Implications of High-Speed Rail on Air Traffic

KENNETH R. BUCKEYE

Three high-speed rail (HSR) technologies were examined in the corridor connecting Minneapolis–St. Paul to Madison, Milwaukee, and Chicago. Travel characteristics in the existing market show the predominance of the air and automobile modes for nonbusiness purposes. Projected travel times for the 185-mph Train á Grand Vitesse and 300-mph magnetic levitation trains show that rail could be competitive with air depending on origination and termination points of a given traveler. An analysis was conducted of the various HSR alternatives and their effect on projected air traffic from Minneapolis–St. Paul International Airport (MSP) to Madison, Milwaukee, and Chicago. The results indicate that although HSR could divert 17 to 33 percent of air passenger traffic in the corridor and 12 to 21 percent of aircraft operations, total impact on passenger movements and aircraft operations at MSP would range from 1 to 2 percent. Whereas capital costs for an HSR system range from nearly $1 billion to more than $5.4 billion depending on the technology, consumer and community benefits range from $8 billion to $10 billion. Projected annual ridership and revenue would cover operating and maintenance costs for any of the rail technologies considered. Despite apparently low impacts on airport operations at MSP, cumulative benefits of HSR to the Minneapolis–St.Paul metro area and the upper midwest should be weighed against the socioeconomic, environmental, and financial costs of airport relocations. Airport and rail operations concepts and strategies may work in concert to significantly extend the life of MSP.

The success of high-speed rail (HSR) systems in Europe, Japan, and the Northeast Corridor of the United States is prompting many officials, organizations, and individuals in the United States to take a serious look at the application of these technologies in several high-demand corridors. HSR proposals are being promoted as a way of alleviating airport and highway congestion, reducing infrastructure costs, and, through private-sector capitalizing, possibly reducing some of the funding problems facing the nation's transportation systems. Experts have suggested that these rail technologies might be appropriate in reducing dependence on the automobile and easing pressure at crowded airports in corridors of 100 to 400 mi in length.

One proposal currently under consideration is the study of HSR service connecting Minneapolis–St. Paul, Milwaukee, and Chicago. This corridor, which is 430 mi long, is served by highways, air connections, bus service, and the Amtrak Empire Builder. Travel in the corridor is dominated by automobile and air travel.

One concern of transportation officials in Minnesota is the impact that HSR might have on the need for a new major airport in the Minneapolis–St. Paul metropolitan area. The question of a new airport has resurfaced in recent years amid controversies surrounding airport expansion, noise, and capacity problems (particularly in relation to economic implications for the region) at Minneapolis–St. Paul International Airport (MSP). Since deregulation of the airline industry, demand at the airport has increased significantly.

The MSP master plan projects an increase of nearly 30 percent in aircraft operations and 75 percent in passenger movements by 2010 (*1*). By some national estimates, revenue passenger miles could double by 2010 (*2*).

With all of the inherent uncertainties about growth projections, the need for a new airport has not been clearly determined. Because of this, the 1989 state legislature established the dual-track planning process, which lays out the requirements of the Metropolitan Airports Commission to plan for major improvement options of runways and terminal facilities at MSP while the Metropolitan Council conducts a broad search for a new airport location. Both agencies are to report to the legislature, which is scheduled to make a decision on airport expansion or relocation by 1996.

The legislation establishing the dual-track planning process did not require consideration of alternatives such as HSR and the impact it might have on the need for a new airport or the relief it could provide at the existing airport. Examined here is the issue of HSR and its potential effect on reducing air demand in the Minneapolis–St. Paul to Madison, Milwaukee, and Chicago corridor; landside and airside congestion at MSP; and socioeconomic considerations.

EXISTING TRAVEL CHARACTERISTICS

The Departments of Transportation in Minnesota, Illinois, and Wisconsin conducted a preliminary feasibility study of HSR as a means to determine whether the corridor among Minneapolis–St. Paul, Milwaukee, and Chicago could support an HSR system. The Tri-State Study of High Speed Rail Service was conducted by the consultant team of TMS/Benesch (*3*). Requirements of the study were to evaluate three technology alternatives in two study corridors, identify the existing market shares for all modes of travel, and project the ridership and revenue for three selected HSR technologies given the various performance characteristics. In addition, an analysis was conducted of potential routes, engineering and environmental considerations, and the financial and economic impacts of such a project.

The study determined that if an HSR system were to be constructed, the southern corridor, with the cities of Madison,

Minnesota Department of Transportation, Office of Railroads and Waterways, Suite 925, Kelly Annex, 395 John Ireland Blvd., Transportation Building, St. Paul, Minn. 55155.

