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A Consumer Logistics Framework for Understanding Preferences for High-Speed Rail Transportation, MTI Report 05-04

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A Consumer Logistics Framework for Understanding Preferences for High-Speed Rail Transportation



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MTI REPORT 05-04

**A CONSUMER LOGISTICS FRAMEWORK FOR
UNDERSTANDING PREFERENCES FOR
HIGH-SPEED RAIL TRANSPORTATION**

August 2007

**Kenneth C. Gehrt, Ph.D.
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EXECUTIVE SUMMARY

The prospect for high-speed rail (HSR) service for the San Francisco–Los Angeles corridor has been under consideration since the early 1980s. The enabling legislation required the California High-Speed Rail Authority to connect the state’s major metropolitan areas. The plan remains to connect California’s major cities at a total cost of \$33 to \$37 billion.

The consumer logistics framework can help HSR system planners understand how demographic groups, groups defined by public transportation usage frequency, and groups defined by HSR usage intention level perceive various logistical aspects of HSR service. The consumer logistics framework is also used to develop a macro model that examines the relationship between performance of consumer logistics functions, perceptions of HSR travel value (consisting of travel efficiency and effectiveness), and HSR travel intention for intercity business commuters.

The purpose of this study is to reach a fuller understanding of consumers’ perceptions of the proposed HSR service using consumer logistics theory. In this study, consumer logistics theory is the framework to provide this understanding of consumer perceptions and to inform future efforts to develop and market HSR service.

Seven logistics themes were explored in this study:

- information
- safety and cleanliness
- on-board amenities
- transportation connections
- station arrival and departure
- computer connections
- station amenities

Research revealed that safety and cleanliness and transportation connections were the two most important consumer considerations when making the decision to use proposed HSR services.

INTRODUCTION

The prospect for high-speed rail (HSR) service for the San Francisco–Los Angeles corridor has been under consideration since the early 1980s. The enabling legislation required the California High-Speed Rail Authority to connect the state’s major metropolitan areas. The plan remains to connect California’s major cities at a total cost of \$33 to \$37 billion. The fare for the 2 1/2-hour trip is expected to be approximately half the average airfare for the San Francisco–Los Angeles commute.¹

The purpose of this study is to reach a fuller understanding of consumers’ perceptions of the proposed HSR service using consumer logistics theory. In this study, consumer logistics theory is used as a framework to provide this understanding of consumer perceptions and to inform future efforts to develop and market HSR service. Consumer logistics theory has been used to understand online banking,² grocery shopping,³ and other consumer phenomena. The theory lends itself well to an examination of perceptions toward HSR service.

This study uses the consumer logistics framework to help understand how various demographic groups, various groups defined by public transportation usage frequency, and various groups defined by HSR usage intention level perceive various logistical aspects of HSR service. The consumer logistics framework is also used to develop a macro model that examines the relationship between performance of consumer logistics functions, perceptions of HSR travel value (consisting of travel efficiency and effectiveness), and HSR travel intention for intercity business commuters. Intercity business commuting is the focus of the study because this is likely to be the mainstay for HSR service in the San Francisco–Los Angeles corridor. Much of the air travel in the corridor consists of business commuters. It is also known that in the successful Tokyo–Osaka corridor in Japan, a corridor in a number of ways analogous to San Francisco–Los Angeles, much of the HSR travel consists of business commuting.

A great deal of the convenience value for intercity business commuting resides in the activities involving location, storage, communication, transportation, and transaction activities. For example, the physical location of the stations, the actual transportation and transaction activities all could possibly enhance the appeal and utility of HSR if positioned as well as communicated properly to the appropriate target segments. Consumer logistics applies aptly to these activities.⁴ In this study, behavioral and perceptual data is collected to test a consumer logistics model of HSR travel intention. The results show the manner and extent to which the logistics of HSR are likely to lead to customer intentions to use it for intercity transportation, and how HSR service providers, by enhancing their consumer logistics capabilities, can increase intended HSR usage between San Francisco and Los Angeles for business commuters.

Based on a framework from consumer logistics theory, this study is designed to explain customer perceptions of high-speed rail systems and also how to effectively build upon favorable perceptions.

LITERATURE REVIEW

CHANNELS, CONSUMER LOGISTICS, VALUE, USAGE

Channels, logistics, supply chain management: A channel of distribution is the chain of entities that starts with the manufacturer, often includes intermediaries, and ends with the consumer. Seldom has channels research explicitly examined the role the consumer would play in performing logistical functions. As a result of this discrepancy, consumer logistics theory examines the performance of logistical functions by the consumer within the consumer household as well as at the consumer-service provider interface.⁵ Logistics refers to the functions that members of a channel of distribution perform and the manner in which this performance contributes to customer satisfaction.⁶ Logistics activities include the issues of location, transportation, communication, handling/storage, and inventory.

In an attempt to provide transportation services to the consumer, transportation service providers must either perform all these functions or shift some or all of them to other channel entities, including the consumer.⁷ Channels research shows that perceptions of value, consisting of efficiency (equivalent to costs of service) and effectiveness (equivalent to efficacy of service), are influenced by the logistical functions that the consumer must perform to obtain goods and services.⁸ Channels research also shows that perceived value is linked to consumer usage intention.⁹

The theoretical components of consumer logistics, value, and satisfaction were successfully linked in a recent study that yielded important insight to providers of consumer banking service, a consumer market that is changing rapidly as a result of the emergence of online logistics.¹⁰ This study examines the link between the performance of consumer logistics functions, value, and usage intention in the context of HSR. This will be done to determine whether it is possible to massage the logistics of HSR travel to stimulate HSR usage.

