Transforming High-speed Rail Stations to Major Activity Hubs: Lessons for California

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Abstract

This paper presents findings from domestic and international case studies of developments around high-speed rail stations and derives from these findings some lessons for station area development for California's high-speed rail system. The paper reviews the case for high-speed rail as a complement to air and highway systems in addressing congestion and providing needed additional services as the population of the State continues to grow. Review of domestic and international experiences reveals that well-planned station-area developments can result in desirable impacts on the communities served including: a) good intermodal connections – convenient access and ease of transferring between local and regional transport systems and modes, facilitated by the creation of multi-modal stations; b) physical improvements – increased and/or upgraded development of residential, retail, work and cultural land uses within walking distance of station areas; c) economic improvement – generation of economic activity and benefit as agglomeration economies take place; and d) social improvement – creation of vibrant activity centers or hubs for social interaction and recreation. Together these changes would result in significant reduction in negative environmental impacts, locally and beyond. These desirable impacts may be harnessed in planning for high-speed rail stations in California through the creation of activity hubs with coordinated transportation and land use, urban design, and multimodal access and circulation. Designs would be similar to transit-oriented development but also accommodate travelers arriving or departing stations by auto (including rental cars). This synthesis of lessons for California should also be widely applicable for more sustainable and environmentally friendly transportation systems.

Introduction

As the prices of petroleum-based fuels sky-rocket, many travelers find it cost effective to switch to more fuel efficient vehicles, including shared modes in high-capacity vehicles. Public transit use, carpooling and vanpooling, for example, increase when fuel prices are high. For longer-distance trips, where both air and auto modes are impacted by high fuel costs, rail systems can be an attractive alternative. The limitation of conventional rail is that it often is too slow to compete with air travel, especially for trips in the 200- to 600-mile range. High-speed rail – trains traveling at 125 to 350 miles per hour – can offer a competitive alternative in this range and need not depend on petroleum fuels.

Can high-speed rail also compete over shorter distances, e.g. 50 to 200 miles? What conditions are needed for high-speed rail to be competitive in this distance range? In particular, Can station area planning help increase rail use for such shorter distances and improve the station's overall performance? Can it also help improve conditions in the cities and towns served? This paper addresses these issues, drawing on cases from the literature as well as an analysis of their lessons for California, where a high-speed rail system is being proposed.