Milwaukee, and Chicago, would achieve the greatest ridership and revenue and the greatest net consumer surplus. Therefore, for the purpose of this analysis, only the southern corridor will be assessed in determining the impact of HSR on air traffic.

Modal Preference

The study revealed that the air and automobile modes constitute the majority of person trips in the corridor, accounting for more than 97 percent of the existing travel. The automobile alone has nearly 63 percent of the market share; air accounts for 35 percent. Existing bus and passenger train modes serve a small portion of the passenger movements in the corridor, accounting for less than 3 percent. Although the bus and existing train modes are not expected to grow substantially or increase their respective market shares in the next 10 to 20 years, projections for air and automobile modes indicate increasing demand and associated congestion (*3*).

Annual person trips for air, automobile, and rail or bus between Minneapolis–St. Paul and Madison, Milwaukee, and Chicago total nearly 3.7 million today (Figure 1). The trips represent travel in both directions and have been annualized from FAA and Illinois and Wisconsin departments of transportation survey travel data. The figure indicates that 2.3 million automobile person trips were made in 1989 between Minneapolis–St. Paul and the three origin and destination cities. Rail or bus person trips amounted to less than 75,000.

Whereas total air travel amounted to nearly 1.3 million trips for the corridor in 1989, the number of air trips originating and terminating in the Minneapolis–St. Paul and Madison, Milwaukee, and Chicago city pairs is estimated today at 1 million annually (Department of Transportation, Origin-Destination Survey). Chicago's two major airports (O'Hare and Midway) and MSP are currently served by 98 commercial carrier flights per day. Madison, Milwaukee, and MSP are currently served by 22 flights per day.

Trip Purpose

The category of other travel, which includes personal business, pleasure, and vacation, is the major reason for travel in the corridor, representing 80 percent of all trips (Figure 2).

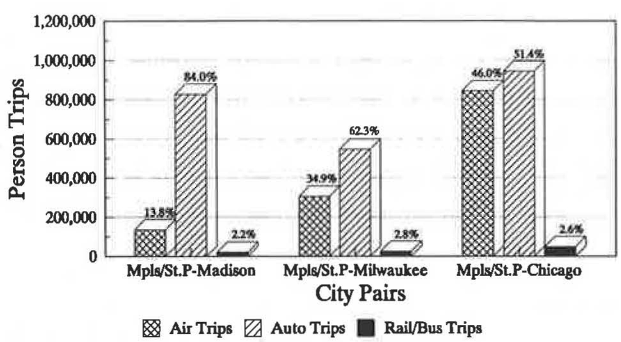

FIGURE 1 Trips by air, automobile, and rail or bus to and from Minneapolis–St. Paul, 1989 (source: FAA, Illinois DOT, Wisconsin DOT, Southeastern Wisconsin Regional Planning Commission).

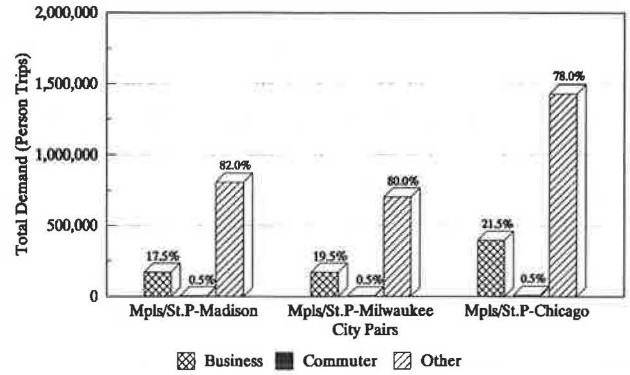

FIGURE 2 Travel purpose by city pair (data are from 1989) (*3*).

Cumulatively, 19 percent of all travel between the major metropolitan areas is considered business. Commuting accounts for less than 1 percent of travel purpose.

HSR POTENTIAL IN CORRIDOR

It was concluded in the tri-state study that significant potential existed for developing an HSR system in the southern corridor, achieving operating times, ridership, and revenue that could make it viable and competitive with other modes. The following summary presents the major findings of the Tri-State High Speed Rail Study in relation to the southern corridor. HSR technologies, a route evaluation, timetables, costs, and ridership and revenue estimates are presented in the following tables and discussion. Although Minneapolis–St. Paul is an important traffic generator, only a portion of the costs as well as ridership and revenue can be directly attributed to that metropolitan area or the state of Minnesota.