HIGH-SPEED RAIL

High-speed rail (HSR) systems have spread throughout Europe and Asia where public transport systems are viewed by governments and consumers as an essential public service because of practical considerations such as traffic congestion reduction, convenience, pollution abatement, compact urban development models, energy conservation, transport safety issues, and provision of travel options.¹¹

In 1964, Japan became the first nation to develop a high-speed rail network, the Shinkansen (bullet train) service, using the Tokyo Olympics as a backdrop to showcase the country's technological capabilities to the world. The Shinkansen system operates on conventional steel rails of international gauge (1,435 mm), and the system's fastest trains use dedicated tracks with an exclusive right-of-way to avoid slower rail traffic.¹²

At present, six Shinkansen lines are in operation (the Tokaido, Sanyo, Tohoku, Joetsu, Hokuriku, and the newest, Kyushu), covering almost the entire country. “Mini” Shinkansen trains, which run on existing rails widened to the standard Shinkansen gauge, have been operating since July 1992. The Shinkansen now offer differing levels of service ranging from Nozomi (Super-Fast Express), Hikari (Super Express), and Kodama (Express).¹³

The Shinkansen are packed with travelers on business trips, seeking to cover many miles without staying overnight. Some companies even subsidize train fares for long-haul commuters. However, the Shinkansen is not just about speed. Japanese travelers often take advantage of the trains to avoid getting stuck in heavy traffic on Japanese toll roads.¹⁴ Perhaps the best-known feature of the Shinkansen’s performance is that it runs on time. A noted authority on the Shinkansen made the following observations:

Average delays are well below a minute. Anything more than a minute’s delay is considered officially to be late (compared to 10 minutes in the UK and 15 minutes in France). How is this achieved? Partly due to some spare capacity in the timetable—i.e., trains do not operate at their maximum speed all of the time. However, it also relies upon the cooperation of passengers. Most station stops are 50 seconds long. To get passengers on and off in this time requires passengers to be ready to get off once the doors open, and for boarding passengers to be queuing at the correct place on the platform. This in turn requires the driver to stop the train—which may be as much as 400m in length—within a few centimeters of a specific place. This is done with skill and precision. Computers are not used. Indeed, the only significant automatic procedure on the Shinkansen is the over-ride in case the train is above the permitted speed.¹⁵

In fiscal 2004, the Shinkansen carried 291 million passengers in total, and the volume of traffic was 74.5 billion passenger-kilometers.¹⁶ Trains on the original Tokaido Shinkansen route between Tokyo and Osaka have carried 4.2 billion passengers and traveled a total of 1.5 billion kilometers (937.5 million miles)—this exceeds the distance between the sun and the planet Saturn and is far enough to girdle the globe 37,500 times.¹⁷

High-speed testing began on a superconductive, magnetically levitated train in April 1997.¹⁸ Japan Railways (JR) East set a technical target of service operation at 360 km/hour, and is promoting development of Shinkansen trains that will be at the world’s top level in speed, reliability, eco-friendliness, comfort, and more. As a result, the company unveiled their newest bullet train currently under development, the “Fastech 360S.” This Shinkansen logged speeds of 366km/hour at a test run for media on March 1, 2006. In the near future, JR East will also be testing the “Fastech 360Z,” which has been designed for the “mini” Shinkansen routes.¹⁹

The first overseas venture modeled after the Shinkansen system opened in Taiwan in January 2007. The \$15 billion system will offer relief to Taiwan’s overcrowded highways and also

reduce pollution.²⁰ The Shinkansen system has also been knocking at the doors of India, the largest recipient of Japanese aid. In December 2006, Japan's trade minister pledged cooperation in creating a high-speed rail line between India's capital, Delhi, and its financial hub, Mumbai.²¹

At the 40th anniversary celebrations of the Shinkansen, JR Tokai's managing director Takashi Tategami noted that "our service has supported Japan's economic growth in the past 40 years... We will go on by enhancing the Shinkansen's brand image of safety, punctuality, amenity, and convenience," referring to the system's almost impeccable record so far.²²

An excellent overview of high-speed rail development and services in Europe is available in Andrew Nash's 2003 publication, *Best Practices in Shared-Use High-Speed Rail Systems*.

France's high-speed rail system was established in 1981 by Société Nationale des Chemins de fer Français (SNCF or the National Society of French Railways) as a response to declining consumer rail usage. The TGV's (Train à Grande Vitesse) first route was between Paris and Lyon. A technical and financial success, this first TGV line proved that high-speed rail could truly compete with the medium-distance airline market.²³

Meanwhile, Europe's economy became stronger as neighboring countries began to interconnect more easily and trade increased. In the 20-plus years following TGV's creation, most European countries have adopted high-speed rail systems, including Germany's InterCityExpress (ICE) and Spain's Talgo and AVE systems in 1992; and the Thalys trains that link France, Belgium, The Netherlands, and Germany.²⁴ Eurostar trains run on the hour, speeding London passengers at up to 186 m.p.h. to Paris in about 2 1/2 hours, for about \$266 round trip.²⁵

Recently, the TGV set a new speed record in rail transport by reaching 357 m.p.h. on the tracks of the new Eastern Europe TGV line linking Paris and Strasbourg.²⁶

Today, Europe is blanketed by a modern high-speed rail system that provides service between most major cities.²⁷

Internationally, Russia, India, China, and Canada all either have high-speed trains or are in the process of setting up these rail systems. Even Vietnam recently approved plans to build a \$33 billion high-speed railway system that will link the northern capital of Hanoi with Ho Chi Minh City in the south, cutting travel time between the two cities to nearly a third in a move to boost economic development.²⁸

While Japan and Europe have well-established systems, the United States has not quite followed suit. After World War II, the U.S. federal and local governments focused on building an infrastructure of roads, and thus development of rail networks and their usage lagged. The U.S. government established Amtrak in 1970 under the Rail Passenger Service Act, envisioning the organization as a way to consolidate and revitalize America's steadily declining private rail lines.²⁹

