THE TEXAS TGV PROPOSAL: NEXUS OR NIGHTMARE?

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ABSTRACT

This thesis objectively analyzes the current Texas TGV High Speed Rail (HSR) proposal. The purpose is to determine whether or not this proposal is in the best economic and environmental interests of the State of Texas and in the larger picture, the United States. The primary objectives are to analyze current HSR systems throughout the world and to critically evaluate the specifications of the Texas proposal. It will also assess the relative success of the HSR systems that are in operation in reference to current U.S. expenditures on different modes of transportation. The major arguments for and against this proposal will also be evaluated. After a comprehensive review, it is the determination of this thesis that the proposed Texas TGV system is in the best interest of the state and in the larger picture, the United States.

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Acknowledgments

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Chapter 1

Introduction

Throughout the history of man, the human race has relied on new developments in transportation to further the goals and meet the needs of our everyday lives. Obviously, we have come a long way from the days of the horse and wagon or sailing vessels that crossed the world's oceans at a snail's pace. Some of these innovative transportation modes have proven to be most beneficial, while others have fallen along the wayside. We, as a species, still have a long way to go in travel including the potential to move more frequently and freely among the stars.

Transportation in the United States has played a vital role in our development as a nation. This began with the settlers arriving via sailing vessels after months of traveling across the world's oceans. Once here, we began to utilize domestic animals to aid in travel such as horses and mules or horse-drawn carriages and carts. We can all visualize our ancestors seeking their fame and fortune, moving westward in a Conestoga which contained not only our kin, but their complete life's savings and material items. Shortly thereafter, the steam engine was invented and before long, there were plans to span the country with a railroad system. This obviously increased our potential to seek out new opportunities and to exploit our natural resources. Our very development as a nation hinged on the success of our port cities which relied on ocean vessels for the transportation of people and goods and our ability to move people and products across the country via rail or carriage. Obviously, we made drastic improvements in travel throughout the United States with the development of the automobile and the airplane, but our roots were and are based in the railroad system that still provides us with the ability to transport our vital resources such as hazardous chemicals, coal, oil and gas, manufactured goods, and dairy products. The list is seemingly endless. However, as time and technology have changed, we as a nation have become lax in being innovative and are quickly falling behind the times, and other nations, in our ability to quickly and efficiently move people and products. While other nations are investing in their railroad infrastructure, we have let our rail system fall into such a state of disarray that we should literally feel embarrassed. While France is moving people along at speeds of over 180 miles per hour, we have trouble breaking the 120 miles per hour barrier which equates into a net loss in time and energy. What we once knew we have forgotten, and that is the lesson that sustained economic development cannot occur in the absence of a viable infrastructure.

In Texas we have benefited greatly from innovative transportation revolutions that have helped the state maintain its' provincial spirit. These include the Goodnight-Loving trail, the Port of Houston, the major railroad freight lines, a reliable and well-kept highway system, Dallas-Fort Worth (DFW) Airport, Houston

Intercontinental, Love Field and many other transportation facilities that have helped to keep Texas one of the most economically prosperous states in the country. Without the foresight to build such wonderfully accessible and efficient transportation systems, Texas would simply be another Mississippi.

Many in Texas like to think that "How goes the state of Texas, goes the United States." In some cases, this is true. Currently, all the major airports in Texas are severely overbooked. Highway expansion is severely needed as the major arteries become more and more congested, and populations are growing at such a rate that we need something to aid us in moving these people conveniently and efficiently. This is correspondingly occurring all over the country. The obvious response is to build more airports, highways, houses, and whatever else it takes to alleviate the transportation grid-lock that we find ourselves facing. However, these options are costly and increasingly inefficient for a variety of reasons which will be delineated in following chapters. The state of Texas has decided to examine, and hopefully will decide to build, a High Speed Rail (HSR) system that would revolutionize travel and some industries in the state making us the first in the country to do so. There is currently a proposal to build a HSR system that would carry passengers around the state at 186.4 miles per hour. It would further be able to transport freight in a much more efficient manner than the current freight systems which rarely move above 50 miles per hour. Unfortunately, when the contract was awarded, it was stipulated that no taxpayer subsidization would aid in the construction of such a project and this was a big mistake.

Around the world, many countries have already made major commitments to their respective infrastructures. There are already HSR systems running in Japan, Germany, France, and many other countries have already dedicated funding to build HSR systems. These rail systems increase the efficiency with which people can move around and they bring in a transportation system capable of spurring economic development and growth. When Europe was faced with overcrowded highways and airports, they became innovative and implemented new ways of moving people and products, while the U.S. has been caught with our proverbial pants down. These countries utilized a variety of funding methods to aid in the development of these systems, which is something that we need to learn how to do. The U.S. has forgotten about our 'rail roots' and this oversight is a severe blemish on our innovative transportation record.

Research Objectives

The objectives of this thesis are fivefold: (1) to conduct an inventory of international HSR systems, (2) to assess the relative success of these systems in reference to U.S. expenditures on different modes of transportation, (3) to describe the nature and specifications of the recently proposed HSR system for Texas, (4) to evaluate the potential economic benefits for the state, McLennan

County, and Waco, and (5) to analyze the arguments for and against this HSR proposal in an effort to determine whether this project is in the best interest of Texas and in the larger picture, the United States.

Methodology

Due to the timing of this research, it has been very difficult to obtain concrete figures on the current HSR proposal in Texas. The construction firm of Morrison & Knudsen, which holds the construction contract for the system, has not even publicly released the specifics on the costs of building the proposed system. To date, no direct economic impact analysis has been conducted on this particular system, nor have any commerce officials projected the economic impact figures associated with the construction of this project. Furthermore, the Texas TGV will not release funding source figures either because of the tenuous situation of the funding or because they simply do not have any funding. It is widely known that they missed the first deadline of $170 million by December 31st, 1992. They were then granted a one-year extension which they also failed to meet and the livelihood of the project currently sits with the legislature.

As a result, economic impact figures for this thesis are based on a similar 1990 proposal submitted by a German Consortium. The Perryman Consulting firm has produced a report based on the same route that is currently being considered and utilizing similar (though not exactly the same) technology. For the purpose of this thesis, the difference between the two is not significant enough to cause concern. The Perryman firm utilizes a highly complex and detail-oriented computer program to make projections based on potential projects throughout the state. They are also one of the most highly regarded economic forecasting firms in Texas. They produce the annual state economic forecasts for the state of Texas and have been very successful in their predictions. For this particular study, they utilized their Texas Multi-Regional Impact Assessment System (TMRIA) to make economic projections based on the previously mentioned HSR proposal. The system evaluates the direct, indirect, and induced effects of the proposed system on numerous measures of statewide business activities. Usually reports of this nature are limited to direct and indirect activity. This program is innovative and is able to project economic stimulus associated with major projects through such items as new potential payrolls and their influence on consumer spending. The Perryman study makes two basic assumptions. First, that the HSR will make the overall efficiency of commerce within the study area increase. Second, that there are definable industries which will benefit most from this new form of transportation. The firm had to determine the potential trade flows for each city in the corridor. They had to calculate the export capacity of all the cities in the corridor for over 500 goods and services and then calculate the net import requirements of each urban area for each of the previously mentioned goods and services. By analyzing these two aspects of each city in the corridor, Perryman has been able to evaluate the potential for trade within the area (Perryman 1990, 17-18). Specifically, this report analyzes the economic development and stimulus through construction, operation and maintenance, and ridership spending associated with the proposed HSR system. Though impossible to quantify the impact of a major infrastructure development, this system also attempts to portray potential developments associated with a project of this nature through 'value capture' techniques. This term means that they attempt to hypothesize what could happen if such a system were built.

This thesis will also utilize the statistics generated from the "Independent Ridership and Passenger Revenue Projections for the Texas TGV Corporation High Speed Rail System in Texas" which was produced by the Charles River Associates (CRA). They rely on the industry standard "three-step" approach for forecasting intercity travel demand. This includes estimating intercity HSR ridership by first estimating the size of the total market for intercity air and auto travel in the absence of HSR. Then, using new mode choice models that incorporate customer preferences developed from new air and auto survey data, they estimated HSR's share of the future travel market based on the anticipated service levels of the various transportation modes. Finally, they estimated induced demand which are trips that would not have been taken if there was not a HSR system in operation. This whole process requires an extensive series of input data, historically and presently, to forecast future HSR ridership and revenue (CRA 1993, 25-26). This study is considered by those in the industry to be the most current travel analysis and ridership modeling available.

As is evident, this thesis will utilize a variety of sources to determine whether or not the Texas TGV proposal is a viable mode of transportation for the state. Chapter Two of this thesis focuses on HSR systems operating around the world. It will look at the French TGV, the Japanese Bullet Train, the German ICE train, and many other new technologies. The Third Chapter will analyze the specifics of the Texas TGV proposal including the train sets, routes, and schedules. Chapter Four offers concrete data on the economic impact of the proposed project as well as some projections on expected ridership of the system. Chapter Five will critically evaluate the major arguments both for and against this proposal and Chapter Six will offer conclusions derived from the text.

Chapter 2

High Speed Rail Systems In Operation Throughout The World

There are a number of countries that already have HSR systems in operation or have already dedicated funding for such systems around the world today. Most of these are industrialized European countries and include France, England, Spain, Germany, Italy, Switzerland, and Japan. Furthermore, there are many countries that have plans to construct HSR systems or to modify existing rail systems to make them compatible with HSR. In an effort to provide some background information, this chapter will analyze the success of systems that are currently in operation and detail some of the plans that other countries have for future HSR plans. The reasoning behind looking at these systems is that all of these countries are facing problems similar to those being experienced here in the United States. For the most part, they are industrialized and their respective populations have grown to such an extent they are finding it increasingly difficult to provide transportation in a timely, environmentally-benign, safe, and cost-efficient manner. Also, they need a system that has the potential to spur economic growth which is something that the United States, as well as Texas, can always benefit from in the long run.

The Japanese Bullet Train

The Japanese were the first nation in the world to use high speed rail as a mode of transportation. They invented the Bullet Train which is a steel wheel on track system that started off running at 125 miles per hour. The first Bullet Train went into operation on October 1, 1964. The first corridor was a line between Tokyo and Osaka. This line was built on a completely grade-separated and exclusive right-of-way and covered 320 miles of mountainous terrain. The line was dubbed the "Shinkansen" which means 'new trunk line.' Over the last 25 years, the system has expanded dramatically. The Shinkansen now runs south to the Island of Kyushu and another line runs north to Niigata and Morioka. Japan now enjoys almost 1,300 miles of high speed rail line (Map 2.1). Furthermore, they plan to build lines from Morioka to Aomori on to Sapporo which is located on Hokkaido Island, another from Takasaki to Komatsu, and another from Hakata to both Kagoshima and Nagasaki. When the trains first started operating, they were built by Hitachi and made the Tokyo-Osaka route in four hours. With upgrades, the trains shortened that time to 2 hours and 52 minutes. The newest trains are called the "Super Hikari" and are more powerful and lighter. They can make the trip in under 2 hours and 30 minutes. There are plans to construct a new HSR system called the "Series 400 Shinkansen" which would be used to run on routes converted from narrow to standard gauge (Vranich 1991, 77).

Figure 2.1 - Map of Japanese Bullet Train Routes - Operating and Planned

Source: Vranich 1991

Success of the Bullet Train

The Bullet Train in Japan has been highly successful by all standards. Koji Takahashi, senior vice-president for engineering of the old Japanese railway states that:

> The Shinkansen has captured at least 80 percent of the market between Tokyo and Osaka, 320 miles apart. That led us to believe that our Shinkansen is competitive with other modes of transportation in

> medium-length of 100 to 500 mile intercity corridors. The increase in ridership in the Tokyo-Osaka corridor for 1970, after five years of operation, was more than 1.5 times our optimistic estimate. The actual daily ridership grew by 300 percent in those first five years (Takahashi 1991, 77).

Today, more than 135 million people ride Japan's Bullet Trains every year.

The Bullet Trains in Japan run everyday without any problems and have a 99 percent on-time efficiency rating. In 1989, when a train was late, it was late by an average of only 28 seconds (Hiroumi 1989, 80). Currently, over 260 Bullet Trains run on a daily basis. The system serves over 400,000 passengers and now run at speeds reaching 170 miles per hour. The most amazing aspect of this system is that it is also the safest known transportation mode on the planet, with no passenger mortalities or injuries in all the time that it has been in operation. The system has now carried almost three billion passengers without incident (Vranich 1991, 85).

In the United States, more than half of our country's accidental deaths occur in or around some transportation mode, while over 90 percent of those occur on our highways. During the period from 1978 to 1991, the average number of annual passenger fatalities for automobiles in the U.S. was 22,834, while airlines averaged 131, and buses 37. Amtrak, which is the American passenger train service, averaged 2.5 fatalities for the same time period. In its 23-year history, Amtrak has had 88 fatalities or .08 fatalities per 100 million passenger miles, based on 107.6 billion miles from 1971 to 1993.

Important to note is that 84 percent of the accidents occurred at highway-rail intersections and in the majority of cases were caused by vehicle-driver inattention or their poor judgment in trying to go around the safety gates (Amtrak 1994, 2). Amtrak, in comparison to the Bullet Train, is a veritable death trap.

In addition to on-time performance and safety records, financial success can be equally important to a rail system's viability. In Japan, some of the train routes were designed for high volume and turning a profit and others were designed to stimulate economic growth. These systems are not as concerned with quick returns on investment, but instead help provide the future of the country. For instance, the Tokyo-Osaka corridor cost $640 million to build and within a very short period of time, less than two years, it was the only Japanese rail system to make a profit. The system was built by loans from the World Bank and the Japanese government provided a subsidized interest on the loans during construction. Since 1975, the rail has operated financially independent and has been able to pay off its World Bank construction loan. On the other hand, some Bullet Train routes serve smaller cities and are subsidized by the government. There are plans to connect Hokkaido, which is Japan's northernmost island, with the main island via the Bullet Train. This route is not expected to make a profit based on the fewer numbers of people involved in the cities that the system will serve, but it is expected to help aid in economic development of the region (Vranich 1991, 82). This shows incredible foresight, something that perhaps the United States could use a little of these days.