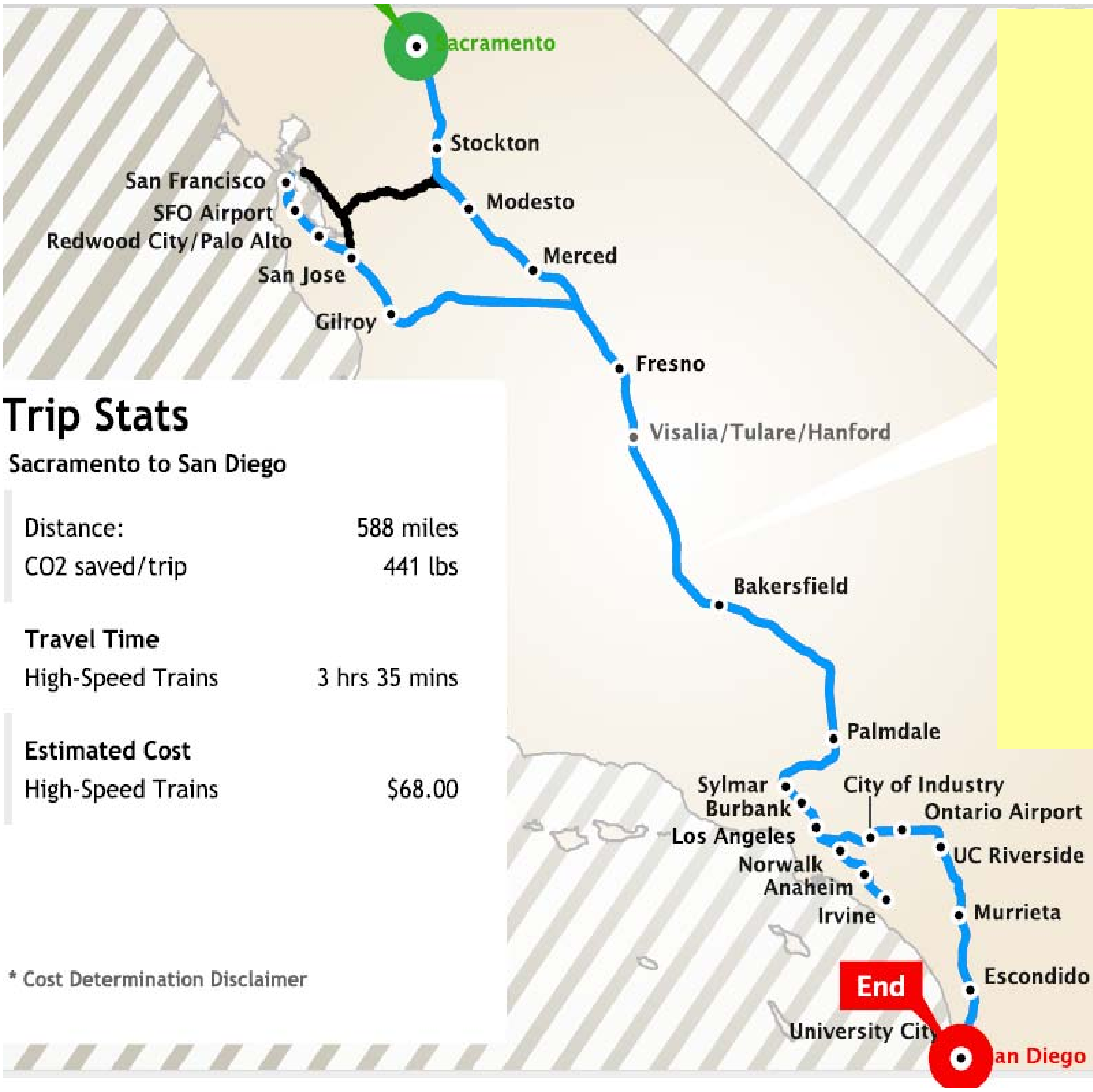
This paper provides a review of domestic and international cases on the station planning issue, drawing upon a wide literature, and extracts key lessons from these cases that could apply not only to California cities and towns but more generally.

Background: California's Proposed HSR System

In 1996, the California High-Speed Rail Authority was established and charged with planning, designing, constructing and operating a state-of-the-art high-speed train system across the state. With the November 2005 certification of a program-level Final Environmental Impact Report (EIR) & Environmental Impact Statement (EIS), California high-speed rail (HSR) became ready to move into the implementation phase. The 2006-2007 state budget included $14.3 million to allow the Authority "to begin project implementation". This funding is to be used primarily for project-specific environmental work, preliminary engineering, and right-of-way preservation and acquisition. (California High-Speed Rail Authority website)

The proposed HSR system would be approximately 700 miles long. See Figure 1. It would connect Sacramento and the San Francisco Bay Area in the north with Los Angeles and San Diego in the south, traveling through the Central Valley of California, a rich agricultural area containing a number of smaller cities with limited air service. The HSR system would not only connect these major population centers and smaller cities, but would also link them to existing air, rail and highway systems. Much of the HSR system would share rail alignments with freight lines, requiring safety, operations and design improvements to joint facilities, including grade separation. Overall, however, as currently proposed, the HSR system would provide a predominantly separate transportation system.

Figure 1: Proposed California High-Speed Rail Network



Source:

California High-Speed Rail Authority website: http://www.cahighspeedrail.ca.gov/about/, accessed July 1, 2008

As envisioned by the California High-speed Rail Authority, trains would operate at speeds up to 220 mph, with express services traveling between downtown San Francisco and Los Angeles in 2 ½ hours. Between California's major, longer-distance intercity markets, door-to-door travel times would be comparable to air transportation and less than half as long as automobile travel times. For trips of intermediate length, HSR trips would be quicker than either air or automobile transportation, taking into account total travel times including check-in and waiting. Fares would be competitive or lower than the costs of travel by auto or air especially under today's high fuel prices.

Riders are anticipated to include business travelers, tourists, and leisure travelers as well as commuters for city pairs such as Los Angeles and Anaheim, Palmdale and Los Angeles, Riverside and San Diego, and Central Valley cities and the Bay Area. In addition, the HSR system would offer both interregional and intraregional travelers convenient connections to airports and to regional transit services. Forecasts are for 42 to 68 million passengers per year by 2020. The HSR system would also carry light-weight, high-value freight.