Despite frustration with increasing gridlock on the nation's highways and delays in congested airports, indifference on the part of U.S. lawmakers primarily has seriously hampered the development of HSR systems in the United States. From 1978 to 2000, annual federal, state, and local government transportation spending increased from \$40.6 billion to an estimated \$154.8 billion. Over the years 1978 to 1999, highway spending averaged 49.9 percent of the total transportation budget, and air travel averaged 22.6 percent, while spending for rail dropped from 10.2 to 1.2 percent of the transportation budget.³⁰

In spite of such obstacles, Amtrak introduced its Metroliner, connecting New York to the nation's capital, in 1969. The service is somewhat slower than present-day HSR, but is still considered as HSR because it exceeds the 100 m.p.h. threshold. In 1985, the Metroliner surpassed the shuttle operations of several airline companies as the largest single carrier of passengers between New York and Washington, DC. Amtrak has since introduced Metroliners with improved service (higher speeds and increased frequency) between other cities, for example, New York and Boston.³¹

More recently, Amtrak introduced the Acela Express which makes the trip from Washington DC to Boston in about 6 1/2 hours for about \$321 round trip. The Acela typically runs at speeds up to 120 to 130 m.p.h. and on one short stretch at 150 m.p.h.—speeds that make it the fastest train in the United States but that are considered slow by global standards.³²

In his book *End of the Line*, former Amtrak public affairs spokesman Joseph Vranich discusses the innovative private and semiprivate train systems of Europe, Asia, and Canada as positive models for what rail systems can be. According to Vranich, the government-run, U.S. train system (Amtrak) should be discontinued because the public system stifles free-market competition, is sustainable only through an enormous annual outlay of public funds, and offers relatively mediocre service.³³

However, skeptics of privatization point out that devolving the U.S. train system will require already cash-strapped individual states to put additional money into maintaining and improving rail lines. According to Professor John Spsychalski from Penn State's Smeal College of Business, “[High-speed train service] is not going to be built by private enterprise, no more than the interstate highway system was built by private enterprise...The U.S. would not have the air-transport system developed to where it is today without public-sector involvement.”³⁴

Concerned with congested roads, gas consumption, emissions control, and lack of federal initiative or support, various states began to look at the possibility of high-speed trains. During the past 20 years, Florida and California have intermittently undertaken feasibility studies. In both states, there has been a history of “stop and start,” as various commissions decided for high-speed trains and against high-speed trains. Funding has also been controversial.

In California, a high-speed train system that would connect San Francisco, Los Angeles, San Diego, Sacramento, and some of the smaller inner cities has been proposed for more than two decades. If implemented, the train system, traveling at speeds of 220 m.p.h., would cut the

journey between San Francisco and Los Angeles to between 2 and 2 1/2 hours, with a cost of \$42 each way. The plan was (and remains) to connect California's major cities at a total cost of approximately \$40 billion, and the electric-powered railroad would be similar to the bullet trains prevalent in Europe and other parts of the world.³⁵

However, in yet another setback to the project, Governor Arnold Schwarzenegger asked the legislature to indefinitely delay a \$9.95 billion rail bond slated for the 2008 ballot, clearing the way for \$29 billion in bonds that the governor wants to put on the ballot to pay for courthouses, schools, and dams—the second phase of his “strategic growth plan” that would spend billions of dollars on roads but nothing on high-speed rail. With his focus on road building, the governor also proposed slashing funding for the High-Speed Rail Authority from \$14 million to \$1.2 million, leaving the group with enough just to keep its doors open. “In our plan that we put together, it didn’t fit in,” Schwarzenegger said in an interview in January 2007. “It doesn’t mean that it is not going to fit in the future.”³⁶

Because of such lack of support at the federal or state government level, frustrations run high among supporters of high-speed rail networks in the United States. “Unless we kill a busload of nuns, we don’t get network airtime,” rail advocate James RePass bemoaned publicly. Jerry Epstein, a Los Angeles developer and Pete Wilson appointee on the California High-Speed Rail Authority board remarked that “we should invest money in a proper PR firm that will force the legislators to come up with some money... We are absolutely living in the dark ages here. We must do something to wake up the people of California. Unless we have a rail system we are going to be just mired in traffic.”³⁷

In his landmark book *The Future of Capitalism*, economist Lester C. Thurow noted that “deciding to beat the Japanese and Europeans when it comes to having the best intercity high-speed rail network in the world would be a good place to start,” highlighting the importance of such a national rail project in his treatise on the need for the United States to either be a leader or remain competitive from a global competition standpoint.³⁸

According to Penn State’s Spychalski, rail uses the least amount of land to move the greatest number of people, and high-speed trains promise better air quality. He also states that rail tends to be less vulnerable to severe weather and terrorism.³⁹ Furthermore, the safety record of high-speed trains has been nothing short of phenomenal—except for a few reported incidents (Japan’s Shinkansen killing linemen or a driver of a car stuck on the tracks during a snowstorm and derailment from earthquakes in Niigata, but no fatalities; and two fatalities involving TGV), the safety record is near 100 percent despite transporting an excess of 4 billion passengers.⁴⁰

Despite all the obstacles, there have been some rail program successes in the United States. Rail service has been restored between Boston and Portland, Maine, as well as intercity and commuter rail passenger services such as Caltrain serving key areas within California. Ridership is increasing in both places. Specifically, in intercity rail ridership operated by Amtrak, ridership jumped from 2.3 million in 1994–95 to 4.4 million in 2004–05.⁴¹

Another reason the United States still lags behind other nations in the development of high-speed rail networks is the generally inadequate public support or patronage of rail transportation. No less an authority than former U.S. Secretary of Transportation Norman Mineta highlighted this issue, warning that while high-speed rail is “a very important transportation mode that has to be considered,” systems must be profitable and, perhaps more important, Americans first have to “change their mind-set about rail travel.”⁴²

METHODOLOGY

The research design consisted of five steps: focus group interviews in Tokyo and San Francisco, a pretest of the study's questionnaire, final development of the questionnaire, the survey itself, and data analysis. Each step is outlined below.