The French TGV

The first *Train a Grande Vitesse* (TGV) project originated in the 1960s in France. The reasoning behind the innovative TGV was that the train system which was in place at the time had become saturated. They progressively developed three separate, but integrated lines. The first one that went into operation was the TGV Atlantic line which connected Paris with Bordeaux via the points along the Atlantic coast. It began running in 1989 at up to speeds of 184.6 miles per hour. This made the French TGV the fastest operating train in the world. The operators of the system, known as the *Societe Nationale des Chemins de Fer Francais* (SNCF), hope to keep upgrading the potential speeds of the TGV and have plans to run a system that would connect London with Paris at speeds of up to 217 miles per hour. The Atlantic TGV operates over new tracks of a 177-mile main line connecting Paris to Courtalain. It branches out at Courtalain forming a Y-shape. One section heads south towards Tours where it connects with existing lines to Bordeaux and Lourdes that have been upgraded to accommodate the TGV at speeds of up to 136 miles per hour (Map 2.2). This ability to convert from TGV specific rail to existing rail lines has increased the trains' ability to head directly into urban centers while traveling exclusively on TGV rails when operating in the more remote countryside. The other branch heads west to Le Mans where it connects with existing tracks to move towards Brest and other western locations. The TGV Southeast line travels between Paris and Lyon. After leaving Lyon, it heads as far south as Marseilles and Nice which are located on the Mediterranean. They now travel into Switzerland and serve Bern, as well as Geneva and Lausanne. The TGV North line was planned in 1987 and will link Paris with Brussels; it will also link the two cities to London via the "Chunnel" (Map 2.2).

Success of the French TGV

The TGV in France has been so successful that there are plans to integrate the entire continent utilizing this technology. The specific countries and proposed routes will be discussed in the following section. In 1989, the TGVs carried 24 million passengers. The TGV Atlantic and Southeast lines run every ten minutes during peak hours and have an on-time efficiency rating of 98 percent with zero injuries or fatalities associated with their usage. The trains are operated on continuous-welded rails, which provides for the elimination of noise associated with outdated train systems. Tracks are built above or below existing roads to eliminate any chances of safety hazards at road crossings. The new generation of TGV trains are 10 cars long with power cars at either end. One set carries over 485 passengers each trip with the capability of coupling, which would bring the passenger number up to around 1,000 people per trip. The train is divided into compartments, meeting rooms, and first and second-class accommodations. There are also spaces set aside for children to play, a nursery for babies, and a video lounge. Needless to say, it provides much more comfort than any airliner in operation today (Vranich 1991, 30).

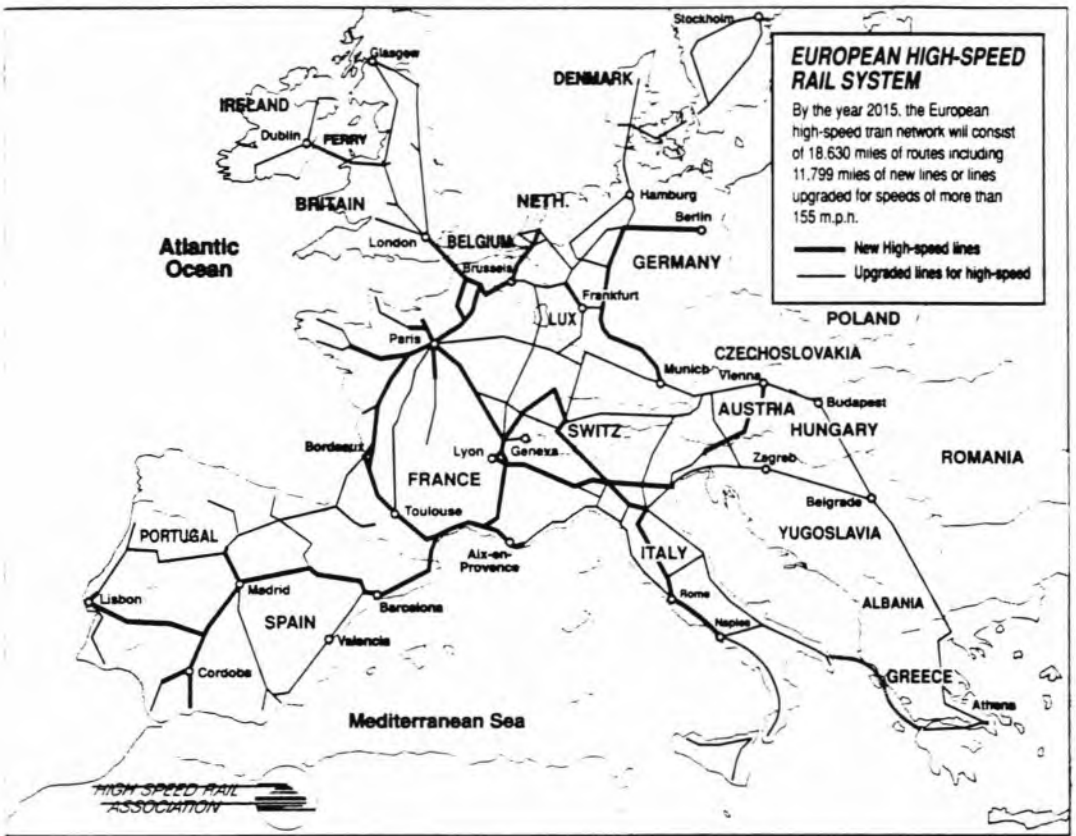


Figure 2.2 - Map of European High Speed Rail Lines

Source: Vranich 1991

In the early 1980s, the French placed orders for 95 trains for the Atlantic line at a cost of almost \$1.4 billion. Another \$1.9 billion was allocated for construction of the line and the upgrade of existing rail structure which brings a grand total of \$3.3 billion for the Atlantic line section of the French TGV. The TGV Atlantic line was partially financed by the government which put up around 30 percent of the initial construction costs. The first year ridership results were high with over 10 million people using the line. By 1993, the Atlantic line is expected to serve over 25 million passengers on a yearly basis, one quarter of whom will have come from other modes of transportation. The capital costs of this line are forecasted to be paid back by the year 2000 with a return rate of over 12 percent (Vranich 1991, 30).

The Southeast TGV line which opened in 1981 has been another huge economic success. The Southeast line is so popular that in its first nine years of operation, it carried over 100 million passengers. It served over 47,000 riders daily throughout 1988, which was a 74 percent gain in overall ridership prior to the TGV's traveling this route. The rail was and is taking passengers away from automobiles and airlines. It has been estimated that by 1984, the TGV was taking away two million passengers from the airline industry which comprised 33 percent of the TGV ridership. It is further estimated that the TGV operations took around 1.5 million drivers off the road for the same year (Mathieu 1991, 36). Further, as many as three million riders were actually generated by the rail itself, which is termed, "induced ridership." The Southeast line was built with no government subsidization. The SNCF covered the $1.6 billion cost from internal funds and by securing loans from private capital markets. It should be noted that the government did guarantee the loans, just like the U.S. government has done with many of our large aircraft manufacturers. A former Federal Railroad

Administrator representing the TGV here in the United States was quoted as saying about the French TGV Southeast line:

> Capital costs were about $1.6 billion using 1983 dollars and exchange rates. Cost overruns were negligible for a project of this size-about 1 percent over the original estimate for fixed facilities and 4 percent for rolling stock. The train is remarkably economical. At a 65 percent load factor, the entire cost of a TGV train running between Paris and Lyon, including interest and depreciation, is less than the cost of jet fuel alone on an Airbus. The TGV is truly a case of the right technology in the right place at the right time (Blanchette 1991, 36).

This certainly seems like the type and form of technology that would be beneficial for any state in our country to have. Texas has the potential and ability to be the first state to incorporate such an efficient, cost-effective transportation system.

In 1987, the revenues for the Southeast line were $737.5 million and $291 million in direct expenses, which left an operating surplus of $446.5 million. The expenses included money which had to be paid for sharing stretches of track with other rail users. The net surplus covered the interest on the debt that allowed for the initiation of the rail line, depreciation, track maintenance and renewal, and a contribution to the SNCF for its overhead costs. The rest of the surplus was used for paying off the principal on the loans taken out to initially finance the project. Full repayment of the debt was expected by 1993, less than ten years after the rail started operating and well ahead of schedule. This is a 15 percent rate of return which is considered to be an excellent investment in financial circles (Vranich 1991, 34).

There are now plans to link the TGV North, Southeast, and Atlantic lines via a 65-mile route which would serve the Charles de Gaulle International Airport and Euro-Disneyland. This line would bypass Paris and allow for further travel north to Brussels and elsewhere. This project is estimated to cost around $1 billion, serve around 11 million passengers on an annual basis, and has an expected rate of return of approximately 10 percent (Mathieu 1991, 37).

Other European Countries

In addition to the countries discussed above, there are several more European nations that either have plans to build HSR systems or have already dedicated funding to build such systems. They see the obvious need for moving greater numbers of people in an efficient, environmentally sound, and cost-effective manner. These countries include England, Spain, Germany, Italy, and several others. Map 2.2 clearly delineates currently operating HSR systems as well as proposed systems throughout Europe.

England's "Chunnel" System

For the first time in history, the Channel between France and England has been tunneled through and is now prepared to be a major route for travel between mainland Europe and Great Britain.

The name commonly associated with this is the 'Chunnel.' It is projected that the HSR system to be used, a version of the TGV called the *Transmanche Super Train* (TMST), will link Paris and London via rail for a one-way travel time of just under 3 hours. As of 1985, around 48 million passengers crossed the channel between Britain and Europe and this is expected to grow rapidly by the year 2000. Obviously, the Chunnel provides all parties concerned with a fast, reliable, transportation system to improve not only travel time, but exporting and importing potential. Planners are hoping for initial ridership of approximately 33 million passengers, with expectations that this will increase to over 45 million passengers after the turn of the century. As constructed, the tunnel has three parts. There are two main tunnels which will carry rail traffic and a third which will be used for maintenance and ventilation (Vranich 1991, 44-47).

This project was financed privately through Britain's Channel Tunnel Group Limited and France Manch SA. They expect an approximate 19 percent return on their investment from charges paid by the railways which will be using the tunnels for passenger and freight traffic. They had to raise $10.2 billion to construct the system, and more than 200 banks agreed to an $8.2 billion underwriting of the proposal. There have been some cost overruns and delays in construction, but the project is well on its way to being completed. A magazine article noted:

> If the revenue projections are even close and if there are not bad construction delays, the investors may have gotten themselves a pretty good deal. With operating costs expected to come to only 19 percent of revenues

> after its planned opening, Eurotunnel should become a giant cash machine once up and running. Watching the situation unfold, an American is struck with a thought: if the Europeans can harness private enterprise to improve their infrastructure, why can't the United States (Forbes 1991, 49).

Great Britain is experiencing political difficulties in upgrading and installing new track to provide for an extended HSR system, but many think that the infighting will discontinue and that it will be a relatively short period of time before all of England has HSR at its disposal (Vranich 1991, 46-49).

Spain

Even the Spaniards are hopping on the HSR wagon. Spain is taking measures today to ensure its future in the people-moving business. The government of Spain made the first proposal for the new system in April of 1987 and passed the proposal and started financing it by April of 1988. This scenario would never occur that quickly in the United States. The Spanish National Railroad, the *Red Nacional de los Ferrocarriles Espanoles* (RENFE), has already ordered TGV trains and renamed them *Alta Velocidad Espanol* (AVE). The RENFE has ordered 24 AVE trains from the French for around $745 million which is the first time that TGV technology has been sold outside of France. They are due in Spain by early 1992. The Spaniards are building three new lines for 155 miles per hour operation and are upgrading existing track for 125 miles per hour, all of which will serve their new HSR system. Further, they are altering the gauge of their track to meet European standards. They have always run on a broad gauge of 5 feet, which is the distance between the two tracks, whereas the European standard is 4 feet, 8.5 inches. In the past trains arriving in Spain, had to switch wheel assemblies or the passengers would have to switch trains. This obviously is not conducive to an HSR system and they have taken the appropriate measures to make RENFE and the AVE system a viable entity. The AVE's will operate between Madrid and Barcelona and Madrid and Seville via Cordoba. There is also investment in a new Madrid-Seville line which will cost around $250 million. This line alone is expected to see an annual ridership increase from 1 million to 2.25 million. It appears this system will be up and running by the mid-1990's. The new AVE system is expected to connect Barcelona and France in the near future (Vranich 1991, 52-55).

Germany

The German equivalent of the French TGV is the Intercity Express (ICE) train. The German Federal Railways, the *Deutsche Bundesbahn* (DB), maintain that their 180 miles per hour system is designed, "to go twice the speed of the car and half the speed of the plane" (Gohlke 1991, 56). The trains are a little larger than the TGV which only serves to enhance the comfort of the passenger. They are also electrically powered and run in 14-car train sets. The first ICE train went into service on June 2, 1991, on the Hamburg-Munich line. Other lines include a segment between Hannover and Wurzburg and one between Mannheim and Stuttgart (Map 2.2). There are plans to upgrade dozens of other lines and to serve around 1,670 miles of route by 1995, including a line between Cologne and Frankfurt. These trains have been highly used and are constantly being rescaled to go faster. Other routes to be considered include ones into East Germany. Due to the reunification, Germany now has more than 200 daily trains running between the old East Germany and West Germany. There are major plans for integrating East and West Germany with HSR routes and the details are still being worked out. Hopefully, construction on some of the planned routes will begin as early as 1994. Unlike the SNCF, which uses a combination of private and governmental funding, the DB provides all the funding for the ICE trains. They have already ordered 60 ICE trains at a cost of over $1 billion total. The comprehensive cost for the equipment, construction, upgrading, maintenance, and station work is expected to exceed $5 billion total. The government is more than willing to pay for this because of the benefits derived. Wolfgang Henn, who is the director of the DB has stated:

> High speed rail is protecting the landscape. It is clean. It is saving energy. No means of transport is more ecologically beneficial than a high-speed rail system. An efficient rail system is, therefore, not only for the customers, but everybody (Vranich, 1991, 62).

It would seem that the United States could learn a few valuable lessons from the German initiative in HSR. At a time when people are becoming more and more sensitive to environmental issues, it would be prudent for any politician to understand the need for an environmentally 'friendly' mode of transportation in the United States.