HSR Technologies

The HSR technologies that were evaluated represented three performance categories: high speed (125 mph), very high speed (185 mph), and super speed (300 mph). Within each performance category, existing rail systems, or prototypes, were selected in order to determine timetables, costs, and physical performance requirements (such as track curvatures) for routing considerations. Selected for study were the British High Speed Train (HST), representing the 125 mph category; the French Train á Grande Vitesse (TGV), representing the 185 mph category; and the prototypical Japanese magnetic levitation (maglev) train, representing the 300 mph category. Steel wheel on steel rail systems are proven performers under conditions similar to the Midwest, but maglev systems have not yet been put into commercial service anywhere.

Route Evaluations

Within the two general corridors identified for the tri-state study, potential routes were analyzed on the basis of field inspection of right-of-way, environmental constraints, population and employment distribution, and topographic and geologic conditions. To evaluate the alternatives it was necessary to establish route objectives to form a basis for comparisons. The objectives were as follows:

- To minimize travel times among the major cities to be served,
- To minimize the impact of natural topography on the rail system,
- To maximize regional accessibility, and
- To minimize the impact of construction and operation of HSR on the environment.

On the basis of a comparative engineering and environmental analysis, one route in each corridor was selected. For purposes of this analysis, only the South Route Modified is considered for the very-high-speed and super-speed options. For the high-speed option, the Amtrak Route was selected (Figure 3). The termini of the routes were Minneapolis–St. Paul and Chicago with a stop in Milwaukee. In the southern corridor, the route included Rochester, La Crosse, and Madison. The Amtrak upgrade option included only cities on the existing line.

Specific station stops were not identified in any of the cities. However, using a unit cost assessment, consideration was given to possible stops in suburban Chicago and downtown Chicago or O'Hare Airport, as well as a suburban Minneapolis–St. Paul station (possibly at MSP) and a downtown stop in one of the two cities. It was assumed that all other cities identified along the selected routes were to have one station stop.