FOCUS GROUP INTERVIEWS

Focus groups generally are used to generate original questionnaire items and to adapt items from past research to new contexts. This was the course taken by this study. The strength of a focus group interview is the chemistry that is created between respondents. Consequently, a focus group interview is best conducted by carefully managing the number of questions on the interview agenda to avoid stifling the group chemistry.

Two focus group interviews were conducted. The first was conducted in Tokyo, Japan. Tokyo was chosen because it is one end of a transportation corridor (Tokyo–Osaka) that is analogous to the San Francisco–Los Angeles corridor in terms of distance, concentration of business in the terminal cities, and relatively heavy concentration of business commuting. Further, the corridor is one in which HSR has been an unqualified success. Ten relatively frequent HSR business commuters were selected to take part.

The second focus group interview was conducted in the San Francisco metropolitan area with eight relatively frequent air-travel business commuters. Although rail service is available between San Francisco and Los Angeles (although with a bus connection between San Francisco and Emeryville), the commuter who is the focus of this study of HSR is interested in rapid travel between the two metro areas. The closest facsimile to this type of service in the San Francisco–Los Angeles corridor currently is air travel; thus, frequent air business commuters were used for the San Francisco focus group session. Although the questions about HSR were relatively more hypothetical for the U.S. focus group, the data from the Japanese session helped to inform the focus group agenda for the U.S. session.

PRETEST

The second step in the research process was to pretest the questionnaire. A pretest sample of 194 responses was collected. Following the methodology of O'Brien, et al. (2003), a convenience sample was used for this part of the study since the purpose of a pretest is to help refine the final version of the questionnaire. Respondents were drawn from three MBA programs in the San Francisco area. These individuals tended to travel regularly for business purposes, with 55 percent of them commuting between San Francisco and Los Angeles by air in the past year. Pretest respondents were queried regarding question ambiguity as they returned their responses. Descriptive statistics were also run as a means of identifying

instrument irregularities. Results of the pretest indicated that the questionnaire was fairly well designed. Consequently, minor modifications were made to the questionnaire.

QUESTIONNAIRE

The final questionnaire began by providing basic information such as the likely cost and duration of HSR service between San Francisco and Los Angeles. Color photos of the exterior and the interior of an HSR train were also included. This information was intended to make the response setting tangible to respondents. The questionnaire consisted of sixty-four items to measure perceptions of consumer logistics issues, four items each to measure travel efficiency and travel effectiveness, and three items to measure usage intention. All this data was collected using a five-point Likert-type scale. Other data collected included two items to measure actual travel behavior (number of business trips per year and number of business trips between San Francisco and Los Angeles per year) as well as various demographic measures. A copy of the questionnaire is attached as [Appendix A](#).

DATA COLLECTION

The fourth step in the process was to administer the survey. The survey was conducted at Norman Y. Mineta San José International Airport. Questionnaires were collected at departure gates for flights with any of the major Los Angeles metro area airports (LAX, Burbank, Orange County, and Ontario) as the destination. Arrival areas of flights with a Los Angeles origination were used only in the beginning of the data collection process because arriving passengers were sometimes rushed as they prepared to leave the airport. Travelers at the departure gates, however, with a known amount of time before their departure, appeared to devote a great deal of care to their responses.

Since the focus of this study is business commuters, the survey was conducted on weekdays because airport administrators verified that these were the days with the heaviest business travel. Potential respondents were screened by asking them whether they were traveling for business or leisure and whether the Los Angeles area was their final destination. If they met these criteria, they were informed that a study was being conducted about HSR service in the San Francisco–Los Angeles corridor and that the researchers were interested in their perceptions of such a service. The data collector indicated that respondents would be provided with a \$10 cash incentive for completing the questionnaire. This procedure resulted in an 87 percent response rate and a total of 398 questionnaires were collected.

DATA ANALYSIS

The final step in the research process was to analyze the data. There were three phases of data analysis. In the first phase, descriptive statistics were generated for the data. In the second phase, exploratory factor analysis was used to provide preliminary information about the

consumer logistics-related perceptions of HSR service. A regression procedure was also used to help understand how various demographic groups and groups defined by air travel usage frequency perceived each of the logistical aspects of HSR service.

The third phase of data analysis comprised two basic steps. First, confirmatory factor analysis was used to develop the measurement model. This ensures that important variables are retained for the structural model. Second, structural equation modeling was used to examine the nature of the relationship between the performance of consumer logistics functions, HSR travel effectiveness and efficiency, and HSR usage intentions. Structural equation modeling is similar to multiple regression analysis, which assesses the relationship between a set of predictor variables and an outcome variable. Structural equation modeling goes further by making it possible to assess the relationship between more than two levels of variables. In the case of this study, three levels are assessed: consumer logistics variables, efficiency and effectiveness, and HSR usage intention.

RESULTS

PHASE ONE: DESCRIPTIVE STATISTICS

Phase One of data analysis involved generating descriptive statistics. Of the 398 respondents, San Francisco area residents accounted for 43 percent of the sample, Los Angeles for 23 percent, San Diego for 16 percent, other California locations for 5 percent, and areas outside of California for 13 percent. Because San Francisco residents exceeded Los Angeles residents, the consumer logistics factor scores of the groups were compared to determine whether there might be nonresponse bias. There were no significant differences between the two groups, so nonresponse bias is not a problem.

Two-thirds of the respondents were in managerial or professional positions; another 22 percent were technical, sales, and administrative personnel. Men comprised 73 percent of the respondents. In terms of ethnicity, two-thirds of the respondents were Caucasian, followed by Asians, who constituted a little more than one-sixth (18 percent) of the sample. Hispanics or Latinos (5 percent), African-Americans (3 percent), American Indian, Alaskan, or Hawaiian (1 percent), and Other (4 percent) were the other categories in the sample. Respondents were about 40 years old and earned approximately \$100,000 to \$125,000 annually.