Italy

The Italians have had an innovative rail system in place since World War I. They built a system that ran between Rome and Naples that sped along at 125 miles per hour which at the time, was quite a feat. More recently, the Italian State Railways, *Ente Ferrovie delo Stato* (FS), started a feasibility study in 1986 and formulated a General Transport Plan which focused on the development of HSR. The plan calls for a high speed line that will have a 'T' shape. One line will head north and south between Milan and Naples. The other line will make up the cross of the 'T' and will travel east-west between Torino-Milan and Venice. Construction is already underway and the rail is expected to be fully operational in the mid-1990s. They also have expansion plans to build lines that will serve the southern parts of Italy (Map 2.2). The Italians are currently running the ETR-450, which is a tilting train built by *Fiat Terroviaria* which runs at around 155 miles per hour. There is thought being given to upgrading to the *Avril* which tops out at around 200 miles per hour. The financing for the first part of this HSR plan, around $4 billion dollars, came from governmental funding. They passed a law in 1987 which dedicated funding to national transportation. It is expected that in the future, a mix of public and private funding will be used for expansion in the system.

Proposed European Integration

As the world is quite aware, Europe has joined together in an economic partnership that is unparalleled in history. The Europeans are starting to cooperate on many fronts including trade, jobs, and immigration. They are also integrating their travel modes among nations, specifically interlinking HSR. Already France, Belgium, the Netherlands, and Germany have agreed to build an HSR system that will link Paris, Lille, and Brussels. Once the system reaches Brussels, it will split into two separate lines which will head to Amsterdam and Cologne respectively. This is not only a major breakthrough in cooperation, but will connect some of Europe's largest cities via rail which is, in turn, taking cars off the roadways. The roads throughout that region of Europe are well known for traffic congestion and environmentalists, among others, are happy to see this proposal become a reality. This proposed rail integration will not only take cars off of the roads, but will reduce the need to expand highway systems which would ultimately harm their fragile ecosystems. The line will originate in Paris and is known as the TGV North route. The system will allow travel between Paris and Brussels in 1 hour and 30 minutes. It will also provide for travel between Paris and Cologne in under 3 hours which is a substantial reduction in current travel time. Plans for this route were announced in 1987 and this system will also link up with the HSR that will be traveling to London via the Chunnel. The ridership projections for this new line are 17 million passengers between France and Great Britain and approximately 12 million between France and Belgium. The project's cost is estimated at around $5 billion with an expected rate of return of 13 percent. It should be noted that this is only one aspect of the French master plan of building an HSR network of over 2,000 miles throughout Europe with Paris as the center of the system. This would require around $33 billion dollars to build and would add an additional 14 HSR systems by 2015. The projection forecasts ridership of 160 million passengers annually, not including local ridership. Beyond the French proposal, the European Community is looking at an HSR network that would eventually require laying a total of 4,600 miles of new track and improving around 12,000 more miles. This investment would require at least $105 billion with $18 billion having been already spent. There are still many uncertainties, especially with the political turmoil that is now prevalent in several European countries, but the latter represents the grand scheme of HSR in Europe. Without doubt, the Europeans are moving ahead rapidly in the development of an integrated HSR system for the continent (Vranich 1991, 42).

Other Countries

As is evident from the discussion above, there are many countries that have HSR plans and it is important to note that most systems utilize either a mixture of public and private funding or are completely funded by the respective government. The following is a listing of some of the other countries that are currently considering HSR systems.

Though Switzerland already has a very progressive train system, they have just dedicated $2.6 billion through the, "Rail Referendum 2000" to upgrade the existing infrastructure and possibly add a few new lines that would run through tunnels to Italy. Austria's new rail plans include projects which would allow for travel of speeds up to 155 miles per hour on two lines. The first line would connect Vienna with Amstetten and the other would connect Vienna with Graz. Though short in length, both routes will cut down travel times significantly. Other countries with plans to upgrade their rail systems in the very near future include Denmark, Turkey, Greece, Ireland, Sweden, Finland, Poland, the old Czechoslovakia, the old Yugoslavia, Romania, Bulgaria, Hungary, Poland, the old Soviet Union, Australia, Taiwan, Korea, and Brazil (Vranich 1991, 65-76).

Conclusion

All of these governments see the need for environmentally sound and economically feasible methods of mass transportation. The United States is rapidly losing ground in the mass transportation arena and the potential for economic gain that will be enjoyed by leaders in this field. By not supporting and investigating HSR technology immediately, we are only hurting our country economically and our people financially. These systems have been shown to be efficient, effective, and successful in every country where they have been implemented. In an era where economic security is relatively non-existent in the United States, here is a transportation mode that would not only create jobs and potentially generate economic security, but offer one of the most efficient mass transportation systems available.

Chapter 3

Texas High Speed Rail Proposal: Background and Specifications

In June of 1987, the Texas Legislature directed the Texas Turnpike Authority (TTA) to study the feasibility of a HSR system in Texas extending from Dallas to San Antonio to Houston. In January of 1989, the TTA reported that under certain assumptions, a HSR system in Texas would be feasible. HSR generally refers to train systems that travel over 150 miles per hour. On May 28, 1991, the franchise was awarded to the Texas TGV Consortium which is based on French rolling stock. The type of rail system which is to be implemented is based on the French TGV technology, which has been discussed in detail earlier in Chapter 2. It should be noted that the consortium changed its name to the Texas High-Speed Rail Corporation, then to the Texas TGV Corporation (Texas High Speed Rail Authority [THSRA] 1992, 1-5).

This chapter will provide specific information about the train sets themselves, the power required to run such a system, the preventative maintenance required to ensure system safety, the cost-effectiveness of constructing an independent system and the costs associated with the construction of the system. Furthermore, it will detail the phased financial arrangement, the route that will be utilized, and the forecasted schedules that will be maintained. This breakdown will give the reader an insight into how a HSR system operates and what parameters must be taken into consideration in developing a project of this nature.

Project Specifications

The proposed track system for the Texas TGV would consist of 590 route miles of double track with twenty miles of single track between DFW Airport and Fort Worth. There will be fifteen feet between track centers. The tracks and the overhead power lines will be enclosed within fences with no road crossings for safety reasons. The rails will be welded into 1440 feet strings in the plant, which will then be field welded to provide a continuous rail. This will provide a smoother ride and will also decrease the train's noise level. The limit of sound level exposure for a continuous noise in a locomotive cab is an eight hour time weighted average of 90 dB(A). The noise level in a TGV power car is 78 dB(A) and the noise level in a TGV trailing car is 70 dB(A) at 200 mph (FRA 1991, 1, 3-5, 28).

Each train set will consist of a leading power car followed by a first-class car, a business-class car, five coach-class cars, a restaurant and bar car, and another power car in the rear. The train will have 317 total seats. Of these, twenty-five will be first-class, forty-eight will be business-class, and 244 will be coach class (FRA 1991, 7). Among the amenities will be a phone at every seat in the first and business classes, every two seats in coach, and phone jacks for hooking up computer modems or facsimile machines (O'Malley 1992, 78).

The power cars will draw twenty-five thousand volts from the overhead lines and will produce some twelve thousand horsepower. As many as twelve power cooperatives could end up supplying power to parts of the system, with about a fifty-five mile spacing between each. The power cars will move the 656.3-feet-long trains at 186.4 miles per hour, which is the maximum speed in Texas. The trains can accelerate from zero to 50 miles per hour in fifty-two seconds, zero to 100 miles per hour in 123 seconds, and zero to 200 miles per hour in 408 seconds (FRA 1991, 6-13).

Preventative Maintenance

For any project of this nature, there must be a comprehensive plan for maintaining all aspects of the system. The TGV system in France follows a strict maintenance schedule which would hopefully be followed in Texas as well. Safety inspections are performed as follows on the TGV Atlantic line:

1. Continuous performance monitoring of critical components through the train diagnostic and reporting system.
2. Inspection of vital safety functions every time the train re-enters the Paris station.
3. Safety systems and current collection, including roof inspections, every 1,864 miles.
4. Comfort systems every 9 days.

5. Running gear every 18 days.

6. Traction motors, automatic couplers, and filters every 36 days.

7. Axles and batteries every 72 days.

The train sets must stop in to the maintenance yards on occasion to be checked out for any potential malfunctions. The train sets undergo a detailed inspection process outlined as follows:

1. *Limited Visit* - 2 days every 4.5 months. May be extended to 6 months because of favorable operating experience.
2. *Limited General Visit* - 3 days every 9 months.
3. *General Visit* - 4 days every 18 months (FRA 1991, 8).

These visits consist of stops at the maintenance facility to ensure the safety and convenience of all the operating functions of the train sets.

Independent System

Many of the opponents of a HSR system in Texas would prefer that the system, if built, utilize existing track or existing right-of-ways. This wouldn't be acceptable for a HSR system for a variety of reasons. First, existing track would require extensive and costly upgrading (Table 3.1).

Table 3.1 - Estimated Cost Comparison for Constructing Independent Track versus Upgrading Existing Track

Track Type	**Estimated Construction cost (1988 dollars)**	**Track Miles Texas Triangle**
Existing	$5,105,695,000	686 miles
Independent	$4,392,600,000	618 miles

Source: FRA 1991

As shown in Table 3.1, it would be cheaper to simply build new tracks. An independent system allows for more direct routes, which leads to savings in construction costs and operating costs. Through an independent route, it would be possible to avoid grade crossings, thus achieving a higher safety coefficient. The trains would not directly cross any roads, as the track would either be built under or over existing roads. Furthermore, there is substantial use of existing track by freight trains. This would defeat the purpose of having a HSR. Freight trains move at relatively slow speeds in comparison to a HSR train and would serve to ultimately slow down the entire system. It is not efficient or safe to have one train set moving at a 150 plus miles per hour getting stuck behind a freight train that is moving at 50 miles per hour. It would be a logistical nightmare to try and keep the HSR trains on schedule. In addition, the weights involved with freight trains would create the need for extensive maintenance of the tracks for the system. Also, the safety of the HSR system would be compromised. The reason that the Japanese and German systems have had perfect safety records is because the only train sets on the tracks at any one time are the trains that they are running which are continuously monitored via a computer system. Thus, the potential for accidents has decreased because the number of train sets on the track system at any time has decreased.

Those in favor of an independent HSR system rely on the arguments previously discussed as well as a few others. First, it is important that a system configuration be maintained for safety and efficiency purposes. This is possible through an independent system where only the TGV train sets would be utilizing the track. In addition, fencing would be put on either side of the tracks to keep animals and people off the system. Also, it should be noted that one of the arguments against the TGV technology being utilized is that it will be dated technology in twenty years. This may or may not be a valid argument, but either way, having an independent structure in place would allow for an easy transition to any technological advances such as magnetic levitation technology (McNamara 1993).

It has also been suggested that the original right-of-ways be used for building a new train system. Though wonderful conceptually, it is not possible with HSR. Due to the high speeds attained during travel, the trains require longer space for turning and less grade differential. In other words, they cannot turn too rapidly or have steep inclines or declines without compromising the safety of the system (McNamara 1993).

In the interest of cost-effectiveness concerning passenger terminals, existing Amtrak terminals would be utilized in four of the five cities (Austin, Dallas, Fort Worth, and San Antonio). All of these supplying passenger amenities comparable to airline terminals.

The main maintenance facility, as well as the train control center and administration facilities, would be located in Houston. Daily service and repair sites would also be located in Dallas and San Antonio. Maintenance-of-way capacities would be located at or near 50-mile intervals along the tracks.

The cost of construction for the HSR would be divided into three separate stages. Estimated cost in 1988 dollars with service dates included are presented below in Table 3-2:

Table 3.2 - Costs of Constructing HSR

Stage/Year	Rolling Stock	Construction	Right-of-Way
1 - 1998	$432,300,000	$1,509,730,000	$80,735,000
2 - 2003	362,900,000	1,009,890,000	38,650,000
3 - 2008	341,700,000	660,686,000	16,000,000
Total	$4,392,600,000	$2,022,774,000	$1,411,440,000

Source: Texas Turnpike Authority. 1989.

Taking these figures into consideration, a likely course of action would be a combination of public and private sources for funding. In almost every scenario described previously in Chapter 2, the funding for HSR has come directly from the respective government and/or from private interests in a consortium scenario.

Financial Backing for Implementation

Following a phased approach for the financing of the project, it has been recommended that the following approach be utilized:

1. *Public Sector* - Participation with tax-exempt revenue bond financing (under the Technical and Miscellaneous Revenue Act of 1988) would provide the majority of capital needed for construction. Current plans involve three types of notes: (a) short-term bonds which will cover construction costs and mature shortly after construction is completed, (b) long-term bonds which will cover the maturation of other notes and also the costs of operation, and (c) a bond will be used for a 1.25 times debt service coverage. Initial advances for each stage are also required by state and local governments for engineering and pre-construction costs. The advances for the first phase would total one hundred million dollars, for the second stage fifteen million dollars, and no advancement would be necessary for the third stage. These bonds will be repaid from excess revenue, once the system is in place and running.

2. *Public/private Sector* - Passenger stations are assumed to be financed by ventures involving either and/or private developers and local governments (Estimated cost of stations in Stage 1 was 35 million 1988 dollars) (TTA 1989, 14).

A major concern addressed by the public is that the burden of funding the project will eventually be assumed by the taxpayer. Since the initiation of this proposal, there have been scoping meetings held throughout the state to get public feedback on this issue. Though there are several reasons that rural citizens do not support this project, the primary reason noted through these meetings was the fact that the project wouldn't be economically feasible and that the taxpayer would ultimately assume responsibility for the system (McNamara 1993). This concern has been a major sticking point for the Texas TGV. The Texas High Speed Rail Authority has guaranteed that no state tax dollars will be used. This includes the event of forfeit or abandonment (Guerrero 1992, 1). The nuances of this argument will be addressed further in Chapter 5.

Routes

The proposed routes for the Texas High Speed Rail consist of rails between the cities of Fort Worth, Dallas, Austin, San Antonio, and Houston. There will be terminals located at Fort Worth, Dallas/Fort Worth Airport, Dallas Austin, San Antonio, and Houston. There have been meetings, however, to provide service to Waco and Bryan College Station. It has also been proposed that the wishbone junction of the Dallas to Houston and Dallas to Austin alignments be moved to a point just outside of Waco called the "Waco Wishbone". The proposed terminal in Waco is at the James Connally Airport. One other proposed route is a rail between Austin and San Antonio to Houston, thus completing a triangle system (see Map 3.1). The final decision on routing was made in 1993 and is discussed in the following section where times and schedules have been delineated as well.