Funding would be needed for the capital costs of the project, and $10 billion in bond funding for the project must be authorized by voters for the system to proceed to construction. (California High-Speed Rail Authority website)

Benefits and Costs of a California HSR System

High-speed rail has been popular and successful in the European Union and in Asia, but it has not yet taken hold in the United States. Whether it can succeed in California has been the subject of considerable discussion both in the academic literature and in popular media.

Some academics, e.g. Charles Lave, have questioned the benefits of new rail systems, arguing that when the costs of construction are considered, net benefits are questionable (Lave, 1977). However, when the comparison is construction of new roads or new airports, costs are not necessarily higher. A mid-1990s study of the proposed California high-speed rail system analyzed its cost competitiveness relative to highway and air transportation (Levinson et al, 1996), and found it least costly in terms of social costs alone, but not in terms of total costs. The study concluded that California HSR would be most effective if treated as an alternative to highway use and a complement to air transportation. With the tripling in the price of gasoline fuel since the Levinson et al. study, HSR's cost competitiveness is likely to have improved significantly.

A subsequent study (Brand et al, 2001) assessed that the benefits of the California high-speed rail system would outweigh its costs by a factor of two. The study considered both user and non-user benefits in the calculations.

Studies that have addressed the proposed California high-speed rail system's feasibility, alternative alignments, and ridership projections include Parsons Brinckerhoff et al, 1999; Charles River Associates, 1999, and Cambridge Systematics, 2006. The studies have found that a California HSR system would provide a reasonable modal alternative to air or auto travel for long distance trips, and that diversion of trips to HSR would reduce pressures for costly road and airport expansion. HSR also is expected to improve mobility and accessibility to several parts of the state that are not well served by air or conventional rail transportation.

The rationale for implementing a high-speed rail system among available options presented in these studies is as follows:

- *Population* – California's population is projected to increase from 37 million (2005) to 59.5 million by the year 2050 (California Department of Finance, July, 2007). The projected population increase necessitates finding practical options to accommodate intercity travel needs that are sustainable, efficient and economically viable.
- *Highways* – Portions of the road network in the state of California currently rank among the most congested in the nation. In 2005, for instance, the Texas Transportation Institute designated Los Angeles as the number one congested very large city and the Los Angeles-Long Beach-Santa Ana area as the number one congested very large urban area in the country. To the extent that economic prosperity and quality of life are dependent upon the efficiency of the transportation network, they may be in jeopardy as population and attendant human activity and travel continue to grow. Cost-effective transportation system investments will be needed to enable the state to sustain its economic vitality and quality of life.
- *Airports* – The airport system in California is a key component of the state's transportation network and an essential element for the facilitation and promotion of economic growth (Twomey & Tomkins, 1995). However, major airports in Los Angeles and San Francisco are consistently busy and prone to delays. For example, the Los Angeles World Airports (LAWA), which includes Los Angeles International Airport (LAX), Ontario International Airport (ONT), Van Nuys Airport (VNY), and Palmdale Regional Airport (PMD) currently lack the facilities to meet the expected passenger demand for 2015 (Los Angeles World Airport, 2004). The most dominant air facility in this system, LAX, is constrained in its efforts to expand due to its proximity to residential neighborhoods and other urban facilities. Recent expansion plans for LAX were dropped in an agreement between the City of Los Angeles and neighbors of the aviation facility opposed to the new plan, San Francisco International airport also had to drop plans for a new runway in the Bay because of the damage to fisheries it would cause. Opposition to airport expansion has led transportation officials in several parts of the state to call for new alternatives and complements to air transportation. The Southern California Association of Governments (SCAG), for instance, proposed the use of maglev technology (a form of high-speed rail transportation) as a feasible solution to solving the future transportation needs of Southern California (SCAG, 2004).
- *Energy Cost & Consumption* – Comparative energy use measured in "energy intensity", that is, energy consumption per passenger mile shows that intercity rail at 2400 Btu outperformed transportation by both passenger car at 3700 Btu and air at 4100 Btu in 1996 (Bureau of Transportation Statistics, 1999). Compared to air transportation particularly, which is dependent on fossil fuels, HSR could run on electricity that may be generated from more sustainable sources of energy.
- *Air Pollution* –Assuming that the electricity for HSR is generated from clean sources, .HSR running on electricity will emit far less pollution into the atmosphere than automobiles and aircrafts running on fossil fuels. .