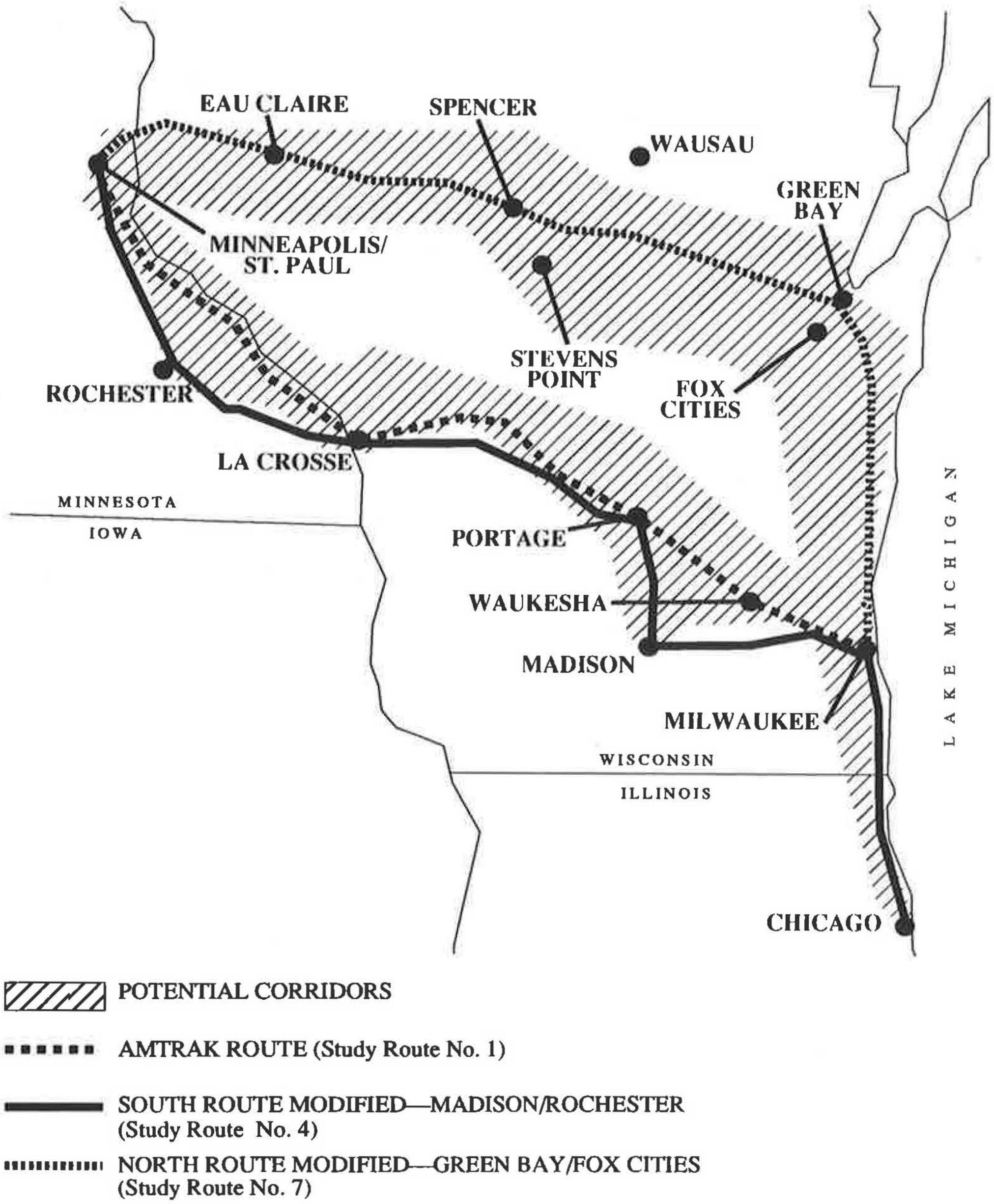

FIGURE 3 Routes selected for study of HSR service.

Operating Timetables

Operating times for the various HSR technologies were calculated using the LOCOMOTION© Train Performance Calculator (*2*) for each route option. Train running times were computed using performance data, including acceleration and deceleration and horizontal curve speed capabilities for each technology. Also considered were physical track condition data on a milepost-by-milepost basis, curve radii, station locations, and track speed limitations. Travel times for terminal-to-terminal and terminal-to-downtown trips by the various modes are compared in Table 1.

Essential to achieving projected rail timetables was the assumption that the technologies would be operated as modern railroads. This means high platforms for ease of passenger entry and exit, and 2-min station stops. Travel times for the 185-mph TGV and 300-mph maglev technologies show that rail will compete with air for terminal-to-downtown business trips, assuming rail stations are located downtown. Although total access, egress, and transfer costs have not been compared, the terminal-to-terminal rail trip also could be competitive with air, depending on the origination and destination points for a given traveler, as well as the location of suburban rail stations.

Capital and Operating Costs

Capital cost estimates were assembled for each route and technology using a unit cost data bank generated from previous HSR feasibility studies and local information on rail infrastructure costs (Table 2). Cost estimates were made by assessing the physical requirements of each route on a milepost-by-milepost basis and estimating the construction quantities. Rolling stock costs were added to infrastructure costs. The estimates assume that the 125-mph option would operate on the existing Amtrak alignment, and approximately one-third of the crossings would be grade separated, one-third closed, and one-third fully gated. For the 185- and 300-mph technologies all crossings would be grade separated or closed.

Estimates of the capital costs for development of an HSR system ranged from nearly $1 billion for the 125-mph high-speed technology on the existing Amtrak route to more than $5.4 billion for the 300-mph maglev option.

Annual operating and maintenance costs were generated from an understanding of the life cycle and maintenance costs of rolling stock combined with the proposed levels of service. Operating unit costs were estimated from the data obtained on operational high-speed railroads in Europe and Japan and from estimates of previous HSR studies in the United States and Canada. Operating costs include track, signaling, rolling stock and other equipment maintenance costs, train control, station and administrative staff costs, and energy requirements.

Ridership and Revenue

The ridership estimates for each route/technology were developed using the COMPASS© demand forecasting system, which provided specific behavioral analysis of travel characteristics in the study corridors (*3*). Ridership estimates reflect the central case economic scenario, which assumes continuation of current trends and the implementation of currently planned air and highway improvements. As expected, ridership is projected to increase with the increasing speed of the technology (Table 3). The models for total, induced and diverted demand were calibrated using value of time from original data, the origin and destination data base developed from existing data sources, and the network information (Tri-State Study). Train frequencies were set at 12 per day for the 125-mph technology, 18 per day for the 185-mph technology, and 24 per day for the 300-mph technology.

In the southern corridor for the year 2000, 5.8 million riders are forecast on the entire system for the 125-mph technology. Of these riders, 1.03 million passengers would travel between the Minneapolis–St. Paul and Madison, Milwaukee, and Chicago city pairs. Passenger movements increase with the 185-mph and 300-mph technology to 1.64 million and 2.10 million, respectively. By the year 2020, passenger movements between Minneapolis–St. Paul and Madison, Milwaukee, Chicago for the 125-mph technology would total 1.70 million, for the 185-mph technology 2.72 million, and for the 300-mph technology 3.50 million.