The following eight features or amenities were identified by the respondents as the most important elements in a high-speed rail system. The items are listed in descending order with their mean scores (on a scale of 1 to 5 with 1 being Highly Disagree to 5 being Highly Agree) shown in parentheses:

- It is important to simplify the ticket purchase process (4.58)
- Passenger seats should be roomy and comfortably designed (4.54)
- The ease and convenience of purchasing tickets is important (4.49)
- Boarding platforms should be clean and safe (4.48)
- The availability of information about train schedules is important (4.47)
- The availability of information about fares is important (4.47)
- HSR stations should be easily accessible (4.46)
- The HSR cabin should be clean and spacious (4.46)

The four least important items or amenities (in ascending order) were:

- The availability of coin lockers for luggage storage at stations is important to me (2.23)
- On-board reading materials should be provided for each seat (2.55)
- An on-board shop should be available (for magazines, snacks, souvenirs, and so forth) (2.84)
- Stations should provide business support services (photocopying, fax, and so forth) (2.92)

The following six items or amenities had the greatest variation in responses in terms of standard deviation scores (descending order), indicating a lack of consensus among the respondents:

- HSR travel should provide an option for private rooms (Std. Dev = 1.183)
- Luggage carts should be available at stations (Std. Dev = 1.173)
- The ability to combine the tickets for two or more public transportation modes is important (Std. Dev = 1.160)
- The availability of coin lockers for luggage storage at stations is important to me (Std. Dev = 1.145)
- For home-to-station travel, public transportation options are important (Std. Dev = 1.242)
- The frequency of public transportation routes to an HSR station is important (Std. Dev = 1.217)

PHASE TWO: FACTOR ANALYSIS

Phase Two of data analysis used exploratory factor analysis. The purpose of exploratory factor analysis is to identify underlying consumer logistics themes (factors) in the data. Seven logistics themes emerged:

- information
- safety/cleanliness
- on-board amenities
- transportation connections
- station arrival and departure
- computer connections
- station amenities

The factor labels resulted from an interpretation of the statements that loaded on each consumer logistics factor. For each factor, [Table 1](#) shows the constituent statements.

Table 1 Rotated Component Matrix

Info	Safety	On-board amenities	Connections	Arrival/ Departures	Computer Connections	Station Amenities
Boarding Info						
Fare Info						
Station access info						
Departure/ arrival						
Station facility info						
Connection info						
Simplified ticket purchase						
Train schedule info						
Convenience of ticket purchase						
Special deals info						
Local transportation mode info						
	Walk to departure gate safely					
	Walk from arrival gate safely					
	Station safety					
	Station cleanliness					
	Boarding platform safety					
	Signage					
		On-board vending				
		On-board shops				
		On-board service				
		personnel				
		On-board food/beverage				
		On-board entertainment				
		On-board TV news, entertainment				
		Multiple class tickets				
		Wide aisles				
			Frequent public transportation connections			
			Good public transportation connections			
			Home-station connections			
			Combined ticket for multiple modes			
				Easy drop-off		
				Easy pick-up		
				Easy boarding		
				Easy deboarding		

Table 1 Rotated Component Matrix

Info	Safety	On-board amenities	Connections	Arrival/ Departures	Computer Connections	Station Amenities
					Computer services Electrical outlets Telecom signal	Station shops Station restaurants Station ATM and other facilities Station business support

Table 2 shows the relationship between demographics (age, income, occupation, and so on) and business travel frequency, with overall number of business trips with each of the seven factors. The body of the table provides information for the relationships that were statistically significant. Discussion will be limited to the two most important consumer logistics factors (as identified in Phase Two of data analysis), safety/cleanliness and transportation connections.

Gender was significantly related to the safety/cleanliness factor, with women being more highly concerned than men. Age also has a significant positive relationship with the safety/cleanliness factor. For the transportation connections factor, the number of business trips between San Francisco and Los Angeles and the overall number of business trips were positively related. Income and age were negatively related. In terms of gender, women were more concerned with the transportation connections factor than men; in terms of occupation, people working in professional, technical, and managerial occupations were less concerned with it than other occupational categories.

Table 2 Demographic Characterization of Logistics Factors

	SF trips	Trips	Age	Income	Occupation	Gender
Information		Fewer trips		Lower		Women
Safety/ Cleanliness			Older			Women
On-board Amenities						
Transportation Connections	More trips	More trips	Younger	Lower	Professional	Women
In/Out						
Computer Station	More trips	More trips	Younger	Higher	Non-professional	Men

(Significant relationships are shown in cells)

PHASE THREE: CONFIRMATORY FACTOR ANALYSIS AND STRUCTURAL EQUATION MODELING

In Phase Three of the data analysis, a two-step process was used. First, confirmatory factor analysis is used to develop the measurement model. This more stringent procedure yields four consumer logistics factors rather than seven. This is because greater demand is put on the data

since data related to logistics statements (independent variables) as well as the efficiency, effectiveness, and usage intention statements is reconciled. The consumer logistics functions that emerge are information, safety/cleanliness, on-board amenities, and transportation connections (see Table 2). Second, the number of consumer logistics factors to be retained was further reduced when the structural model was tested (Joreskog and Sorbom, 1983). The final model is shown in Figure 1. Overall model statistics were strong. Further, all of the relationships depicted by the arrows were statistically significant at the 0.05 level of significance. The strength of each relationship is shown by the coefficients next to each of the arrows. These values can potentially range from 0.00 to 1.00. The values that result from this study are very strong for this type of consumer research.