Harnessing the Potential of a High-Speed Rail System

The implementation of HSR is a very large capital expenditure - a mega public works project that needs to be harnessed to benefit the State. Public works projects have traditionally served as catalysts for economic development (Forkenbrock, 1990; Boarnet, 1995), but they also can be money sinks (Altshuler and Luberoff, 2003; Flyvbjerg et al., 2003). It is therefore desirable to undertake careful planning to maximize benefits.

As described earlier, the California HSR proposal is a hybrid, intended to serve both as a complement and alternative to air and highway travel. It further is a hybrid in its aims to serve long distance as well as middle-distance trips. The latter trips would include, for example, commute trips of over 50 miles in length as well as business and recreation trips in the 50-200 mile range.

One strategy for maximizing benefits is development of urban and intercity transport station areas. For urban transport systems, this is a widespread phenomenon in the US and abroad, undertaken to increase the effectiveness of the transport system by increasing ridership as well as to capture the value created by the increased accessibility the transport services provide. In the urban public transit sector, such developments are often called transit-oriented developments (TOD), and are found on urban heavy rail, urban light rail, commuter rail, and intercity rail lines.

Outside the US, station area development is also found along long distance commuter and intercity travel lines. Many examples of high-speed rail station area developments exist in Europe, for example, at stations in Lille and Lyon in France. In Curitiba, Brazil, station area development exists at major stations along the bus rapid transit network. Indeed station area developments are also found in the vicinity of airports. An entirely new community is being developed on the land side approach to the new Hong Kong airport.

International comparisons shed light on what could make HSR successful. For example, in a study of the state-of-the-art in high-speed rail and airport connections in Europe, López-Pita and Robusté (2004) noted increasing intermodal collaboration. The authors pointed out the logic of rail-air intermodal connections that would shift short distance air travel to rail, thereby freeing up the short haul air slots for long distance air travel in increasingly congested air spaces. The authors assert that European airports and airlines view the high-speed rail as complementary rather than competition. In contrast, airlines are among key opponents of high-speed rail development in the US (Itzkoff, 1991)

Both the US and international cases suggest that successful station area developments meet several objectives:

- Intermodal connections: Convenient access and ease of transferring between local and regional transport systems and between modes, facilitated by the creation of a multi-modal station;

- Physical improvement: Increased and/or upgraded development within walking distance of the station area, creating a vibrant activity center or hub for social interaction and entertainment. land uses include residential, retail, work and cultural activities;
- Economic improvement: Generation of economic activity and benefit as agglomeration economies take place;
- Social improvement: Creation of a vibrant activity center or hub for social interaction.

Intermodal Connections

The potential for intermodal connections is illustrated with an international example of a multi-modal station area in Hong Kong.

Hong Kong has a new International Airport that opened for operations on July 6th, 1998. It operates as the 5th busiest international passenger airport in the world. As a "station area" it is developed with: (a) one of the longest airport terminals in the world at 0.8 mile long; (b) four underground tunnels; (c) a six lane highway; (d) railway line; (e) five bridges; and (f) an adjacent small city of 260,000 residents.

The airport was designed to function around a centrally located rail terminal. It is truly multi-modal as it is connected to the transit network comprising rail, bus, and ferry services. It has a four-story Ground Transportation Center, which provides an airport interface point for the Airport Express trains, buses, tour coaches, taxis, hotel limousines and private cars. Adjacent to the terminal is SkyPier, which provides passengers with ferry access to and from the airport.

The Airport Express trains provide the only direct rail link to the Airport. Operated by the Mass Transit Railway (MTR), the Airport Express operates on 12 minute headways and links the airport to Hong Kong Island in approximately 24 minutes. The dedicated express service runs alongside the existing general purpose commuter rail system. The MTR has modified this existing system to allow two separate services to run on the same infrastructure. Expensive tunneling and bridge segments were added to create the bypass operations at certain segments to make this dual operation possible.

The existing general purpose commuter rail system serves all five existing stops while the express service stops at only two intermittent stations between Hong Kong Island and the airport. The rolling stock is similar to that used throughout the region with un-upholstered bench seating and copious amounts of standing room. The express service is approximately 20% faster and costs approximately 25% more than the commuter service.