Corporation Preferred Alignment and Stations

In late 1993, the Texas TGV Corporation decided on a Corporation Preferred Alignment (CPA) which included stops in Waco and Bryan College Station (see Map 3.2). The preferred alignment includes service to Dallas-Fort Worth (DFW) Airport with on-line connections to American Airlines. The HSR service would substitute for American Airlines flights between the Texas Triangle cities and DFW airport. The CPA would include two HSR stations in Houston. One station would be located downtown just north of the rail yards near the intersection of I-10/US90 and I-45 and the second would be a suburban station located at the junction of US 290 between the Sam Houston Toll Road and FM 1960. In the Dallas-Fort Worth area, there would be a total of three stations. One would be located in downtown Dallas at the intersection of I-35E and the Dallas Central Expressway spur. The second downtown station would be located at the T & P Tower between Vickery and I-30 in Fort Worth. The third

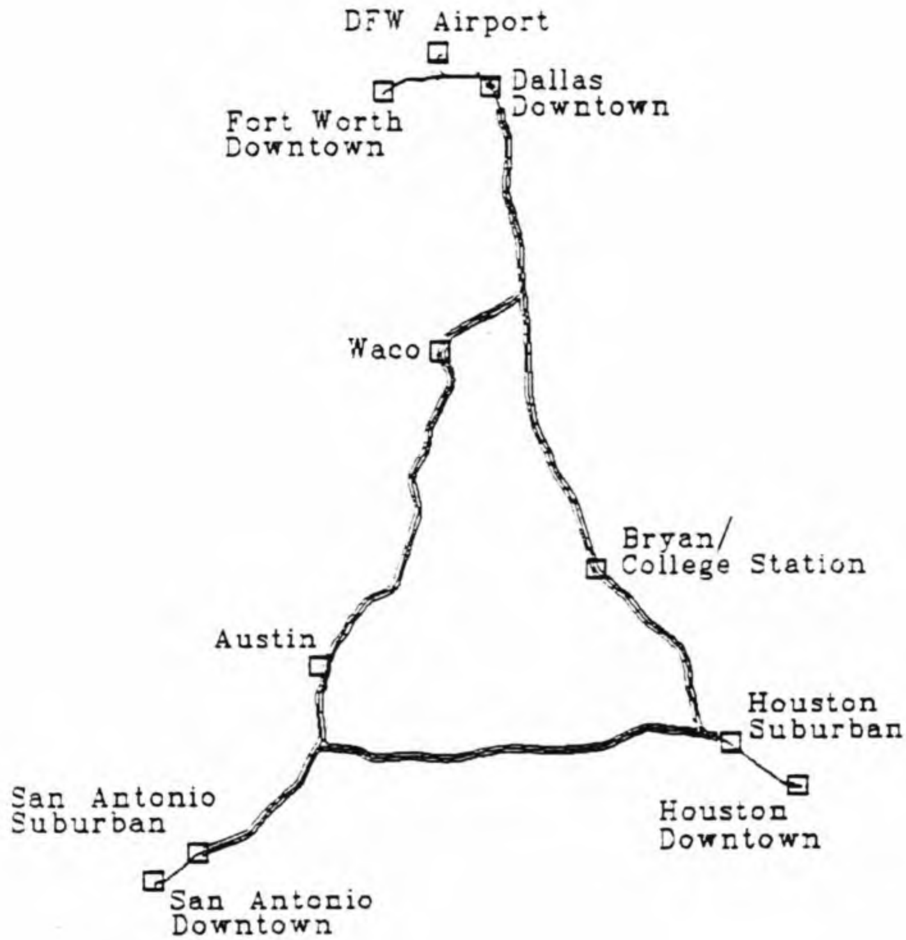


Figure 3.1 - Map of Originally Proposed High Speed Rail Route

Source: CRA 1993

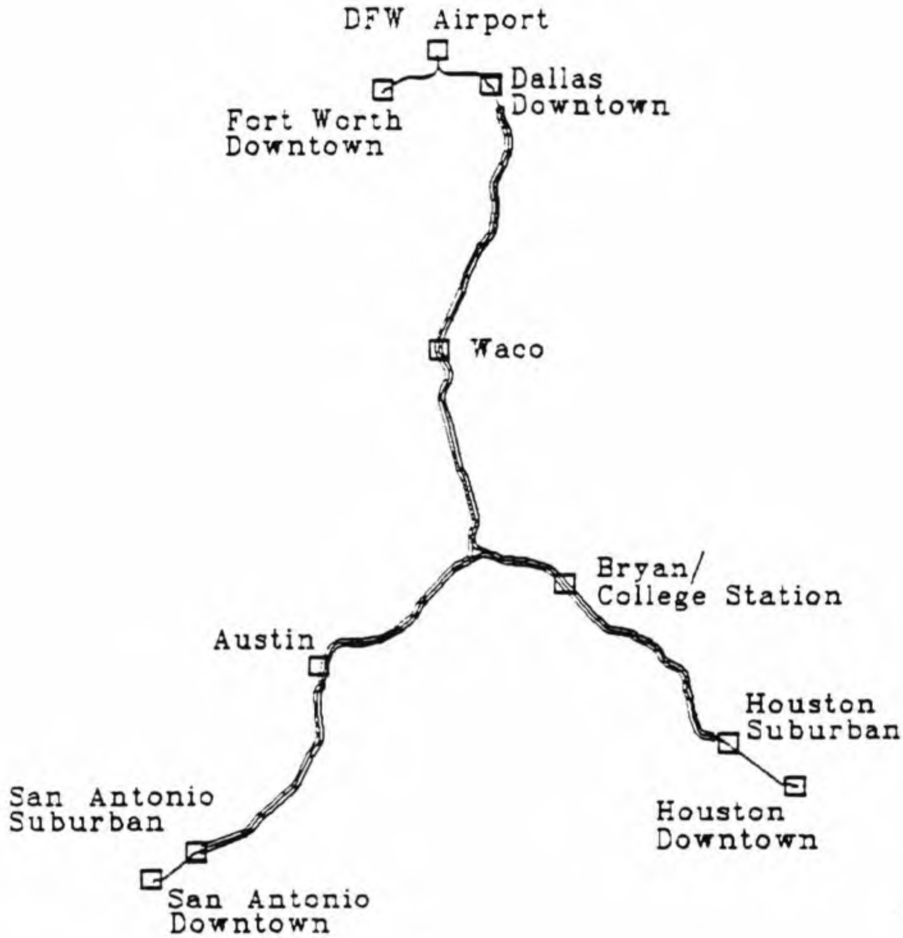


Figure 3.2 - Map of Corporation Preferred Alignment for High Speed Rail

Source: CRA 1993

station would be directly connected to DFW airport (CRA 1993, 1.4).

There would also be two HSR stations in the San Antonio area. One would be located on the east side of downtown on the Southern Pacific tracks between East Commerce and Glorietta Streets and the suburban station would be located near Randolph Air Force Base at the intersection of Loop 1604 and Route 78. The Austin station would be located 5 miles east of downtown and about one-half of a mile from US183 on the Austin and Northwest railroad line. The Bryan/College Station stop would be located southwest of College Station on Highway 60, approximately 4.5 miles from the central business district. In Waco, the stop would be located 6 miles north of the central business district along Route 340 (CRA 1993, 1.4).

Schedules

The Texas TGV Corporation plans on running the HSR 34 times a day in each direction among the major city groups. The only deviation from this are from Houston to Austin and San Antonio which would only run 10 departures each way per day. The Waco and College Station stops would be served up to eight times per day. The projected travel times are indicated in Table 3.2.

Because of the short distance involved between Fort Worth and Dallas, the trains would only operate at 60 miles per hour. When

Table 3.3 - Proposed Schedules for Texas TGV HSR

City Pair	Travel Time
Austin-Houston	1 hour and 14 minutes
Dallas-San Antonio	1 hour and 58 minutes
Houston-Dallas	1 hour and 41 minutes
Fort Worth-Houston	2 hours and 22 minutes
DFW-Austin	1 hour and 28 minutes
Austin-San Antonio	42 minutes

Source: CRA 1993

trains are entering or leaving terminal cities, a maximum speed of only 60 miles per hour will be attained. However, through the rest of the system, trains will run at a maximum speed of 185 miles per hour (THSRA 1992, 9).

Conclusion

In conclusion, if there is going to be a HSR system built in Texas it should be built as an independent system. Such a system would be more cost-effective and safer than upgrading existing track. This is due to the construction following a more direct route and the fact that there will be no grade crossings. Furthermore, the financing should encompass a private and public backing that would be phased in through the three phases of construction. Also, the system will have a rigorous preventative maintenance and safety schedule that will ensure passenger safety and comfort. Now that the Texas TGV has decided on a preferred route, the obvious next step is to build the system. Further questions regarding this technology and system format will be addressed in Chapter 5.

Chapter 4
Economic Impact of HSR in Texas

There are two major studies that have been undertaken to analyze the potential economic impacts of the HSR system in Texas. The first is , "Economic Impact Of The Proposed Texas High Speed Rail Project On Business Activity" which was produced by the Perryman Consultant firm here in Waco, Texas. This analysis is based on a 1990 German proposal to build a HSR system here in Texas. The route is virtually the same as the Texas TGV's current corporation-preferred route proposal. The only major difference is the technology that would be used, which is comparable in price and performance to the TGV technology. It should be noted that this study assumes that the Texas High Speed Rail Joint Venture (THSRJV) is committed to maximizing economic activity in Texas. The second major economic report generated is a ridership study produced by the Charles Water Associates (CRA) of Massachusetts. This study is based on the current Texas TGV proposal and is considered to be one of the most in-depth and realistic ridership studies of its kind. This chapter will examine the economic effects associated with construction, operations and maintenance, ridership and induced spending, and economic development of a HSR proposal. The CRA ridership study will project ridership derived from existing mass transportation modes and induced ridership figures.

Construction

The Perryman study includes an in-depth analysis of a variety of factors associated with the construction of HSR in Texas. This section of the analysis will take a look at a number of variables which include (1) Aggregate Expenditures within the study area (1990 dollars), (2) Nominal Gross Area Product, (3) Employment, (4) Nominal Personal Income, and (5) Nominal Wage and Salaries. These variables are those used in the study and hence are the ones specifically addressed in this analysis. The results include such factors as direct and indirect effects of the project and the payrolls associated with induced consumption from the project. Real estate will not be taken into account for this particular analysis due to the fact that construction will take place at a relatively quick place and workers are expected to commute. However, it should be noted that these factors will be included in the long-term impacts associated with the construction of this project (Perryman 1990, 5). The analysis covers the three proposed phases of construction for this project.

Phase One

The first phase of construction in this proposal connects Dallas/Fort Worth with the DFW airport, then continues on to Houston via Waco and Bryan/College Station (See Map 3.2). The total cost for constructing this phase is estimated at $3.4 billion. Including rolling stock, nearly 75% of the direct purchases needed for this phase will be in Texas. The estimated direct, indirect, and induced economic impact of Phase One includes $7.2 billion in total expenditures in the state, or $5.7 billion in constant 1982 dollars. This level of spending would result in a stimulation to the Gross State Product of $3.9 billion. Using these figures, personal income would increase by $2.6 billion, with wages and salary incomes increasing by $1.8 billion. Throughout the construction of phase one, 103,487 total person years of employment would be created. Obviously, these figures would be concentrated in the areas in which the construction took place. McLennan County would expect to see an expenditure of $870 million, an increase in Gross Area Product of $453 million, $400 million in Personal Income, $223.9 million in Wage and Salary Income, and 14,067 Employment or Person Years (see Table 4.1).

Phase Two

Phase Two of this construction would take place between Waco and Austin and San Antonio. This construction would generate $3.7 billion in total state expenditures. The Gross State Product would increase by $2.0 billion, and Personal Income would rise by $1.4 billion. There would be an increase of 57,933 person-years of Employment and a Wage and Salary Income of $0.93 billion. These figures would be concentrated in the construction areas, as previously noted. For this section of construction, McLennan County

Table 4.1 - Economic Impact Of The Construction Of Phase One Of The Proposed High Speed Rail System (1990 dollars)

County	Expenditures (Millions)	Gross Area Product (Millions)	Personal Income (Millions)	Wage and Salary Income (Millions)	Employment (Person-Years)
Harris	$1,196.0	$648.0	$404.0	$326.1	14,451
Waller	171.3	90.8	61.5	39.9	2,578
Grimes	256.0	131.8	96.6	66.4	4,550
Brazos	815.1	446.7	290.8	212.0	13,495
Robertson	619.1	335.8	231.4	157.4	10,696
Falls	501.7	287.6	178.9	110.4	7,946
McLennan	870.0	453.0	400.0	223.9	14,067
Hill	463.4	262.8	170.1	99.6	6,829
Ellis	727.4	366.7	264.9	159.5	10,859
Dallas/Tarrant	1,533.9	823.4	527.8	394.0	18,016
Totals	$7,153.9	$3,846.6	$2,626.0	$1,789.0	103,487

Source: Perryman 1990

would see an increase in Expenditures of $3.9 million, in Gross Area Product of $206.1 million, in Personal Income of $140.9 million, in Wage and Salary Income of $102 million, and in Employment of 6,412 person years (see Table 4.2).

Phase Three

The final phase of construction involves linking Houston with

Table 4.2 - Economic Impact Of The Construction Of Phase Two Of The Proposed Texas High Speed Rail System (1990 dollars)

County	Expenditures (Millions)	Gross Area Product (Millions)	Personal Income (Millions)	Wage and Salary Income(Millions)	Employment (Person-Years)
Bexar	$458.3	$248.6	$159.3	$123.3	6,806
Comal	55.7	29.3	20.4	11.9	769
Guadalupe	575.7	289.5	209.5	138.3	9,353
Caldwell	397.6	217.3	148.7	75.6	6,216
Travis	669.3	371.6	241.6	184.2	9,515
Williamson	438.3	224.7	159.8	100.0	6,312
Bell	568.2	310.5	207.2	155.5	9,672
Falls	182.1	104.4	64.8	40.2	2,878
McLennan	393.7	206.1	140.9	102.0	6,412
Totals	$3,738.9	$2,002.0	$1,352.2	$930.9	57,933

Source: Perryman 1990

Austin and San Antonio. As of the preparation of this analysis, there was not enough detail to adequately address the economic impact of the construction of this leg. However, the reader can deduce from the previous two sections of construction that the corridor area would expect to see a significant increase in overall economic Expenditure, Gross State Product, Personal Income, Wage and Salary Income, and person years of Employment.