Like the ridership projections, revenue estimates increase with the increasing speed of the technologies. The revenue estimates were not optimized, but were based on a reasonable level of fare, set at 65 percent of 1989 full business class air fare. An analysis of the competitive response from the air and bus modes was not conducted for this report, although in reality it is fair to assume that such a response would occur.

TABLE 1 TRAVEL TIMES FROM MINNEAPOLIS–ST. PAUL TO CHICAGO

Technology	Terminal-to-Terminal (hours, minutes)	Terminal-to-Downtown[a] (hours, minutes)
Air	1:15	2:00-2:30
125 mph - HST	4:20	4:20
185 mph - TGV	3:15	3:15
300 mph - Maglev	2:15	2:15
Amtrak	9:30	9:30
Auto	8:00	---
Bus	10:00	---

[a] Terminal-to-Downtown assumes 45 minute ground travel time for Midway and MSP and 1 hour and 15 minute ground travel time for O'Hare.

TABLE 2 CAPITAL AND ANNUAL OPERATING AND MAINTENANCE COSTS FOR THE SOUTHERN CORRIDOR (*3*)

Technology Options	Capital	Annual Operating and Maintenance
125 mph - HST	940.0	90.9
185 mph - TGV	3,020.0	101.3
300 mph - Maglev	5,450.0	123.3

NOTE: Values are in millions of 1989 dollars.

Summary of Major Findings

The Amtrak Route and South Route Modified were considered for analysis in this study. Although the application of any HSR technology in the Midwest is yet unproven, steel wheel on steel rail systems operate in somewhat similar conditions in Europe and Japan. However, maglev systems, still in prototype development, have not yet been proven. The 185-mph very-high-speed technology, with a running time of 3 hr and 20 min, may have a slight advantage over the 125-mph high-speed technology for service to the Minneapolis–St. Paul market. The analysis indicates that the 185-mph technology can be competitive with air travel in the corridor, especially for terminal-to-downtown trips.

Revenue and ridership increase with increasing speed of the technology in the market. Using a unit cost assessment in the estimating procedure, revenue achieved for all technologies will cover the operating and maintenance costs for the various technologies, suggesting that an HSR system could potentially operate without a public subsidy.

PROJECTED TRAVEL MARKET

HSR Projections

Ridership estimates projected for HSR comprise trips generated by natural growth of the rail mode, trips diverted from other modes, and travel that is induced because of the existence of more and better travel options. If ridership estimates projected in the Tri-State High Speed Rail Study could be achieved, the market share for high-speed train travel between Minneapolis–St. Paul and Chicago would increase with increasing speeds (Figure 4). Whereas the 125-mph HST technology could expect to capture 15 percent of the market in 2020, the 185-mph TGV might gain as much as 22 percent. At 300 mph, the maglev system might gain as much as 26 percent. The various systems would all divert a significant number of trips from both air and automobile modes. At the same time, a large portion of the ridership would come from induced travel (i.e., travel that occurs because of the existence of a new mode and the improved travel opportunities for the business and social market). The existence of improved travel opportunities for one mode not only induces travel for that mode but for all other modes as well. Therefore, the implementation of HSR in the Minneapolis–St. Paul to Chicago corridor would create additional demand for air, automobile, and bus.

Growth Projections for Air Traffic

Enplanements and Deplanements

In 1989 enplanements and deplanements of passengers at MSP on major, regional, and charter carriers totaled 19.4 million

TABLE 3 FORECASTS OF RAIL RIDERSHIP AND REVENUE FOR 2000 AND 2020 (*3*)

		Year 2000[a]	Year 2020[a]
125 mph - HST	Ridership	5.8 (1.0)	7.7 (1.7)
	Revenue	226.6	320.6
185 mph - TGV	Ridership	7.5 (1.6)	10.1 (2.7)
	Revenue	336.1	480.0
300 mph - Maglev	Ridership	8.5 (2.1)	11.6 (3.5)
	Revenue	409.3	586.0

NOTE: Ridership forecasts are in millions of trips; revenue forecasts are in millions of 1989 dollars.
[a]Numbers in parentheses indicate ridership in millions: Mpls-St. Paul to/from Madison/Milwaukee/Chicago, including Minneapolis-St. Paul suburban to downtown trips.