Physical Improvement

The physical improvement potential of a high-speed rail system is achievable through the application of *land use planning* and *urban design* principles to the station areas and the larger communities in which they exist. The Hong Kong Airport case also illustrates some of the changes that can be accomplished.

Directly adjacent to the Hong Kong Airport is a new landscaped peninsula called SkyCity. The development was marketed as a plan to promote economic growth, trade, and tourism for Hong Kong and includes a trade center, an expo center, a 9-hole golf course, and retail spaces. The Airport's World Trade Center is located directly adjacent to the airport and rail terminal in SkyCity, providing travelers with an exhibition center, hotels and offices as well as retail, entertainment and recreational establishments. The Asia World Expo center is a premier exhibition center with a 13,500 seat arena and 710,000 square feet of other development. Figure 2 is an artist's rendition of SkyCity, Hong Kong Airport.

With a population of a quarter of a million people and varied land uses, this Hong Kong example demonstrates that a "station area" could be planned and built into a completely self-contained community or city. Other world examples (such as the Orient Station in Portugal, for instance) depict the potential for similar scales of development.

Figure 2: An artist's Rendition of SkyCity, Hong Kong Airport

Source: Hong Kong International Airport, SkyCity Brochure; Accessed online 8/15/07 at: http://www.hongkongairport.com/eng/aboutus/scbrochure.html

Economic Improvement

The economic improvement potential of a high-speed rail system lies in the premise that if well-planned and implemented it can contribute toward the *economic development* of areas. This is achievable through the consolidation of activities at the station areas thereby facilitating links between activity centers in the larger region in which they exist. The potential of HSR to generate economic gains through development of its station area may be illustrated with several examples of metro rail, intercity rail and multimodal stations in the US and abroad. The development of several metro rail stations in Washington D.C. into major employment and activity centers has been touted as exemplary for the US (Cervero et al, 2004). Many downtown train stations are similarly developed around the world as exemplified by stations on the New York, San Francisco and London subway systems, among others. Greengauge21, a non-profit organization researched the development and regeneration effects of high-speed rail on cities (Harman, 2006). The study has two conceptual premises about the effect of transportation investments on areas served and their importance for both economic and spatial planning. The premises are:

1. Transportation investments affect the way the transportation system is used, which under conditions of efficiency would affect income gained and return on investment;
2. Transportation investments affect the way activity patterns evolve and consequently the economy and structure of the areas.

While European case studies exist in Belgium, Germany, Italy, Netherland, Portugal and Spain, the Greengauge21 Study paid particular attention to the two case studies of Lyon, where high-speed rail was first implemented in Europe, and Lille, both in France. Figure 3 shows the locations of Lyon and Lille within the TGV network of France.

Figure 3: TGV Network of France Showing Locations of Lyon and Lille

Source: TGV Rail Map website: http://www.beyond.fr/map/tgv_france.html; Accessed 7/30/08

Lyon is one of the largest cities in France and is located in its southeastern area**.** It was the first city to be linked with Paris via the French TGV line. Existing rail service lines operated through the central area of historic Old Lyon, which is located on a peninsula and is thus physically constrained. City officials began the development of a major commercial area east of the central area. With implementation of TGV service, a major new station was built adjacent to the emerging commercial area. This new station became the focus of most new trains serving the city which spurred further commercial development. The public transportation system was reconfigured to facilitate accessibility between the TGV station and most of the metropolitan area. Many companies decided to move their offices from elsewhere in the city to the premises of the new station in order to benefit from the easy access to TGV. Agglomeration economies set in further attracting many new activities including hotels. The station area of the TGV station therefore became a major center of economic activity, which is the cornerstone of the economic expansion of the city.

Lille was traditionally an industrial city located in northern France. Its economy slowed down considerably in the face of competition with cheaper imports from other parts of the world. With strong political leadership and a long term vision and practical action, the city was revived through redevelopment activities. These activities included the building of a new TGV station on a former military barracks site near the existing rail station. The remainder of the site is developed into a major mixed-use center that includes offices, a model retail center, hotels, public housing, a large conference center and events hall, and a public park. A program of metropolitan area-wide adaptive reuse of facilities resulted in major reorganization of land uses and activity locations. In 2004, Lille gained recognition as European City of Culture. Programs run year-long to highlight what was achieved gave impetus to additional initiatives.