If the economic impact figures for the first two phases of construction are consolidated, it can be determined that the state of Texas and areas directly associated with the construction phase would benefit by: (1) $10.893 billion in total Expenditures across all industrial categories, (2) $5.849 billion in total Output or Real Gross State Product, (3) $3.978 billion in Personal Income, (4) $2.720 billion in Wage and Salary Income, and (5) 161,420 person-years of Employment (Tables 4.1 & 4.2).

The sectors that would benefit directly from the construction phase include the new construction sector, business services, fabricated materials, electric and electronic equipment, transportation, real estate, and wholesale and retail trade. The Perryman Consultant's model analyzed the effects on about 700 types of workers in the state and found that many of them would benefit from such a project. Specifically, jobs related to construction trades and engineering services would benefit the most. One factor that wasn't incorporated into the analysis, but will certainly have an impact on the state of Texas, is the construction of the train sets themselves. Though much of the manufacturing for this proposal would take place in Germany, the cars wouldn't be shipped to the United States as finished products. A certain amount of economic activity would result from the finishing work occurring here in Texas. Furthermore, as there are many other HSR proposals in the works, Texas could become the focal point for development of the train sets in the United States. One other point that deserves brief attention is that this project could potentially be the first of its' kind in the United States, thus setting the precedent for similar projects in other areas in the future. Texas companies that were involved in this project would certainly be sought out as 'experts' in the field when other projects of a similar nature come to fruition (Perryman 1990, 5-7).

Operation and Maintenance

Many of the benefits that Texas will derive from such a project will be from an enhanced efficiency and competitiveness due to an effective transportation system within the state. This factor will be more specifically analyzed in the Economic Development section of this chapter. It is expected that the operation and maintenance of a HSR system will bring in significant economic gain. The Perryman report estimates that Texas could expect to gain around $102.1 million in direct expenditures from operation and maintenance of the proposed HSR system once it has reached full operational capacity and maturity. Table 4.3 identifies the specific geographic distribution of funds associated with the operation and maintenance of the system. Waco, as an example, would expect to see an increase of $41.2 million in Expenditures, of $23.6 million in Gross Area Product, of $16.4 million in Personal Income, of $10.6 million in Wage and Salary Income, and of 666 person years of Employment. As evidenced in Table 4.3, Texas would expect to see a much greater increase in all of these categories (Perryman 1990, 9). In the current 1993 Texas TGV proposal, the maintenance station would be located in Waco. So, all of the figures associated with operation and maintenance of the system would increase for this area due to that fact.

Table 4.3 - Economic Impact Of The Operation And Maintenance Of The Proposed High Speed Rail (1990 dollars)

Area	Expenditures (Millions)	Gross Area Product (Millions)	Personal Income (Millions)	Wage and Salary Income (Millions)	Employment (Permanent Jobs)
Dallas/Fort Worth	$119.9	$66.5	$40.4	$30.9	1,488
Houston	57.4	32.9	18.7	14.8	695
Bryan/CollegeStation	19.4	11.6	7.7	4.9	312
Waco	41.2	23.6	16.4	10.6	666
Austin	30.7	18.4	11.9	8.0	448
San Antonio	20.4	11.1	6.7	5.3	305
Total	$289.2	$164.1	$101.8	$74.4	3,915

Source: Perryman 1990

Ridership and Induced Spending

It is assumed that a HSR system would not only capture some of the travel market that already exists, but that it would induce trips through its novelty, efficiency, and effectiveness. Ultimately, this facility would lead to an overall increase in travel throughout the state. The CRA have prepared a ridership analysis for this German proposal. They estimate that a total of 202,434 trips will be induced with introduction of this HSR in 1998, which is when the first phase of construction would have been completed. It is also expected that these trips would generate $11.6 million in direct fares and other expenditures at the rail facilities, such as concessions. Also, it is estimated that the HSR would result in an additional $9.6 million being spent in the corridor cities. CRA estimates that by 2015, the matured system would generate 681,287 induced trips after both phases of construction. This level of use would result in a total induced ridership revenue of $38.5 million and an associated direct spending of the travelers of an additional $32.2 million (Table 4.4).

It is important to acknowledge the assumptions made in producing these figures. First, this level of ridership activity is assumed to be comprised by 80% of additional day trips in the corridor and 20% of overnight stays or extensions by one night. These travelers are expected to spend their money based on surveys and models of the National Travel Data Center. These values were merged into the Texas Multi-Regional Impact Assessment System (TMRIAS) in order to create a tourism figure for the corridor. It is further assumed that persons traveling on business would spend $75 per day trip and $250 per overnight trip. Other travelers were assumed to spend around $50 per day trip and $150 per overnight trip. Second, that the induced trips followed the same distribution of business and non-business riders as the overall pattern projected by

Table 4.4 - Economic Impact Of The Induced Ridership And Related Travel Spending Of The Proposed Texas High Speed Rail System (1990 dollars)

Area	Expenditures (Millions)	Gross Area Product (Millions	Personal Income (Millions)	Wage and Salary Income (Millions)	Employment (Permanent Jobs)
Dallas/Fort Worth	$94.9	$57.0	$33.2	$26.8	1,370
Houston	71.2	43.7	24.3	19.7	1,058
Bryan/College Stat.	0.8	0.5	0.3	0.2	13
Waco	1.5	1.1	0.6	0.4	25
Austin	22.6	13.8	8.2	6.4	397
San Antonio	23.4	14.1	8.3	6.7	399
Total	$214.7	$130.2	$74.9	$60.1	3,263

Source: Perryman 1990

CRA. The third assumption was that each passenger was responsible for a roundtrip. The direct, indirect, and induced economic ramifications of these trips was then plugged into the TMRIAS by Perryman Consultants and broken down into regional forecasts (see Table 4.4). The industries that are projected by Perryman to benefit most from this economic stimulus are transportation, maintenance and repair construction, miscellaneous services, retail trade, real estate, food and kindred products, and restaurants and bars. The industries that would experience the highest growth opportunities would be the transportation service and construction job categories.

Due to the increases in revenue, stemming from operations and maintenance, induced ridership, and direct and indirect expenditures, the local area tax bases are projected to increase. The study provides estimates as to how much these bases will increase. In doing such projections, several assumptions had to be made: (1) for each new direct or indirect jobs, there will be one additional household created, (2) for each four induced jobs, there will be one new household created, (3) average household size among the newly created households will be 2.5 persons, (4) the average price per new housing unit is $60,000, and (5) the demand for new office space and industrial space may be estimated by (a) translating job growth by industry into job growth by occupation and (b) using information compiled by the National Association of Industry and Office Parks to translate job growth by occupation in various industries into demands for space in office and industrial buildings. Furthermore, they made the assumptions that: (1) valuation of new property is $25 per square foot of industrial space and $50 per square foot of office space, (2) an additional square foot of retail space is needed for each additional $250 in sales (1990 dollars), (3) the valuation of new retail space is postulated at $40 per square foot, (4) hotel and motel space is expanded at the rate of one room for each $22,500 in revenue, (5) the valuation per hotel room is $75,000, and (6) the hotel-motel occupancy tax rates for each city are to remain in effect, as are local sales tax rates (Perryman 1990, 12).

Based on these assumptions, it has been determined through analysis that the direct, indirect, and induced economic activity resulting from the operation of a HSR system in Texas would generate a total of $317.2 million in new property development beyond that generated through maintenance facilities and railway stations. Further, it is estimated that it would also generate $97.8 million in retail sales, of which 60% is represented by taxable items. Another item to be considered is the annual tax revenues generated through local property taxation, sales tax collections, and hotel-motel occupancy, which should reach approximately $6.72 million. Waco could expect about $0.281 million of that sum (Perryman 1990, 13).

Economic Development

Any project of this nature is going to generate a substantial amount of economic activity. Quantifying that activity is not an easy task. Luckily, Perryman Consultants are the leading experts in this arena for the state of Texas. It should be noted that for this study and the German proposal in general, it has been stated by the THSRJV that they are interested in establishing and maintaining a solid relationship with all business communities in the state. This study takes that into consideration while still maintaining conservative estimates.

To refresh the reader's memory, it should be restated that the Perryman study makes two basic assumptions in determining economic development forecasts. First, that the HSR will make the overall efficiency of commerce within the study area increase. Second, that there are definable industries which will benefit most from this new form of transportation. The firm had to determine what the potential trade flows were for each city in the corridor. So, they had to calculate the export capacity of all the cities in the corridor for over 500 goods and services, and then calculate the net import requirements of each urban area for each of the previously mentioned goods and services. By analyzing these two aspects of each city in the corridor, Perryman has been able to evaluate the potential for trade within the area (Perryman 1990, 17-18).

There are two scenarios that the study took into account, which has been previously described in the methodology section. The Low-Case scenario utilizes a 1.0% stimulation of trade within the triangle area which is trade that would not have taken place without the HSR system in place. It also utilizes a 3.0% capture rate on exports and imports from beyond the region which can be thought of as an increase in net trade flow captured due to the greater efficiency achieved by a HSR system (Table 4.5). As Table 4.5 clearly indicates, even in a conservative setting, the state and each individual city will receive substantial economic gains from the existence of an HSR system. The state of Texas would see a direct infusion of around $1.8 billion on an annual basis. Direct, indirect, and induced spending would result in a total of $4.7 billion annually in Total Expenditures, $2.5 billion in Gross State Product, $1.4 billion in Personal Income, $1.1 billion in overall Wages and Salaries, and 54,912 new permanent jobs to the state. The gains in employment and production would run the entire spectrum of industry and occupational categories. The total annual fiscal stimulus to local governments from this scenario would increase by $42.9 million (Table 4.6). The Waco area would expect to see an increase in Property Taxes of $656,500, $62,900 in Occupancy Taxes, $112,200 in Sales Tax, and $831,600 thousand overall. Anyway you look at it, even the Low Case scenario provides substantial income for the state and specifically for Waco (Perryman, 1990, 19).

Table 4.5 - Local Fiscal Stimulus Of The Economic Development Potential Of The Proposed Texas High Speed Rail System Under A Low Case Scenario (1990 dollars)

Area	Property Tax (Thousands)	Occupancy Tax (Thousands)	Sales Tax (Thousands)	Total (Thousands)
Dallas/Fort Worth	$13,695.4	$1,821.8	$2,836.5	$18,353.7
Houston	10,209.1	1,446.0	1,871.4	13,526.5
Austin	3,132.9	426.5	537.7	4,097.1
San Antonio	4,201.6	556.8	718.7	5,477.1
Waco	656.5	62.9	112.2	831.6
Bryan/College Station	515.6	56.0	84.4	656.0
Total	$32,411.0	$4,370.1	$6,160.9	$42,942.0

Source: Perryman 1990

Table 4.6 - The Geographic Distribution Of Potential Economic Development Impact Of The Proposed Texas High Speed Rail System Under A Low Case Scenario

Area	1% Internal Trade Flow	3% External Value Capture	Total
Dallas/Fort Worth			
Expenditures	$7.88.8	$1,298.6	$2,087.4
Gross Area Product	388.4	756.2	1,144.7
Personal Income	199.7	453.6	653.3
Wage and Salary Income	157.0	369.4	526.4
Employment	7,741	16,474	24,214
Waco			
Expenditures	19.2	51.1	70.4
Gross Area Product	9.5	27.9	37.4
Personal Income	4.9	18.4	23.3
Wage and Salary Income	3.8	13.9	17.7
Employment	189	865	1,054
Bryan College Station			
Expenditures	11.4	39.7	51.1
Gross Area Product	5.6	23.5	29.1
Personal Income	2.9	14.3	17.2
Wage and Salary Income	2.3	10.8	13.0
Employment	112	654	766
Houston			
Expenditures	687.5	684.5	1,372.0
Gross Area Product	338.5	400.1	738.6
Personal Income	174.1	236.6	410.6
Wage and Salary Income	136.8	186..8	323.6
Employment	6,747	8,731	15,478
Austin			
Expenditures	109.2	290.0	399.2
Gross Area Product	53.8	162.0	215.7
Personal Income	27.6	98.8	126.4
Wage and Salary Income	21.7	78.9	100.7
Employment	1,072	3,952	5,024
San Antonio			
Expenditures	148.9	322.1	471.0
Gross Area Product	73.3	185.7	259.0
Personal Income	37.7	113.0	150.7
Wage and Salary Income	29.6	90.1	119.8
Employment	1,461	4,999	6,451
Rest of Texas			
Expenditures	196.1	n/a	196.1
Gross Area Product	96.6	n/a	96.6
Personal Income	49.7	n/a	49.7
Wage and Salary Income	39.0	n/a	39.0
Employment	1,925	n/a	1,925
Total			
Expenditures	1,961.3	2,686.0	4,647.2
Gross Area Product	965.8	1,555.4	2,521.1
Personal Income	496.5	934.7	1,431.2
Wage and Salary Income	390.2	750.0	1,140.2
Employment	19,246	35,666	54,912

Source: Perryman 1990

The Base Case scenario of expansion within the state utilizes a 3.0% stimulus to the potential net trade flow internally and a 7.0% expansion of the potential external trade capacity. This scenario is based on a more optimistic setting. With these figures being utilized, the state would receive a direct annual stimulus of $4.2 billion, which includes an increase of $12.2 billion in direct, indirect, and induced expenditures. Further, the state would be expected to receive $6.6 billion in Gross State Product, $3.7 billion in Personal Income, $2.9 billion in Wage and Salary Income, and 140,958 permanent jobs within the state (Table 4.7). It must be reiterated that even in this more aggressive Base Case scenario, these numbers only reflect a minute fraction of the potential economic activity associated with this HSR proposal.