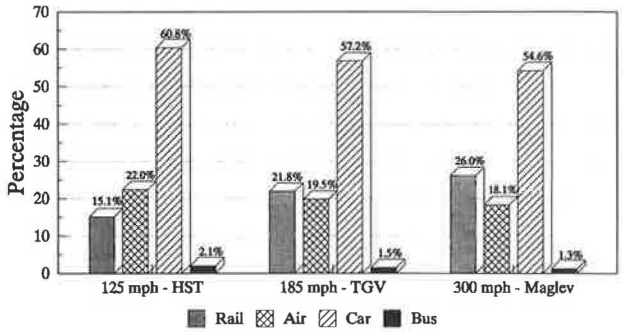

FIGURE 4 Projected market shares by mode, implementation of HSR, 2020 [source: Tri-State High Speed Rail Study (3), COMPASS Strategic Transportation Planning Model].

(4). By 1990 passenger activity surpassed 20.3 million, representing a 5 percent increase and a continuation of the trend in the 1980s, which saw a doubling of passengers. Passenger activity forecasts from the MSP Comprehensive Plan show a significant increase during the next 10 to 30 years, assuming average economic growth. By 2000, more than 30 million enplanements and deplanements could be expected. By 2020, enplanements and deplanements could reach 39 million annually (1).

Air passenger traffic from Minneapolis–St. Paul to Madison, Milwaukee, and Chicago in 1989 totaled 1.3 million and represented 6.5 percent of all passenger movements at the airport. It is estimated that nonconnecting passengers (i.e., those who may be more likely to use HSR) totaled more than one million. If current trends continue, by 2000 there may be nearly two million air passengers in the corridor. By 2020, 2.5 million air passengers could be expected in the corridor.

Aircraft Operations

Aircraft operations (landings and take-offs) at MSP have grown proportionally with passenger activity and also are expected to increase significantly during the next 10 to 30 years. There were nearly 380,000 operations of the scheduled air carriers, regional and air taxi, charters, air freight, general aviation, and military in 1990. That number is projected to reach 453,000 by 2000, reflecting a 19 percent growth. By 2020, operations could grow an additional 16 percent, reaching 527,000 annually (3).

On the average, 110 flights per day (120 per average week day) serve the Minneapolis–St. Paul to Madison, Milwaukee, and Chicago corridor, representing nearly 40,000 annual flights, or more than 10 percent of all aircraft operations at MSP. Chicago's O'Hare and Midway airports alone account for 88 flights per day, or 32,000 flights annually. Assuming continuation of current trends, more than 58,000 operations could be expected in the corridor by 2020, representing 158 daily operations.

Impacts of HSR on Air Passenger Movements

A limiting factor facing airport development is the ability to expand landside capacity. Landside capacity addresses passenger facilities essential to the airport operations such as terminal and concourse space, parking, gates, baggage claim, car rental, and roadway capacity, all of which limit the volume, comfort, and ease with which passengers pass through an airport. As situated, the ability to expand passenger facilities at MSP is constricted, and significant capacity improvements will require major construction.

Issues facing HSR in this corridor are its competitiveness with the air mode and its impact on passenger movements through the airport, thus reducing landside and airside congestion.

Timetables for the 185-mph TGV and 30-mph maglev HSR technologies indicate that they can compete with air for terminal-to-downtown trips given the transfer costs and delays experienced at most airports. Although the 125-mph technology attracts a significant number of passengers, it is less competitive with air for total trip time.

The Tri-State High Speed Rail Study concluded that as many as 1.8 million passengers may be attracted to the train in the Minneapolis–St. Paul to Madison, Milwaukee, and Chicago corridor by 2000. This number could increase to 2.8 million by 2020 if the maglev technology were implemented. However, only those passengers diverted from the air operations would have any effect on capacity at MSP. As a percent of rail ridership, the COMPASS© demand forecasting model predicted that total diversions from all modes (air, automobile, and bus) ranged from 60 percent for the 300-mph maglev technology, to 68 percent for the 185-mph TGV technology, to 72 percent for the 125-mph HST technology (3). Total rail ridership and diversions increase with increasing speed. However, trip diversions as a percentage of total ridership decrease with increasing speed. Natural growth and induced travel accounts for the added volume of passengers attracted to the progressively higher speed technologies.

As formulated, the COMPASS© model does not segregate diversions from individual modes. That is, it is not possible to say precisely the percentage of trips diverted from air, automobile, or bus, only total collective diversions. In this analysis, a conservative estimate was made that one-half of the trip diversions predicted by the COMPASS© model will be attributed to air.