The case study evaluation extracted the following lessons:

- High-speed rail is likely to exert the most impact if service sector activities are primary in the area served. In that case the high-speed rail becomes a catalyst for further growth.
- Site selection for the high-speed rail station is critical and must be implemented as part of a larger master development plan.
- Strong political leadership is essential and must be combined with consistency of strategy over a sustained period of time
- It is critical that surrounding areas are tied to the station area through available transportation options.

It is worth noting that not all TGV station areas have turned into successful development sites. Some stations (e.g. Le Creusot and Haute Picardie) are located on the TGV line just outside the cities served with the aim that they would be accessible by car and public transit. The lack of existing business activity at these locations became a deterrent for others to come and the visions for local activity centers did not materialize. These example cases further emphasize the need for careful site selection and planning for high-speed rail if its economic benefits are to be realized.

Social Improvement

The social improvement potential of a high-speed rail system lies in the premise that if well-planned and implemented it can help improve the social well-being of a community. This is achievable through the application of *smart growth* principles of compact, mixed-used and transit oriented development at the station areas to reduce motorized travel, increase non-motorized travel, shorten trips, and reduce air pollution thereby promoting healthier living. A commuter rail TOD station in suburban Chicago may be used to illustrate some aspects of the social effects of good station area planning (Cervero et al., 2004).

Elmhurst is 15 miles west of Chicago on Metra's Union Pacific West line. In 2000, its population was 43,000 residents. In the 1970s and 1980s the downtown infrastructure was in need of repair. At-grade railroad crossings obstructed traffic as shops were leaving for nearby malls and stores and streets became vacant.

What city officials did included: (a) allowing mixed uses; (b) orienting retail stores to directly front pedestrian streets; (c) mandating street level windows in shops; (d) reducing required parking for mixed uses; (e) offering a facade assistance program; and (f) improved landscaping.

The outcome of these efforts includes the addition of 300 more residential units and 140,000 sq feet of commercial space to the downtown. $17 of private money was invested for every $1 of public investment made. The developments included the construction of several three to five story (mid-rise) buildings. And as a result, the transit station has become the city's main social hub. Concluding lessons include the following:

- Strategic placement of rail stations contribute to effectiveness
- Making short term sacrifices can result in long term gains
- Having strong leadership and continuity by professional staff is necessary for success
- Ailing downtowns or redevelopment areas require public investment
- Good automobile access to stations can contribute to success if carefully managed
- Adaptive reuse of real estate is a necessary ingredient

The Accessibility Factor in Successful Station Area Planning

The case studies reviewed make it clear that multimodal accessibility is a major factor in successful station area planning. Important ingredients include:

(a) The availability of alternative modes to access the station. These include non-motorized modes for trips with origins and destinations in close proximity to the station and both shared and private modes for trips of longer distances.
(b) Gradation in the placement of modal stops at the station area. The stops for modes with the highest occupancy would locate closest to the station platform or center and stops for modes with lower occupancy would be placed further away from the platform
(c) The relative placement of land uses (commercial vs. residential) in the broader area would centralize uses that require frequent use and place others successively further away from the station platform

(d) Gradation in development density from station center. This would decline outward from the station area.
(e) Creation of mixed use corridors along axes that radiate from the station center

Factors that contribute to station area success can be further sorted into two groups: (a) those related to the broader "station area", say ¼ -mile to 1-mile radius and (b) those related to "station layout". The two groups may be outlined in terms of "accessibility" as follows:

(a) Broader area – Efficient accessibility affects the degree of integration of the station to its surroundings and consequently the level of patronage by those in its vicinity. Availability of parking and integrated bus network connections will facilitate station use by those in both the immediate area and slightly distant areas. Auto access and parking should not, however, be allowed to dominate the station area.
(b) Station layout: – Efficient accessibility especially in terms of pedestrian access results in ease of flows and convenience of station use. The layout would place higher occupancy modes closest to the station platform and lower occupancy modes successively away from the platform. That would result in minimized ingress and egress times for users and encourage use of alternatives to the automobile in accessing the station.