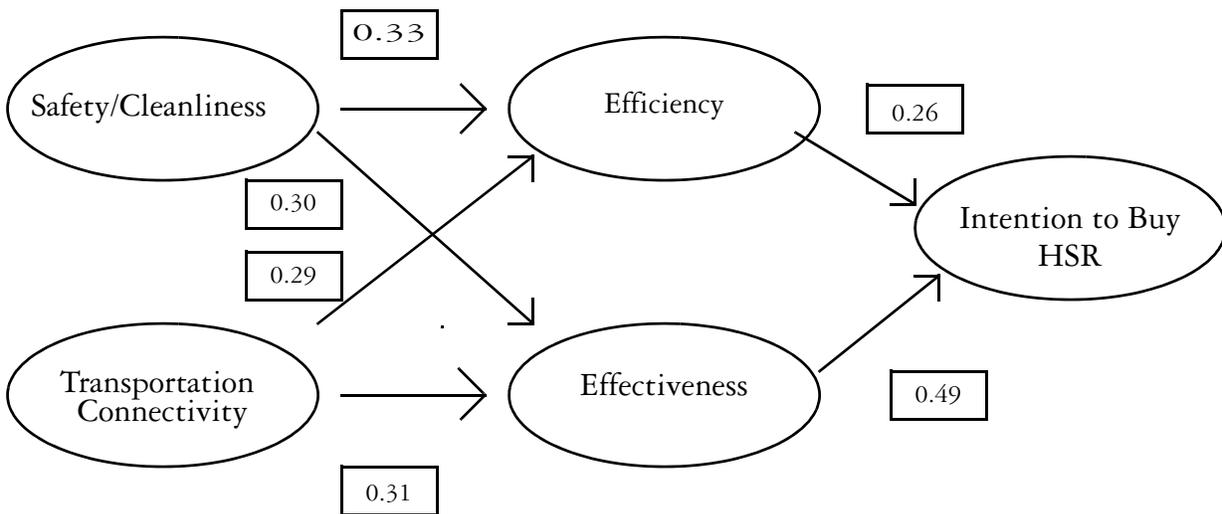


Figure 1 Final/Empirical Model of Influence of Consumer Logistics on Intention to Buy High-Speed Rail

It is extremely important to note that what remains in the structural model are the consumer logistics variables that ultimately will drive usage of HSR service in the San Francisco–Los Angeles corridor. Also note that although nonlogistics variables such as speed of service and cost of service are important, this study’s focus is on additional variables, consumer logistics variables that should be considered in the effort to develop, operate, and market HSR service. The model shows the consumer logistics factors of safety/cleanliness and transportation connections each having a significant positive influence on perceptions of the travel efficiency and travel effectiveness that HSR travel is likely to provide for business commuting between San Francisco and Los Angeles. Further, the model shows that efficiency and effectiveness are both positively related to HSR usage intentions. Although Phase One of the data analysis suggests that there are up to seven consumer logistics factors that may come into play, Phase Three shows that, where a model of HSR usage intention is concerned, the most important consumer logistics factors are safety/cleanliness and transportation connections.

DISCUSSION

It is important to reemphasize that this study's focus is identifying consumer logistics concerns that affect perceptions of HSR travel efficiency and effectiveness and how efficiency and effectiveness then affect HSR travel intentions. The speed of travel is not considered. There is little question that faster tends to be perceived as better than slower. Similarly, cost of travel is not considered because there is little question that cheaper tends to be perceived more favorably than expensive. Thus, the questionnaire establishes the likely speed and cost of San Francisco–Los Angeles HSR service. The study attempts to provide incremental understanding of how to operate and market HSR service by focusing on the consumer logistics of HSR travel.

The importance of a combined safety/cleanliness factor may be somewhat surprising. Although it is not surprising that safety would be judged to be a factor of substantial importance, it might be surprising that cleanliness would be an important factor. Cleanliness, however, may be one of the important faces of safety. Obviously, to encourage commuters to travel by HSR, security procedures and equipment can be put into place. Some of these measures have visible manifestations and visibly demonstrate safety to commuters. Less obviously, cleanliness, although in many ways unrelated to safety, may nonetheless communicate safety to commuters. Similarly, although a clean back alley may be no safer than a dirty one, in the end, it is the perception that matters. The consumer mindset may be that a transportation provider that cannot keep its vehicles and stations clean will not be up to the more formidable task of keeping its stations and vehicles safe. In short, threats of terrorism in addition to everyday concerns about crime have elevated the importance of safety and cleanliness.

The transportation connections factor is relatively straightforward. Business commuters can be encouraged to use HSR by providing good access to HSR stations through public transportation modes.

Just as important as the factors that emerged in the analysis may be what did not. The issue of parking for business commuters who may use HSR did not arise in the final model nor in any other stage of the analysis. Thus, in developing an HSR system for business commuters, resources should focus on providing public transportation connections rather than private transportation. Constituent statements for the transportation connections factor suggest that home-to-station connections are important and frequency of connections is a key issue. Although this study focused on business commuters, it is important to recognize that leisure travelers may well value parking issues more than public transportation connections in their consideration of HSR usage.

In addition to discussing the variables identified in the analysis, it is important to discuss the paths of influence between the variables. The relationship between the consumer logistics variables (safety/cleanliness and transportation connections) and the first level of dependent

variables (efficiency and effectiveness) is strong. To the extent that the safety/cleanliness and transportation connections elements of consumer logistics can be provided to business commuters by an HSR system, the commuters' travel efficiency and travel effectiveness will be substantially enhanced.

The relationship between the first (efficiency and effectiveness) and second (usage intentions) level dependent variables is also strong. In other words, for business commuters, efficiency and effectiveness have important bearing on HSR usage intentions. Effectiveness generally relates to results and efficiency generally relates to costs. What is interesting about the findings is that business commuters' intentions to use HSR are affected more strongly by the effectiveness of HSR than by its efficiency. Some might believe that the advantage of HSR over air travel in the San Francisco–Los Angeles corridor is primarily a minimization of monetary costs. The analysis suggests otherwise.

Although actual flight times are less than HSR, business commuters are apparently including the home-to-station and intrastation logistics in their travel calculus as well as the rail or air transit time. In other words, in addition to the approximately 1 1/2-hour flight time, there is at least another 1 1/2 hours of preflight time for ticketing and security inspections and another 1/2 hour postflight time for the gate arrival and baggage collection processes, resulting in a total of 3 1/2 hours of total travel time. Thus, potential HSR business commuters may expect that the home-to-airport and intra-airport pitfalls encountered by today's domestic air traveler will be averted by HSR service. Thus, HSR service must be designed and promoted to assuage these concerns.