Table 4 presents projected rail ridership for 2020 by technology, total passengers diverted from air, and net percentage effect that HSR will have on air passenger movements in the Minneapolis–St. Paul to Madison, Milwaukee, and Chicago corridor and total percent reduction at MSP. In 2020, with implementation of the 125-mph HST technology, 493,000 trips will be diverted from air. This could reduce passenger movements in the corridor by nearly 17 percent. The net effect of total passenger movements at MSP, however, will be less than 1.3 percent. With the 185-mph TGV technology, 758,000 trips will be diverted from air, reducing passenger movements in the corridor by almost 30 percent. The effect on total passenger movements at MSP will be under 2 percent. With implementation of the 300-mph maglev technology, 851,000 passengers will be diverted from air, reducing air passenger movements in the corridor by more than 33 percent. The net effect at MSP will be slightly more than a 2 percent reduction in total passenger movements.

Although these diversions appear to be modest, they are compared against airport projections, which "double count"

TABLE 4 AIR PASSENGER DIVERSIONS WITHIN MINNEAPOLIS–ST. PAUL TO MADISON, MILWAUKEE, AND CHICAGO CORRIDOR, 2020

	Projected Rail Ridership in Corridor[b]	Passengers Diverted from Air (% rail ridership)	Air Passengers Diverted in Corridor	Reduction of Air Passengers at MSP
125 mph - HST	1,368,455	492,644 (36%)	16.95%	1.26%
185 mph - TGV	2,229,853	758,150 (34%)	29.90%	1.94%
300 mph - Maglev	2,837,041	851,112 (30%)	33.57%	2.18%

[a]Assumptions: 39 million passengers projected at MSP for 2020. Minneapolis-St. Paul to Madison/Milwaukee/Chicago Corridor accounts for 6.5% of MSP passenger movements.

[b]Ridership in corridor counts only trips to/from Minneapolis-St. Paul and Madison, Milwaukee and Chicago. This forecast excludes internal zone trips i.e., Mpls-St. Paul suburban station to downtown station trips.

on-line and inter-line (transfer) passengers. By conservative estimates, these account for more than 30 percent of passenger movements at MSP (*4*). If airport projections were factored down accordingly, the effect of HSR diversions would be proportionally greater.

Impacts of HSR on Aircraft Operations

A more significant issue at MSP is the effect HSR might have on aircraft operations. Physical airside capacity is a concern because MSP is essentially affected by urban and suburban development, which prevents the physical expansion of airport property and the addition of runway capacity. Although it may be possible to develop additional runways on existing airport property, severe environmental and safety concerns must first be addressed. Aside from aircraft safety, the most significant concern is that of excessive noise, which affects many residents of Minneapolis, St. Paul, and surrounding suburbs. Proposals for physical expansion of the airport, which permit significant increases in airside capacity, continue to run into major opposition from home owners. As well, the second track of the dual-track process, involving siting of a new airport, is running into major opposition from residents in the identified search areas. For some, however, relief may be in sight with enactment of the new federal law requiring upgrading of airline fleets with Stage III aircraft by 2000.

As with passenger movements, there would be a concordant reduction of air carrier operations in the Minneapolis–St. Paul to Madison, Milwaukee, and Chicago corridor, as well as total operations at MSP with the implementation of HSR (Table 5). Assuming no competitive response from the airline industry, development of the 125-mph technology between 2000 and 2020 could reduce operations in the corridor by 12 percent, with a net reduction on total traffic at MSP of 1.33 percent. This assumes an average passenger load factor of 70 per plane, which appears to be somewhat higher than typical loadings in the corridor. For the 185-mph technology, aircraft operations could decrease by 10,800, or 18.66 percent, in the corridor and slightly more than 2 percent of total operations at MSP. At 300-mph, HSR could reduce total operations at MSP by 12,159, or 20.9 percent of air carrier flights in the corridor. Total operations at MSP could be reduced by 2.3 percent.

The impact of these reduction estimates also includes the categories of regional and air taxi, cargo, express, general aviation, and military, which currently account for about 25 percent of all operations. Although these categories of operations are projected to increase modestly by 2020, implementation of measures that might reduce their numbers would slightly enhance the effect of HSR on total operations. Although not explored in this paper, some potential does exist in the corridor to reduce small package express operations by means of an HSR system.