It should be mentioned that there are other factors that must be addressed when projecting economic development. These include the need for additional commercial, industrial, retail, lodging, and residential space. Also, other activities that would benefit the state such as retail sales and hotel and motel occupancy which would both contribute to the tax base, should be taken into account. It has been estimated that some of the development would include 2.7 million square feet of office space, 30.3 million square feet of industrial space, 52,530 housing units, 6,273 lodging units, and 5.5 million square feet of new retail space. This activity would result in an additional $102.9 million in annual potential tax revenue for local

Table 4.7 - Local Fiscal Stimulus Of The Economic Development Potential Of The Proposed Texas High Speed Rail System Under A Base Case Scenario

Area	Property Tax (Thousands)	Occupancy Tax (Thousands)	Sales Tax (Thousands)	Total (Thousands)
Dallas/Fort Worth	$23,124.2	$4,591.9	$7,243.2	$43,959.3
Houston	24,388.7	3,713.5	4,934.2	33,036.4
Austin	7,154.8	1,042.3	1,333.6	9,530.7
San Antonio	9,749.9	1,363.6	1,799.9	12,913.4
Waco	1,515.2	155.1	277.7	1,948.0
Bryan/College Station	1,175.2	135.7	206.4	1,517.2
Total	$76,108.1	$11,002.0	$15,794.9	$102,905.0

Source: Perryman 1990

governments (Table 4.8). Under this scenario, Waco would expect to receive $1,515,200 in Property Tax annually, $155,100 in Occupancy Tax, $277,700 in Sales Tax, and $1,948,000 overall. As was the situation with the Low Case scenario, the impacts span a broad spectrum of industries and occupational categories. Table 4.9 provides a breakdown of the overall benefits that the state can expect from the development of a HSR. Through publicity and realized efficiency of a HSR system, it is quite possible that Texas will see a sustained period of major development and economic success. This is what the state needs, yet the government is apprehensive about using any public funding to back a project of this nature.

Table 4.8 - Geographic Distribution Of Potential Economic Development Impact Of The Proposed Texas High Speed Rail System Under A Base Case Scenario (1990 dollars)

Area	3% Internal Trade Flow	7% External Value Capture	Total
Dallas/Fort Worth			
Expenditures	$2,366.4	$3,030.0	$5,396.4
Gross Area Product	1,165.3	1,764.5	2,929.8
Personal Income	599.1	1,058.4	1,657.5
Wage and Salary income	470.9	862.0	1,332.9
Employment	23,222.0	38,438.0	61,666.0
Waco			
Expenditures	57.7	119.3	177.0
Gross Area Product	28.4	65.2	93.6
Personal Income	14.6	43.0	57.6
Wage and Salary Income	11.5	32.4	43.9
Employment	566	2018.0	2,584
Bryan/College Station			
Expenditures	34.3	92.6	126.9
Gross Area Product	16.9	54.8	71.7
Personal Income	8.7	33.4	42.1
Wage and Salary Income	6.8	25.1	31.9
Employment	337.0	1,526.0	1,863.0
Houston			
Expenditures	2,062.5	1,597.2	3,659.7
Gross Area Product	1,015.6	933.5	1,949.1
Personal Income	522.2	552.0	1,074.1
Wage and Salary Income	410.4	435.9	846.3
Employment	20,240.0	20,372.0	40,612.0
Austin			
Expenditures	327.6	676.6	1,004.3
Gross Area Product	161.3	377.9	539.2
Personal Income	82.9	230.5	313.5
Wage and Salary income	65.2	184.2	249.4
Employment	3,215.0	9,222.0	12,437.0
San Antonio			
Expenditures	446.8	751.5	1,198.3
Gross Area Product	220.0	433.2	653.2
Personal Income	113.1	263.7	376.8
Wage and Salary Income	88.9	210.3	299.2
Employment	4,384.0	11,643.0	16,027.0
Rest of Texas			
Expenditures	588.4	n/a	588.4
Gross Area Product	289.7	n/a	289.7
Personal Income	149.0	n/a	149.0
Wage and Salary Income	117.1	n/a	117.1
Employment	5,774.0	n/a	5,774.0
Total			
Expenditures	5,883.8	6,267.2	12,151.0
Gross Area Product	2,897.3	3,629.2	6,526.5
Personal Income	1,489.5	2,180.9	3,670.5
Wage and Salary Income	1,170.7	1,749.9	2,920.7
Employment	57,738.0	83,220.0	140,958.0

Note: Dollar values are in millions

Source: Perryman 1990

Table 4.9 - Synopsis Of The Potential Annual Economic Development Benefits Of The Proposed Texas High Speed Rail System Under Two Alternative Settings (1990 dollars)

EconomicIndicator	Low Case	Base Case
Expenditures (Millions)	$4,647.2	$12,151.0
Gross State Product (Millions)	2,521.1	6,526.5
Personal Income (Millions)	1,431.2	3,670.5
Wage and Salary Income (Millions)	1,140.2	2,920.7
Employment	54,912	140,958
Local Tax Revenue (Thousands)	42,942.0	102,905.0

Source: Perryman 1990

Charles River Associates
Ridership Study

In 1992, the Charles River Associates (CRA) were chosen by the THSRA to provide ridership forecasts on the proposed Texas TGV HSR. Specifically, they were assigned the task of collecting significant new data and information on current travel and modal preferences in the Texas Triangle, forecasting future travel in the absence of HSR service, and estimating HSR travel and passenger revenue for a variety of operating scenarios. The figures that were generated by CRA that are of the most interest are delineated in the following section and include forecasts for the total triangle and ridership forecasts by previous travel mode.

Forecasts for the Texas Triangle

The forecasts present HSR ridership and passenger revenue for five different scenarios. The only scenario which is of interest to this paper is Scenario 3, which includes stops in Waco and Bryan/College Station. For this scenario, it is assumed that the east leg (Dallas-Fort Worth/Houston) opens January 1; by the year 2000, the west leg (Dallas-Fort Worth/Austin/San Antonio) opens January 1; 2001, and the southern leg (Houston/Austin/San Antonio) opens January 1; 2003. Tables 4.10 and 4.11, and Figures 4.1 and 4.2, make forecasts for 16 years starting with the opening of the first leg in the year 2000. It also assumes 85 percent of full ridership potential for the first year, 95 percent the second year, and 100 percent the third year. This is based on ridership experience for the original French TGV Atlantic Line (CRA 1993, 7).

These tables and figures include ridership and passenger revenue from (1) diverted intercity air and auto travel for both business and nonbusiness purposes (assuming origins and destinations are within the triangle) (2) induced travel for business and nonbusiness purposes caused by introduction of HSR, (3) commuter travel between suburban and downtown stations in the Houston and San Antonio regions which are served by multiple HSR

Table 4.10 - Projected Annual Total HSR Ridership In The Texas Triangle (Millions)

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
2000	4.56	4.25	4.66	5.18	3.14
2001	9.48	9.14	9.65	11.03	6.69
2002	10.50	10.12	10.68	12.22	7.40
2003	12.19	11.65	12.25	14.01	8.93
2004	12.59	12.02	12.65	14.46	9.25
2005	12.93	12.35	12.99	14.85	9.51
2006	13.20	12.60	13.26	15.16	9.69
2007	13.47	12.86	13.53	15.48	9.88
2008	13.74	13.12	13.81	15.79	10.06
2009	14.01	13.38	14.08	16.11	10.24
2010	14.28	13.64	14.35	16.42	10.43
2011	14.55	13.90	14.63	16.74	10.61
2012	14.82	14.16	14.90	17.05	10.79
2013	15.09	14.42	15.18	17.36	10.98
2014	15.36	14.68	14.45	17.68	11.16
2015	15.63	14.93	15.72	17.99	11.34

Source: CRA 1993

stations. For Scenario 3, there are several other assumptions included due to stops in Waco and Bryan/College Station, and the on-line service with American Airlines at DFW. These account for

Table 4.11 - Projected Annual Total HSR Revenue In The Texas Triangle (1991 dollars - millions)

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
2000	193.39	176.88	190.43	222.60	146.37
2001	405.56	386.17	402.91	474.88	303.97
2002	448.95	427.79	445.94	526.29	335.98
2003	538.82	507.68	527.27	620.42	419.94
2004	558.42	525.59	545.77	642.12	436.53
2005	574.12	540.15	560.88	659.92	449.22
2006	585.73	551.16	572.38	673.63	457.82
2007	597.34	562.17	583.89	687.33	466.42
2008	608.95	573.17	595.39	701.04	475.02
2009	620.56	584.18	606.89	714.75	483.62
2010	632.17	595.19	618.39	728.46	492.22
2011	643.78	606.20	629.89	742.17	500.82
2012	655.39	617.21	641.39	755.87	509.42
2013	667.00	628.21	652.89	769.58	518.02
2014	678.61	639.22	664.39	783.29	526.62
2015	690.22	650.23	675.89	797.00	535.21

Source: CRA 1993

additional travel market segments and include, (1) diverted air travel by airline passengers connecting at DFW Airport to other cities in the triangle, (2) American Airlines passengers connecting to/from Houston, Austin, and San Antonio, (3) airport access travel between downtown Dallas, downtown Fort Worth and, (4) diverted air and auto travel for business and nonbusiness purposes between Waco, Bryan/College Station, and the four major regions in the triangle. It should be noted that diverted passengers from buses and Amtrak are not included due to their relatively small numbers in comparison to auto and air travel within the triangle (CRA 1993, 10-12).

The purpose in presenting these tables and figures is not to compare the various scenarios in the CRA Ridership Study, but rather to show that a credible consulting firm has projected a ridership exceeding 15 million people and revenues exceeding $675 million annually if the proposed TGV project were constructed. These figures were projected conservatively and even if they were a little on the optimistic side, Texas would still benefit greatly from the generated revenue of such a mass transportation system.

Ridership Forecasts by Previous Travel Mode

This section of the ridership study is perhaps the most illuminating. Table 4.12 delineates current travel by previous mode including induced demand. It does not take into account local area travel. The largest diversion of travelers occurs in the local air travelers column. This was to be expected as this is the trend in almost all of the ridership studies that have been prepared to date, both before and after the new transportation mode has been introduced. Under Scenario 3, it is projected that the HSR system will both before and after the new transportation mode has been introduced. Under Scenario 3, it is projected that the HSR system will

Table 4.12 - Year 2010 Intercity HSR Passengers By Previous Mode (millions)

	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**
Local Air					
Percent diverted	65	60	60	72	61
Ridership	5.48	5.11	5.08	6.09	5.19
Connect Air					
Percent diverted	54	51	52	83	n/a
Ridership	2.80	2.67	2.87	4.30	n/a
Auto					
Percent diverted	11	11	9	11	11
Ridership	3.42	3.37	3.91	3.42	3.42
None					
Percent induced	9	8	8	8	12
Ridership	1.01	0.92	0.93	1.04	1.02
Total					
Percent diverted	26	25	21	31	22
Ridership	12.71	12.07	12.78	14.85	9.63

Source: CRA 1993

divert 60 percent of local area air travel and 52 percent of connect travel. Obviously, the lower numbers in diverted auto trips in Scenario 3 are due to the larger number of relatively short intercity as trips of over 200 miles. This table also delineates induced travel, which is entirely new trips that are taken because of HSR and the ease of travel via other modes due to HSR. It is obvious from these figures and those previously denoted, that HSR has the ability to enhance travel throughout Texas. Under Scenario 3, it is estimated that 21 percent of all trips will be diverted to HSR. This is a huge impact on travel for any new transportation system. Furthermore, Texas would expect to experience less air pollution and energy consumption, and it will ultimately decrease airport and highway congestion (CRA 1993, 17-21).

Conclusion

It simply makes good business sense to undertake a project that will do nothing but bring money and a more efficient and effective transportation system to the state. As the figures clearly indicate in the Perryman Study, even the conservative estimates show that Texas has an opportunity to be the front runners for HSR in the United States and would enjoy great economic gain in the process. It should be noted that this study limits its forecasts to the overall impact of the actual construction and operation of the HSR system, but does not attempt to provide information regarding financial feasibility or other more technical aspects of this undertaking. The CRA Ridership Study provides astounding figures regarding induced travel and diversion from current modes of transportation, all of which ultimately benefits both Texas and the environment. These diverted travelers to the HSR system would help to alleviate congestion on our state's highways and airports.

Chapter 5

A Critical Evaluation of High Speed Rail As a Future Transportation Mass Transportation Alternative

In any project which encompasses a broad spectrum of industries and people involved such as a proposed HSR, there will be much controversy. In the case of introducing a HSR to a state such as Texas, some of the issues involved include government subsidization, land acquisition, foreign investment, and environmental concerns. This chapter will explain some of the details involved for each of these issues and attempt to put them into an objective perspective.

Subsidies

Throughout the history of our country just about every form of transportation has received some form of subsidization. This includes our nation's highways and automobiles, airlines and airports, and to a lesser extent, the current Amtrak system. There is a strong vocal minority that oppose any form of government subsidization for a HSR system. The following will analyze current subsidies and the benefits derived from them versus potential subsidization of a HSR system.

Highways

Without doubt, the highway infrastructure in the United States is one of the most heavily subsidized industries in the world, especially if you factor in the subsidizes associated with the automobile industry. In 1806, the American federal government began work on the National Pike, which extended 131 miles from Cumberland, Maryland to Wheeling, West Virginia. After this initial construction, the government decided that states and local communities should pay for building such roads. To aid each of the states in this endeavor, they charged tolls which were then invested in securities of the private companies that built the roads. Around the same time, railroads were building lines to criss-cross the country as well, thus alleviating any immediate need for federal subsidization in the construction of highways.

It was with the coming of the auto age that federal interest in developing highways started to take hold. The first transcontinental highway, the Lincoln Highway, was built in 1913. By 1916, federal funds started to flow to states through the Rural Post Roads Act which required states to establish highway departments. Basically, this legislation mandated that the federal government pay for 50 percent of road construction, as long as the roads were going to be used to aid in delivery of mail. At this time, there were only about 4 million privately owned autos and less than one-tenth of the roads were paved. Through the 1950's, development continued and increased via $1.5 billion in funding which had been granted by the

Federal Highway Act of 1944. President Roosevelt had proposed the Interstate Highway program in 1939, though Eisenhower gets the credit for the program because he authorized construction of a national interstate highway system in 1944. By 1947, both federal and state governments had agreed on a system that would encompass 37,000 miles of highway. However, funds were only available to states on a matching 50-50 basis, thus the system was built slowly. The federal government increased their percentage of support to 60 percent and still, less than one percent of the proposed system was built by 1952. The state governments made it clear that they were not going to foot the bill for a national interstate system. Actually, the government had set a poor example in 1938 when President Roosevelt authorized a grant of $29.25 million, with no repayment necessary, to the state of Pennsylvania to build an interstate toll road. Furthermore, he let the federal government purchase $40.8 million in bonds, which were also to aid the state in the construction of the interstate. So as it turns out, President Eisenhower offered to raise the majority of the $40 billion that was going to be needed to pay for the construction of a national interstate system, which set in motion construction of what became known as the "National Interstate and Defense Highway System." This set off the largest road construction effort ever undertaken in the world. These highways, which were considered to be 'limited access' due to the tolls, were planned to connect 90 percent of all cities with populations of more than 50,000 people and carry 20 percent of the nation's traffic (Vranich 1991, 349-352).