In conclusion, high-speed trains have shown themselves internally to go hand in glove with the increasing demands of global economy. To succeed in an intensely competitive and integrated global environment, fast communication links and fast transportation of goods are absolutely critical. For most of the global players, the 1980s and 1990s brought the realization that congested highways and skies were not the optimal method of traveling. Roads had to be constantly widened in order to provide for the increasing number of trucks carrying goods and for passenger-carrying vehicles transporting people from their homes to workplace or for travel between cities. While air travel is a faster method of transport, it has its limitations. Increased security measures as a result of terrorism concerns have led to slower (longer) check-in and boarding procedures. Increasingly crowded skies result in delayed and even canceled flights. Hence, in countries that have HSR systems, train travel is proving to be a quicker and more efficient option for those making journeys of less than 400 miles.

Moreover, an improved national rail system might serve the public good by alleviating traffic congestion and greenhouse gas emissions, but it remains to be seen whether the United States will develop such high-speed trains or if these innovative ideas ever leave the station.⁴³

However, there is growing support for high-speed rail (and intracity rail) networks among the U.S. public, who are increasingly concerned about environmental pollution, congested roads and skies, and an unhealthy dependence on (foreign) oil. As aptly noted by former U.S.

Secretary of Transportation Norman Mineta, high-speed rail is “a very important transportation mode that has to be considered.”⁴⁴ Hence, a proper and careful implementation of the system based on the perceptions and needs of prospective customers is absolutely imperative, if such a system is to succeed in the United States.

We hope that this study has shed some light on how to effectively design and implement high-speed rail systems based on prospective customer feedback and thereby ensure increased support and patronage of such intercity transportation alternatives.

LIMITATION AND FUTURE RESEARCH

Because this study tests consumer responses to a service that does not yet exist in the United States, some precaution must be taken in interpreting the findings. Nevertheless, the questionnaire was designed with illustrations, scenario-setting introductory remarks, and phrasing of questionnaire items in an effort to help the respondent visualize HSR service as fully as possible.

From a geographic perspective, the findings may be limited by the regional nature of the sample. Data collected from a national sample, however, would be undermined by the fact that the role of HSR will vary from region to region. Thus, if there is an interest in making generalizations to other regions of the United States, future studies in several regional sites are likely to be superior to a national study.

From a passenger perspective, the findings may be limited by the business commuting focus. This choice was made, however, because the San Francisco–Los Angeles corridor is similar to the Tokyo–Osaka corridor, in which business commuting is the mainstay. Nevertheless, future studies of leisure use of HSR are called for, particularly for corridors in which leisure travelers may represent the mainstay of fares. The Florida-feeder corridor, for instance, has received attention as a corridor in which HSR may someday provide an alternative means of conveyance for East Coast vacationers.⁴⁵

The results of this research could also be leveraged by benchmarking its results with the results of similar research conducted in proven HSR corridors.

APPENDIX A

HIGH-SPEED RAIL SURVEY

Dear Business Traveler:

As Professors of Marketing at San José State University, we are interested in your opinions about a High-Speed Rail system between SF and LA, proposed for the future.

The proposed system will stretch from San Francisco, with service to the Santa Barbara area, and will continue on to Los Angeles, and then to San Diego. With operating speeds of 220 m.p.h., the express travel time from downtown SF to LA will be just under 2 1/2 hours with a cost of \$42 each way. The system will be designed to connect with existing air, rail, and highway systems.

Please take the next 10 minutes to complete this questionnaire and return it to our research assistant. There are no right or wrong answers to the questions. We are interested in your opinions. In exchange for your time and as a token of our appreciation you will receive \$10 for completing the questionnaire. If you have any questions about this study or if you would like a copy of the results, please contact us at (408) 924-3534 or (408) 924-3537.

Thank you in advance for your valuable assistance!

Sincerely,

Ken Gehrt, Ph.D., Professor

Mahesh Rajan, Ph.D., Assistant Professor

Please rate the extent to which you agree with the following questions as they apply to High-Speed Rail (HSR) business travel, as it is described on the cover page, in the SF-LA corridor:

	Highly Disagree	2	3	4	Highly Agree
1. The availability of adequate parking facilities at my departure station is important to me.	1	2	3	4	5
2. The availability of coin lockers for luggage storage at stations is important to me.	1	2	3	4	5
3. Overhead luggage racks are important for transit storage.	1	2	3	4	5
4. The option for checked luggage is important.	1	2	3	4	5
5. Luggage carts should be available at stations.	1	2	3	4	5
6. HSR stations should be conveniently located.	1	2	3	4	5
7. HSR stations should be easily accessible.	1	2	3	4	5
8. For home-to-station travel, public transportation options are important.	1	2	3	4	5
9. The frequency of public transportation routes to an HSR station is important.	1	2	3	4	5
10. Public transportation should have good connections to HSR stations.	1	2	3	4	5
11. The ability to combine the tickets of two or more public transportation modes is important.	1	2	3	4	5
12. The ease and convenience of boarding the train is important.	1	2	3	4	5
13. The ease of being dropped off at my departure station is important to me.	1	2	3	4	5
14. The ease of being picked up at my arrival station is important to me.	1	2	3	4	5
15. The ease of de-boarding at stations are critical considerations.	1	2	3	4	5
16. Station safety is an important concern.	1	2	3	4	5
17. Station cleanliness is an important concern.	1	2	3	4	5
18. HSR stations should have a good variety of restaurants.	1	2	3	4	5
19. HSR stations should have a good variety of shops.	1	2	3	4	5
20. ATM and other banking facilities should be available in stations.	1	2	3	4	5
21. Stations should provide business support services (photocopying, fax, etc.).	1	2	3	4	5
22. Pleasant station ambiance is important to me.	1	2	3	4	5
23. Boarding platforms should be adequately covered.	1	2	3	4	5
24. Boarding platforms should be climate-controlled.	1	2	3	4	5
25. Boarding platforms should be clean and safe.	1	2	3	4	5
26. Passenger seats should be roomy and comfortably designed.	1	2	3	4	5
27. The HSR cabin should be clean and spacious.	1	2	3	4	5
28. Seat assignment should be done on a reservation basis.	1	2	3	4	5
29. Each HSR seat should have some sort of temperature or ventilation control.	1	2	3	4	5
30. HSR compartment should provide spacious toilets.	1	2	3	4	5
31. HSR compartment should provide wide/big windows.	1	2	3	4	5
32. HSR travel should provide an option for private rooms.	1	2	3	4	5
33. Compartments should have electrical outlets for connecting devices such as computers.	1	2	3	4	5
34. Compartments should have computer servers for internet connectivity.	1	2	3	4	5
35. Compartments should have the ability to receive quality telecom signals.	1	2	3	4	5
36. Compartments should have on-board news and TV entertainment facilities.	1	2	3	4	5
37. Besides individuals seats, HSR should have as an option, group meeting rooms.	1	2	3	4	5
38. HSR aisles should be wide to increase the comfort of passengers who want to stretch their legs.	1	2	3	4	5