SOCIOECONOMIC AND ENVIRONMENTAL CONSIDERATIONS

An important aspect of the HSR and airport issue is the benefit/cost analysis and the consumer surplus generated by such projects. Estimates for construction of an HSR system range from nearly $1 billion to almost $5.5 billion, depending on the technology. Some of these costs would likely be shared by the three states, with a portion coming from private-sector investors. The consumer surplus and community benefits generated by such a project may surpass $10 billion for the region, with as many as 16,000 to 19,000 person years of employment created during the 25-year life of the project (*3*). Costs to the federal government, the state of Minnesota and the Minneapolis–St. Paul metropolitan area in developing a new airport range from $2.0 to $4.5 billion for construction. Improved highway access to the site and business relocation costs are additional associated expenses. Other costs will be severe in terms of land acquisition and access and egress times for travelers if a new airport would be developed 20 to 30 mi or more from the downtowns as currently proposed (*5*).

TABLE 5 AIR CARRIER REDUCTIONS WITHIN MINNEAPOLIS–ST. PAUL TO MADISON, MILWAUKEE, AND CHICAGO CORRIDOR, 2020

	Diverted Air Passengers	Flight Equivalent (70 pass/flt)	% of Corridor Reduction	% Reduction MSP Operations
125 mph - HST	492,644	7,037	12.13%	1.33%
185 mph - TGV	758,150	10,830	18.66%	2.05%
300 mph - Maglev	851,112	12,159	20.95%	2.30%

[a]Assumptions: 527,450 flights projected for year 2020 (MSP Comprehensive Plan): Minneapolis/St. Paul to Madison/Milwaukee/Chicago accounts for 11% of all flight operations at MSP (or 58,020 operations)

Environmentally and socially, large public infrastructure projects have major problems to surmount. A new airport however, consuming 15,000 acres of land in one large tract, may face stiffer public resistance than the development of an HSR system consuming 5,000 acres in a linear corridor, much of which may be on existing right-of-way. HSR with direct access to the downtowns could help to cohere the Minneapolis–St.Paul metropolitan area and reduce the costs of urban sprawl. Development of a remote major airport will encourage sprawl and require the costly extension of urban services.

The impacts of an HSR network cannot be considered in isolation to a single airport of metropolitan area. The benefits, as well as costs, of HSR in reducing passenger movements and air carrier operations at MSP would extend to Chicago, Milwaukee, and Madison in varying degrees. Viewed from a national and regional transportation system perspective, HSR may offer the opportunity to delay or eliminate the need for a new major airport in the upper Midwest, particularly if it were designed as an element of an air and rail hub concept. (HSR has also been proposed as a remote airport link in Minnesota and is under study in the Chicago metropolitan area.) Benefits of an HSR system to the tri-state area could be especially attractive when considering capitalization by the private sector or multi-state cost sharing on various portions of a project. Although both the development of new airports and HSR systems will create jobs, only HSR will diversify transportation opportunities, reduce the region's reliance on imported petroleum single fuel source, and provide considerable overall energy savings.

CONCLUSIONS

This paper presented an analysis of the impact that various HSR technologies could have on passenger movements and air carrier operations in the Minneapolis – St. Paul to Madison, Milwaukee, and Chicago corridor. By 2020 development of an HSR system in the southern corridor would offer relief in passenger movements ranging from 16 percent for the 125-mph HST technology to 33 percent for the 300-mph maglev technology. However, total effect of HSR on landside capacity at MSP would be significantly less, ranging from 1.3 to 2.2 percent.

In the same time frame, a reduction in aircraft operations for the corridor could range from 12 percent for the lower speed rail technology to 21 percent for the highest speed rail technology. Total relief on airside capacity at MSP would range from 1.3 to 2.3 percent, depending on the technology implemented.

On the basis of this conservative analysis, it can be concluded that HSR alone will have a modest effect on total passenger movements and aircraft operations at MSP. An investment in HSR cannot be justified as a means of extending the life of MSP unless it is done in conjunction with other air traffic reduction measures. However, if HSR were coupled with other management strategies, such as reducing general aviation and military operations, the short- to midterm viability of MSP may be extended. It is possible that if HSR were developed in conjunction with expansion of MSP, or linking with a remote hub, long-distance travel needs in the Twin Cities metropolitan area could be satisfied for decades to come.

The socioeconomic benefits of an HSR system must be weighed against the costs of airport expansion or relocation. Viewed from a regional transportation system perspective, HSR will create jobs, cohere the urban area, and conserve land resources with minimal social and environmental disturbance. Diversification of transportation opportunities and reducing energy reliance may provide a substantial economic savings for the region.

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