Through this initiative, the federal government paid 90 percent and the state governments matched the remaining 10 percent. Ironically, this money was not intended to build the highways to the individual cities, but to go around them. Many cities had side-stepped this intention by planning systems that ran directly into their respective downtown areas, thus spending federal matching funds on costly urban mileage versus less expensive rural highway development. By the time the federal government figured out how the matching funds were being spent, it was too late to halt the construction. After realizing his blunder, Eisenhower attempted to put a halt to the money being spent on highways entering the individual cities, only to find out that it was too late. In actuality, Eisenhower wanted a subway system built for Washington D.C., not the highway that eventually was built in its place (Ambrose 1991, 352).

These precedents show concisely the path of subsidization of our nations highways and it has only intensified. The Congressional Budget Office released a report detailing that, through the various levels of local, state, and federal governments, nearly $1 trillion has been spent on our nation's roads (1982 dollars). This includes nearly $400 billion from federal funds and approximately $600 billion from state and local governments. As of today, many of our nation's roadways, bridges, and signals need repairing or replacement which could cost taxpayers almost $3.2 trillion -- which is the equivalent of our entire gross national product and is well over our current national debt. An obvious concern has been the sources of funding.

The monies are essentially coming from the federal tax base. There exists a Highway Trust Fund that supposedly pays for all of our roads. However, most analysts disagree that it is capable of paying even a small percentage of the money actually spent on maintenance and construction of our roadways. In 1989, all of the various levels of government spent over $71.2 billion on highways alone. Of this amount, $44.3 billion came from the user fees associated with gasoline taxes, vehicle taxes, and tolls. Another $26.9 billion came from federal and state income taxes, sales taxes, property taxes, bond issue proceeds, and assorted other user taxes and fees. The WorldWatch Institute has estimated that if you factor into account air pollution and environmental degradation associated with our highway system, every automobile in our country is subsidized by $2,400 annually. In addition, if you removed petroleum subsidies and prices were allowed to increase to 'real' market value, the price of gasoline would be around $4.50 per gallon (Vranich 1991, 352-354).

The point is that the highway infrastructure in this country is heavily subsidized and there are no sustainable objections to not spending money on a system that would be cheaper, safer, more environmentally friendly, and more cost-effective. There are two very good examples of a system run awry concerning highway construction and our dependence on automobiles in this country. First, in Phoenix they plan on spending $5.9 billion for 232 miles of highway construction. This budget is higher for one city than it would cost to build the entire Las Vegas-Anaheim proposed HSR system. One of the more extreme examples involves Boston's Central Artery project. This project will only be 7.5 miles long with 3.7 miles of tunnel and 2.3 miles of bridges. The estimated cost of this construction is $4.4 billion. This equates to $586 million per mile. Needless to say, this would easily pay for many of the proposed HSR systems around the country (Vranich 1991, 354). These are not the only areas that unwisely spend federal tax dollars. Right here in Waco, city officials are aggressively lobbying the Texas Transportation Commission to spend an estimated $10.8 million to build a 1.5 mile spur that would connect Highway 6 with downtown Waco. This is being suggested as a convenience for motorists instead of having to make an exit to reach downtown Waco (Waco Tribune Herald 1994). Quite an expensive convenience. It seems as if federal and state monies would be better used by the City of Waco to promote HSR.

Amtrak

It is curious to note that Amtrak is not nearly as heavily subsidized as our nation's highways, automobile, or airline industries. There are a variety of reasons as to why this skewed subsidization has occurred. As of the end of W.W.II, trains were accounting for over 75 percent of the common carrier share of intercity traffic with airplanes and buses comprising the other 25 percent. Unfortunately, that period in time was the beginning of the end for trains in this country. As market conditions shifted, trains failed to modify their service to accommodate the need for short-distance trips. Train travel was reduced by over 50 percent by 1950, due to mismanagement, unionization, and governmental favoritism to other modes of transportation. While the train industry wallowed in their wile, the automobile and airline industries were out intensely lobbying for their respective causes. By the 1960's, the passenger train network was diminished greatly both in ridership and the ability to provide services (Vranich 1991, 226-227).

In 1970, Congress passed the Rail Passenger Service Act which created Amtrak. Their purpose in doing so was to reverse the decline in rail travel in our country. Amtrak immediately took over intercity travel via rail in our country and discontinued 50 percent of services offered. The new system established was one of a private-public partnership. This act mimics what other countries have done to upgrade and extend their respective rail services. The initial governmental funding consisted of a $40 million grant and $100 million in loans. In comparison to the amount of money being spent on highways, automobiles, and the airline industry, this was a slap in the face. A project doomed before it got started. In the beginning, Amtrak owned no track, stations, rail yards, repair shops, locomotives, or passenger cars. They were forced to take dated machinery and technology and try to create a viable business. The worst part about this scenario is that they were expected to make this project work without the benefit of a Railroad Trustfund, similar to those created for highways and aviation. In addition, when rail service had been viable and the preferred mode of transportation, rail service was hit with an excise tax of 10 percent during W.W.II.

Although this tax was in effect until 1962, the rail service never benefited from the money generated, though it is known that the highways and aviation sectors certainly received a portion of these funds. The irony is perpetuated by Congress which discussed allowing the railroads to keep the revenue from the excise tax at the time, but decided against it because it would mean a public subsidy to the private individuals who were railroad stockholders. This tactic didn't keep them from allowing public subsidies to go into the private shareholders of the aviation or the automobile industries. A clear case of a double-standard. It is estimated that while the federal ticket tax was in existence for rail travel, the government was the recipient of over $2 billion which entered the general Treasury and eventually was spent in part, on highways and aviation (Vranich 1991, 226-235).

One of the major low points for Amtrak occurred in the late 1970s, when President Jimmy Carter chose to make cuts in the Amtrak budget due to the oil crisis. This move illustrates the lack of respect the government has shown for Amtrak throughout its history. Even the scientists at Oak Ridge determined that Amtrak was the most energy and cost-efficient transportation mode available. Despite these obstacles, Amtrak has succeeded in establishing itself as a very productive transportation mode. By 1990, Amtrak took in more than $1.3 billion and covered an astounding 72 percent of their costs. They carried 22.2 million riders and tallied more than 6 billion passenger-miles. This was the eighth year in a row Amtrak had set U.S. records for ridership and overall revenue production (Vranich 1991, 236-238).

It must be stated the Reagan-Bush years did absolutely nothing to aid rail travel in this country. While increasing the budget for airlines by an astonishing 73 percent, President Bush's proposed budget included no increase in funds for rail travel. The U.S. proposed budget for 1985 subsidized airline passengers by $42 and rail passengers by less than $30. To add insult to injury, the Bush budget shows that the trust fund set up to pay for air travel through aviation taxes only collected $3.9 billion while funding for aviation was a staggering $7.1 billion. There is an obvious disparity in the amount of funding paid into the fund versus what was paid out of the fund. The way that the subsidized funding breaks down is that aviation receives 50 cents out of every dollar of subsidies paid out to the various transportation modes. This does not take into account money from the aviation trust fund or the indirect subsidies to aircraft manufacturers. Highways and associated businesses receive 39 cents of subsidized funding from government funding which does not include the monies received via the Highway Trust Fund and Amtrak gets 28 cents of every subsidized dollar with no additional help. This is obviously a skewed playing field with Amtrak ending up with the short end of the stick. Amtrak's funding comes from one source, the federal government. Highways and aviation receive money from a variety of sources including subsidies from numerous federal agencies, state governments, and all of the cities and counties which have highways and/or air facilities. It is difficult to determine precisely how much money these industries receive due to this diversity of income, yet Amtrak's funding can be determined at the drop of a dime. The president of Amtrak makes some interesting points:

> This country cannot get along with a passenger system that is limited to the highway and the air -- no other industrialized country in the world has been able to do that. Amtrak requires 40 percent less federal operating assistance today than we needed just eight years ago. Indeed, if other recipients of federal support could have been as successful as Amtrak in reducing their needs, this country would not now face a federal deficit. Federal appropriations to Amtrak constitute 5/100ths of 1 percent of the total federal budget. We are becoming victims of our own success -- the growing demand for Amtrak service nationwide is outstripping our capacity to provide it. Unless serious steps are taken to provide Amtrak with the means to acquire new cars and locomotives, millions of passengers who depend on our services will be forced to stand on trains or be denied service altogether (Claytor 1991, 241-242).

These statements along with some of the previously mentioned material leads this writer to believe there is not only a need for an effective, efficient, and safe mass transportation mode, but that the government should be willing to at least pay a proportionate share of the costs as they do with other modes of transportation. The premise that a HSR proposal should be completely funded through private investment is ludicrous, given the amount of money our government spends on other less efficient and more costly modes of transportation.

Airlines

Airlines and aircraft manufacturers are subsidized with a sizable chunk of the taxpayer's dollar. Though they attempt to hide this at every turn, it is undeniably true that without government subsidization, airlines would be inoperable due to high operating costs in this country.

The subsidies for aviation in the United States come from both direct and indirect sources. First, the government completely subsidizes the FAA air traffic control system and personnel which severely reduces their infrastructure expenses. They also provide subsidies for the Essential Air Service Program which provides for flights to small towns, whether there is a demand for them or not. The government also foots the bill for FAA, NASA, and Department of Defense research, all of which brings new technology into the airline industry essentially for free. In addition, the military trains pilots who inevitably end up working for the airlines once they leave military service. Thus, they have eliminated the substantial need for airlines to train their own pilots. The government also issues subsidized loans to airlines to buy new aircraft. To add to this, the government has established a relationship with aircraft manufacturers where commercial and military aircraft are being built on the same manufacturers' line, which ultimately lowers costs for those airlines purchasing the planes (Vranich 1991, 296-298).

There has been a double standard for government subsidization throughout the history of the United States. First of all, the railroad industry did not begin to receive any form of subsidization until 50 years after the aviation industry started receiving federal and state subsidies. In 1920, the United States Air Mail Service was initiated. The government then broadened their role in the development of aviation in this country by passing the Air Mail Act of 1925 and the Commerce Act of 1926. By 1929, the U.S. government paid out more than $7 million to support airmail carriers. In 1930, the government passed the Waters Act which provided aviators with major compensation for carrying mail. In 1938, the government formulated the Civil Aeronautics Act which set up two new institutions. The first was an air traffic control service, based primarily on towers taken over from private operators. The second was the Civil Aeronautics Board which was established to formulate and implement both economic and safety regulations. One of the most substantial windfalls for the aviation industry was when the federal government decided to turn over surplus airfields while continuing to at least partially finance them. The Federal Airport Act of 1946 has resulted in the government paying for over half of total capital spent on airports between 1947 and 1969. The government has chosen to finance one mode of transportation over another, which in and of itself is not necessarily criminal except for the fact that the modes they have chosen are not the most cost-effective, safe, or environmentally friendly modes of transportation. A perfect example of these disparities is depicted by a writer from Trains Magazine who states:

> In February 1957, the Pennsylvania Railroad's employee magazine groused that Washington National Airport had been built with $36 million in taxpayer support and since 1941 had accumulated an operating deficit of $4 million, yet paid no taxes itself. By contrast, Union Station and its supporting facilities, built with private capital and valued at about $32 million, were assessed during the same period for more than $6.9 million in property and income taxes, paid to the District of Columbia and the federal government (Cupper 1991, 299).

This is only one of many examples that clearly show there has been government bias toward the aviation industry and against the railroad industry.

Present Subsidy Situation

Many people believe that the situation has improved, but that clearly is not the case. It has been estimated by an economist from Washington that the FAA alone has spent $44.5 billion for aviation projects since 1980 and they have only paid $22.2 billion in taxes and user fees to the aviation trust fund. The taxpayers paid the other $22.3 billion (Brookes 1991, 300). Table 5.1 shows the cost to the taxpayer for aviation subsidies from 1980 to 1989.

The worst part of this scenario is that we've reached a stage where almost all major airports are significantly overcrowded and have become less efficient and less safe; flights are becoming

Table 5.1 - Aviation Subsidies (Billions)

Year	Aviation taxes and user fees	Net general FAA spending	Taxpayer Cos
1980	$1.874	$3.136	$1.262
1981	0.021	3.158	3.137
1982	0.133	3.134	3.001
1983	2.165	4.269	2.104
1984	2.499	4.651	2.152
1985	2.851	5.355	2.504
1986	2.736	4.872	2.136
1987	3.060	4.946	1.886
1988	3.189	5.191	2.002
1989	3.688	5.769	2.081
Total	$22.216	$44.481	$22.265

Source: Vranich 1991

increasingly delayed. It has been estimated that commercial airline passengers have gone from 243 million in 1977 to 455 million in 1989, which results in 1.2 million people flying on a daily basis in the U.S. The worst air-traffic problems are in and around New York and the other eastern seaboard cities. In 1989, delays were up by 111 percent at LaGuardia, and 52 percent at Kennedy. Newark has jumped 844 percent since 1957 and Kennedy has increased 483 percent during the same time period, with LaGuardia increasing by

331 percent. O'Hare International, which is one of the busiest airports in the country, has more than 12 million hours of passenger delays annually. This equates to an increase in an additional $10 per ticket for each individual passenger. The FAA has estimated that the number of airports in serious trouble could triple by the year 2000. Furthermore, they have estimated that 722 million passengers will be flying on a yearly basis which will create delays to such airports as Cincinnati, Las Vegas, and Raleigh-Durham which were free of congestion in the 1980s. Transportation Secretary Sam Skinner has stated he believes 20 new airports, at a cost of $3 to $4 billion, would be needed to handle our air travel needs in the near future (Vranich 1991, 274-276).

Many airports around the country have expansion plans, but it is generally believed that few of them, if any, will be able to expand due to environmental concerns and a vocal majority of citizens who will not tolerate it. There have been attempts all across the country to expand existing airfields and none of them have been successful. The latest airport to be built is the one outside of Denver which will replace Stapleton, but it has been twenty years since another airport has been built.

