in the Tokyo-Nagoya and Brussels-Paris lines). High-speed train services over 1000 km and beyond are beginning to abandon the ability to substitute for airways (for instance, the distance between Tokyo and Fukuoka is 1070 km, and the share of the high-speed train (HST) on this route is only around 10%).

5. LOCAL AND SOCIO-ECONOMIC EFFECTS OF HIGH-SPEED TRAIN (HST)

The transition to high-speed train (HST) operation has resulted in several impacts in addition to the transport effects described above. These effects are local effects and possible social and economic effects. Such effects, especially the effect of economic developments are vaguer, harder to observe and digitize, and also more controversial.

The local and social consequences of railroads are the subject for passengers and freight transport and both intra-city and inter-city journeys. Therefore, this issue can be observed both in conventional railways and high-speed railways, as well as in subways, light rail systems, heavy rail systems and tram lines.

High-speed railway lines have few stations in the city, but especially inner city railway system lines can cause significant impacts due to the location of the stations. There are inner-city and inter-city lines that integrate with each other in many countries, especially Germany and Japan. The accessibility of any European city will be severely affected by the fact that the services of the European high-speed train (HST) are not completely interconnected. Since both Shinkansen and TGV lines are connected to the main cities, medium and small-medium sized cities can often remain between stations. All these extensive effects are the adverse effects of high-speed train (HST) services.

In summary, there is no consensus on the direct impact of the high-speed train (HST) infrastructure as a mode of transport, as well as the size of its broad socio-economic impact. The conclusions are mixed, and there is no consensus at the point of the existence of positive influences and positive or negative. The positive economic impacts are still an important factor for planning and design of potential high-speed train (HST) services. This was justified as the right to register as a key point in the high-speed train (HST) network, rather than to pass it without regard to this issue.

6. ENVIRONMENTAL EFFECTS OF HIGH-SPEED TRAIN (HST)

The impact of high-speed train operation on the environment is usually portrayed in a positive light, with the assumption that the impact on the environment is positive, especially regarding air transport mode, and other transport modes. Nevertheless, high-speed train (HST) operation has some adverse environmental impacts including effects such as local air pollution (LAP), climate change, noise and land occupation.

High-speed trains (HST) are predominantly electric-powered, and emissions from high-speed train (HST) operations are assessed for direct energy consumption and resources used to generate electricity. While high amounts of renewable resources and nuclear power are used to produce electricity, emissions associated with high-speed train (HST) operation are relatively low. The emission is calculated according to the average electricity production mix, assuming if electricity is supplied from the national grid. The use of the power supply also means almost zero emission from high-speed train (HST) operation along the line and the station.

The most hazardous pollutants due to high-speed train (HST) operation are sulfur dioxide (SO2) and nitrogen oxides (NOX). The initial impact of the environment is the local air pollution (LAP) level, followed by the actual implications of both local air pollution (LAP) and climate change. Local air pollution (LAP) due to SO2 emission levels within the high-speed train (HST) operation can be significant, assuming if high-speed train (HST) operations, in general, are not a significant influence on climate change. These levels are mainly dependent on the amount of coal used to generate electricity. Power plants are located far away from densely populated areas, indicating that the current effects of high-speed train (HST) operation on local air pollution (LAP) are lower than that of the relatively minor number of people exposed to emissions and of the mixture.

7. CONCLUSION

A high-speed train (HST) line seems commercially viable. High-speed train (HST) services are ideal for linking distances averaging 200 km with linear corridors between large city clusters over a population of one million [6].

One of the issues that require high-speed train (HST) operation in the related researches is the necessity of a demand about 12-15 million railway trips between the two cities annually. Even though many high-speed train (HST) lines do not match with these definitions, they are still seen as the basis of high-speed train (HST) operation and even as a measure of profitability (As in Tokyo-Osaka and Paris-Lyon lines) [7].

Today, investment in the high-speed train (HST) infrastructure based on existing data is not supported by economic development benefit expectancies. Also, the high-speed train (HST) investment logic should be based on its impact as a mode of transport, for instance in the railway sector, its ability to serve better than conventional railways and capacity to substitute for other transport modes. For efficient substitution of airlines, the high-speed train (HST) must include stations at major airports to ensure complete integration between the operation network, airline and high-speed train (HST) modes. Although high-speed trains (HST) are not a significant influence of high-speed trains (HST) on the potential for substitution rather than automobiles, it seems that a sufficient level of research has not yet been developed (relatively short distances below 300 km).

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