The sum of these development features echo the principles of new urbanist and neo-traditional neighborhood design. The station effectively becomes the central focus of a neighborhood that is designed according to principles of new urbanism. However, unlike at least some new urbanist proposals, where the automobile has at best an uneasy place in the overall design, the cases suggest that cars need to be accommodated, while recognizing their lower passenger productivity in considering access and pricing.

Applying the Lessons to Station Area Development in the Central Valley

California's Central Valley cities are nothing like Hong Kong, or Lyon, or even Chicago in size, layout, economy, or outlook. Consider, for example, the proposed high-speed rail stations for Merced and Stockton, cities with populations of 80,608 and 289,927 respectively as of January 2008 (California Department of Finance). The two cities offer lower housing costs than the San Francisco Bay Area and now house a high percentage of commuters traveling over 50 miles one way to work each day. The commute is strenuous, with highly unpredictable travel times due to congestion and incidents.

Yet the ideas extracted from the cases – that strong intermodal connections can be used as the backbone for urban development that produces economic, social betterment and improved environmental performance – resonate even in these smaller cities and towns, Both Merced and Stockton have downtowns with significant buildings and land uses, and the downtowns are built at densities that could support walking and biking to a HSR multimodal station. Both downtowns also have many underutilized parcels and buildings that could be developed or restored. Both cities are in need of rental housing for low and moderate income households. City officials in both locations are seeking to improve conditions in the downtowns, and HSR may be the reason and the incentive to do just that. For these cities, the proposed high-speed rail station would be located adjacent to the downtown. It thus could be a catalyst for infill, redevelopment, and renovation, resulting in more efficient and sustainable land use and higher levels of HSR use as well. However, the interventions would require a new focus on:

1) Offering variety of housing choices to both existing and newly attracted residents that include transit oriented living in a compact environment in the station areas that would mimic living in a compact city such as San Francisco. The amount of housing should be sufficient to support a mix of uses so that many daily needs can be met by walking.
2) Improving local access by foot, bike, and public transit in and around the station area so that these modes of travel are comfortable and convenient as well as utilitarian.
3) Managing auto use so that cars do have access to the station, but without disrupting the station area itself.

The HSR then would provide relatively quick access to employment as well as to the many social and cultural attractions of the larger urban areas; in turn, urbanites could get out into the countryside via HSR and could take local transit or a rental car to their destinations. Merced has two advantages it could build upon. One is its proximity to Yosemite National Park. The new station in Merced could be the gateway to Yosemite, offering shuttles, tour buses, and rental cars. Merced's other advantage is the new University of California campus located to the North of downtown. A bus rapid transit link between the campus and the centrally located high-speed rail station would provide convenient access to the HSR itself but also would attract shopping and social-recreational trips from the campus to the downtown. Stockton also has an advantage: an existing commuter rail service to the Bay Area. The proposed location of the HSR station integrates its operations with the commuter rail service in opposite corners of one city block, thereby offering additional access and linkage benefits that would contribute to the success of the transit oriented development.

Conclusion

Major urban centers in the State of California experience recurring levels of air and highway congestion. Projected increases in the State's population make it critical to plan for additional transportation systems to augment and complement the existing systems. The rationale for implementing a high-speed rail system among available options lies in its advantages in terms of relatively high travel speed, low energy consumption, environmental friendliness, and high person-carrying capacity. However, HSR is a very large capital expenditure, and it behooves the state to take steps to capture all potential benefits to make the project cost-effective. The HSR project would provide opportunity to harness physical, economic and social improvements in the communities and regions served by the HSR system and in the State as a whole.

Development of transportation station areas is historically a widespread phenomenon in the US and abroad. Review of domestic and international cases revealed that well-planned station-area developments can result in desirable impacts on the communities served that include: (a) consolidation of economic activity and overall improvement in economic health; (b) improvements to and increased attractiveness of the built environment; and (c) positive ridership gains in the use of public transportation and reduction in negative environmental impacts. These desirable impacts can be harnessed in planning for proposed high-speed rail stations in the State through the creation of activity hubs with coordinated transportation and land use, urban design, and multimodal access and circulation in the station areas in line with the concept of transit-oriented development. Central to the transformation of station areas to major activity hubs is the notion of accessibility which underlies groups of factors that contribute to station area success. These factors relate to treatment of both the broader station area and the station layout. While the lessons synthesized here are meant for the development of the California high-speed rail program, they are widely applicable elsewhere toward a more sustainable and environmentally friendly transportation system.

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