	Highly Disagree	2	3	4	Highly Agree
39. On board food and beverages should be available.	1	2	3	4	5
40. Entertainment facilities (personal video screen, headphone jack, electrical outlet, etc.) should be available for each seat.	1	2	3	4	5
41. An on board shop should be available (i.e., magazines, snacks, souvenirs).	1	2	3	4	5
42. On board service personnel should be available.	1	2	3	4	5
43. On board beverage and snack vending machines should be available.	1	2	3	4	5
44. On board reading materials should be provided for each seat.	1	2	3	4	5
45. The availability of information about train schedules is important.	1	2	3	4	5
46. The availability of information about fares is important.	1	2	3	4	5
47. It is important to simplify the ticket purchase process.	1	2	3	4	5
48. The availability of information about special deals and promotional fares is important.	1	2	3	4	5
49. The availability of information about station access is important.	1	2	3	4	5
50. Provision of information about departure and destination station facilities is important.	1	2	3	4	5
51. Provision of boarding information details is important.	1	2	3	4	5
52. Provision of information about connections is important.	1	2	3	4	5
53. The destination station should provide information about local modes of transportation.	1	2	3	4	5
54. The ease and convenience of purchasing tickets is important.	1	2	3	4	5
55. Tickets for various service levels should be available (i.e., first class, coach).	1	2	3	4	5
56. Departure gates need to be easily accessible from ground transportation.	1	2	3	4	5
57. The safety of the walk from ground transportation to the departure gate is important.	1	2	3	4	5
58. The safety of the walk from the arrival gate to ground transportation is important.	1	2	3	4	5
59. Signage that clearly directs passengers to various sections of the station is important.	1	2	3	4	5
60. HSR compartments should be well lit.	1	2	3	4	5
61. Boarding platforms should be well-lit.	1	2	3	4	5
62. Schedules of intracity public ground transportation should be conveniently coordinated with HSR arrivals and departures.	1	2	3	4	5
63. Schedules of public intracity transportation modes should frequently service HSR stations.	1	2	3	4	5
64. HSR stations should be centrally located.	1	2	3	4	5
65. HSR will allow me to minimize the amount of time I spend traveling from SF to LA.	1	2	3	4	5
66. By using HSR for SF–LA travel, I will minimize the amount of running around I must do.	1	2	3	4	5
67. HSR travel between SF and LA will allow me to minimize my travel costs	1	2	3	4	5
68. HSR travel between SF and LA will allow me to travel more efficiently.	1	2	3	4	5
69. HSR travel between SF and LA will provide me with desired travel results.	1	2	3	4	5
70. HSR travel between SF and LA will ensure that I satisfy my travel needs	1	2	3	4	5
71. HSR travel between SF and LA will allow me to achieve optimal travel results.	1	2	3	4	5
72. HSR travel between SF and LA will allow me to travel more effectively.	1	2	3	4	5
73. HSR is likely to satisfy my SF–LA travel needs.	1	2	3	4	5
74. HSR travel between SF and LA is likely to be a pleasing experience.	1	2	3	4	5

Demographics:

___ Number of business travel trips by air per year

___ Number of business travel trips by air between LA and SF area per year

___ Age

Hometown _____

Occupation (check one):

___ Managerial or professional occupation

___ Technical, sales, or administrative support

___ Service occupation

___ Precision production, craft, or repair occupation

___ Operators, fabricators, or laborers

___ Retired

___ Other

Gender:

___ Male

___ Female

Race:

___ White

___ Black or African American

___ Asian

___ Hispanic or Latino

___ American Indian, Alaskan, or Hawaiian Native

___ Two or more races

___ Other

Income (optional):

___ < \$24,999

___ \$25,000–\$49,999

___ \$50,000 - \$74,999

___ \$75,000 - \$99,999

___ \$100,000 - \$124,999

___ \$125,000 - \$149,999

___ \$150,000 - \$174,999

___ \$175,000 - \$199,999

___ > \$200,000

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ABBREVIATIONS AND ACRONYMS

HSR	High-speed rail
ICE	InterCityExpress (German high-speed train)
LAX	Los Angeles International Airport
LISREL	Linear structural relationship (modeling)
MAGLEV	A form of rail transport using magnetic levitation technology
MTI	Mineta Transportation Institute
m.p.h.	Miles per hour
JR	Japan Railways
Shinkansen	Japanese bullet train
SNCF	Société Nationale des Chemins de fer Français (French public enterprise that runs the nation's freight and passenger rail system)
TGV	Train à Grande Vitesse (French high-speed train)

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