The major carriers now realize that we are in a state of 'wing-lock' and that other solutions are necessary to make travel more efficient and cost-effective. Internationally, Pan-Am, United, and American Airlines all incorporate HSR tickets with their own so that for the shorter trips, the passengers can utilize the HSR systems available while maximizing their profits by carrying full plane loads on the longer routes where trains are not as competitive. Thus, they are alleviating the air traffic congestion at the major airports throughout Europe. Federal Express also utilizes HSR to transport their packages because the rail system is cheaper and more reliable for the shorter-length trips. Figure 5.1 indicates the numbers of trips of less than 300 miles from the 10 busiest airports in the United States. These are trips that could be handled more efficiently through the use of HSR. Even here in the United States, there is mounting agreement for the need to ease our air traffic congestion. Officials from the FAA, state governments, city governments, citizens groups, and several of them major U.S. carriers are jumping on the HSR bandwagon (Vranich 1991, 270-274). It will ultimately benefit everyone to have HSR available. The only people who would not benefit from it would be the shorter distance air carriers such as Southwest Air, which is a major opponent to HSR in Texas.

Southwest Air is a major carrier in Texas with earnings of over $1 billion. The chairman of Southwest is Herbert Kelleher and he really is the Ross Perot of the airline industry. He is a man who wants it all without any competition and will say and do anything to get it. Kelleher believes that Texas should not create a new transportation business that would be heavily subsidized with taxpayer's money to compete with 'private' enterprise. The state of Texas spent a sizable amount of funding to get Southwest Airlines a certificate designating and authorizing them as a major carrier. Their fight had to go all the way to the U.S. Supreme Court with Texas footing the bill for the hearing and regulatory processes. Kelleher claimed that it would be ludicrous for passengers to prefer rail based on it being an unsafe transportation mode. Yet as previously stated, this technology has never had a fatality associated with it whereas there are hundreds of deaths each year associated with airline crashes. Next, Kelleher described the French TGV as a "Conestoga with lights," in reference to it being an outdated technology even though it is successfully being utilized all over the world. He has even threatened that if the proposal were to go through, Southwest Airlines would have to re-evaluate their headquarters location in Dallas, an obvious threat. The hysterical part of all of this is that Kelleher is the chairman of a pro-aviation lobbying group called "Partnership for Improved Air Travel." This group lobbies for more aviation spending, which they conveniently do not refer to as subsidization, less taxation, and a reduction in the surplus in the aviation trust fund. Southwest Airlines actually tried to file an injunction against the state to halt the development of any HSR project in Texas. Well, luckily things have not been completely halted for the HSR proposal, though the Texas TGV is currently having difficulty finding private financing because the state has agreed to not include any government funding, even though the aviation and highway systems currently enjoy massive funding.

Environmental Issues

Even the most adamantly opposed individual to the proposed

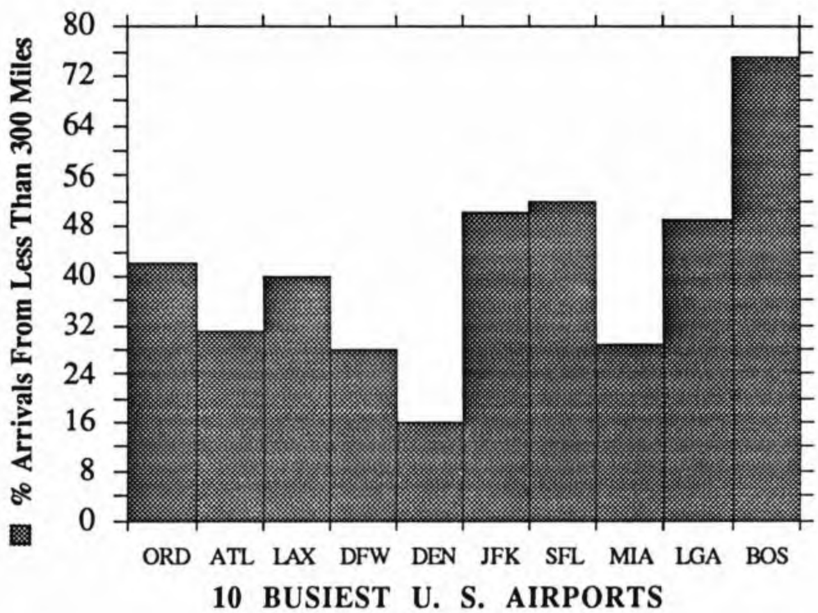


Figure 5.1 - Airline Trips of Less Than 300 Miles For 10 Busiest U.S. Airports

Source: Vranich 1991

HSR would have to concede there is very little environmental destruction associated with the construction and use of a HSR system. The following sections will briefly outline the case for trains versus automobiles or air travel. Further, it will delineate our petroleum addiction and the ramifications of our continued reliance on fossil fuels as our only means of transportation fuel. The remainder of this chapter will focus on land use and foreign investment.

Oil Consumption

Most people in the United States are probably familiar with the "greenhouse effect." The U.S. population consumes over 25 percent of the world's oil annually, yet only consists of 6 percent of the world's population. Between 1970 and 1989, this country spent $1.1 trillion on oil imports. Whether we choose to acknowledge the fact or not, we are quite dependent on foreign oil for our energy and travel needs. In the 1970s, the U.S. went through two major oil crisis situations which were a direct result of wars that were taking place overseas. Transportation represents over 66 percent of our oil use in the United States. In both cases, the prices of oil skyrocketed and so did the amount of people utilizing public transportation and Amtrak for their inter-city needs. The obvious reason for this is the fact that these modes of transportation are more cost-efficient and less reliant on overseas oil imports. When reliant on others for our energy needs, it poses a threat to our national security and our ability to travel independently.

Throughout the Reagan years, this country did very little to increase our self-reliance on internally generated energy supplies other than debate over whether or not we should open up environmentally sensitive areas to oil exploration. Actually, the Reagan Administration increased new road construction, decreased automotive fuel standards, raised the national speed limit, and cut funding to public transportation systems and Amtrak. This eliminated any gains the nation had made in energy conservation, at least in terms of our transportation usage. Figure 5.2 details our BTU usage in 1987 numbers. As noted, the highest percentage of BTU's comes from personal vehicular use.

The most recent oil shock came in 1990, when Saddam Hussein sent his forces into Kuwait which ultimately threatened our oil lifeline. Within one week, the invasion caused gasoline prices to increase by thirty cents per gallon. The price of oil rose by over 170 percent in three short months and led to panic in the world's financial markets (Flavin and Lennsen 1991, 318).

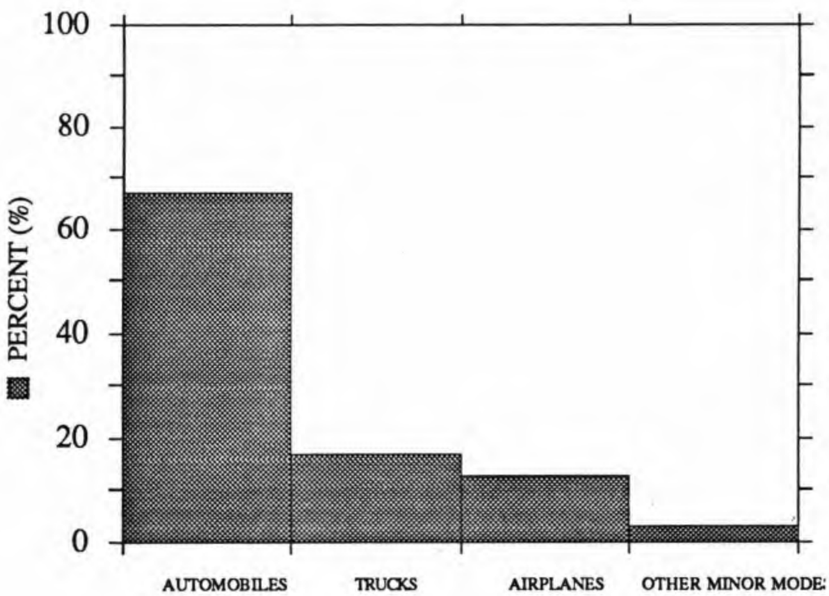


Figure 5.2 - Personal Transportation Use, 1987 BTU Data
Source: Vranich 1991

Obviously, it wasn't only automobile users who were affected by these oil crisis situations. The airline industry was also heavily impacted. United Airlines has an annual fuel bill of approximately $1.35 billion and it was expected to rise by as much as $400 million because of the 1990 invasion of Kuwait. Also, airline fares rose by 10 percent across the board as a result of the oil shortages produced by the conflict. On the other hand, Amtrak did just fine because fuel only represents 3 percent of their total costs of operation versus 15-20 percent for the airline industry (Vranich 1991, 318).

Many other countries were less affected by the latest squabble in the Middle East because they are less reliant on individual modes of transportation. For instance, even though Japan has the world's second largest economy and lost over 10 percent of their imported oil during the latest crisis, it had little affect on their populace. While Japan has doubled it's economy since the oil crises of the 1970s, its' oil dependence has risen very little. The Japanese have been able to achieve this 'miracle' through some basic energy efficiency measures such as increasing fuel economy in automobiles and through their reliance on their HSR network. They are able to produce the electricity that is required to run their Bullet Trains internally and are much less reliant on imported fuels than the United States (Vranich 1991, 319). In addition, the majority of Europe relies more heavily on public transportation systems than the United States. Figure 5.3 depicts the average per capita gasoline consumption in several North American cities and compares them

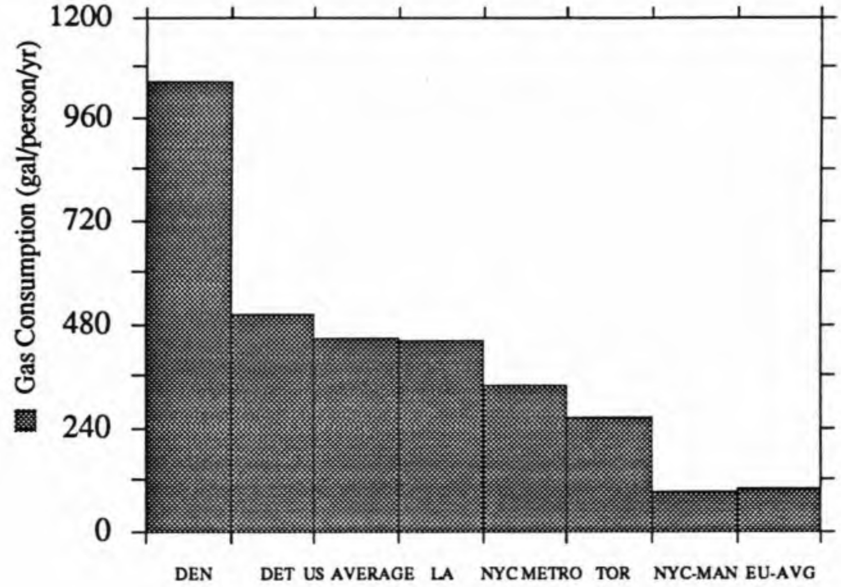


Figure 5.3 - Per Capita Gasoline Consumption Among Some North American Cities

Source: Vranich 1991

with the average European City. There is a noticeable differentiation between the two based on our individual use of automobiles versus their reliance on more efficient mass transportation modes.

The Federal Highway Administration has released the total gasoline consumption figures and they are quite disturbing for many states. In 1988, the total gasoline use for highway travel in California was 12.5 billion gallons. Texas ran a relatively close second with 8.5 billion gallons consumed, while Florida burned more than 5.7 billion gallons. As is obvious, these are very large states with many large cities that are relatively far apart. This is exactly where Supertrains would be the most effective mode of mass transportation. This mode of transportation would reduce pollution and limit the amount of energy required to move the same number of people the same distance.

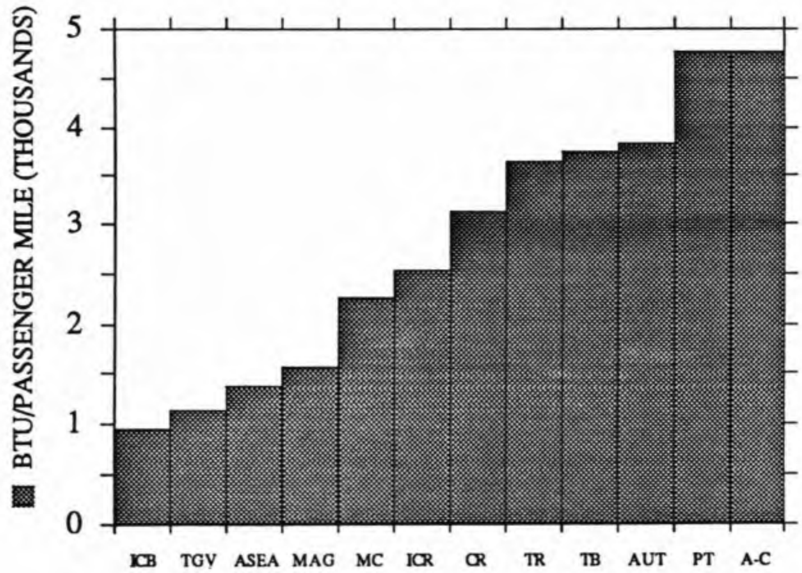
The figures for the proposed Las Vegas-Los Angeles route indicate that over a million interstate travelers and between 1.5 and 2.5 million commuters would opt for the train and leave their vehicles at home. Furthermore, it would reduce vehicle-miles by 70 million which would ultimately result in savings of millions of gallons of fuel and a reduction of air pollution by hundreds of tons on a yearly basis (Katz 1991, 321). The HSR proposals on the board in Florida would result in a reduction of 20 million gallons of oil annually which would also reduce the amount of air pollution being emitted in the state on a yearly basis (Lynch 1991, 323). The Senate's report by a maglev advisory committee even stated that in relation to automobiles and airplanes, HSR is "twice as efficient as autos and four times as efficient as airplanes, in terms of gross energy used"(Vranich 1991, 323).

Supertrains in general are much more energy efficient than traditional forms of transportation such as cars, transit buses, and airlines (see Figure 5.4). On the French TGV Paris-Lyon line, the trains use one-sixth as much energy per mile as an airliner and the new Atlantic line is even more energy efficient due to technological

advances. In the United States, airplanes use around 16 billion gallons of fuel annually. In many areas of the country, this fuel is being used on short-hop flights of less than 500 miles where HSR would be much more energy and cost-efficient. High speed trains represent a good energy tradeoff. There would be more centrally generated electricity, a form of energy in which environmental intrusion is relatively easy to control, in return for less combustion at the vehicle level, where environmental impact is widely dispersed and very hard to control" (Plous 1991, 325). Furthermore, electrical companies in the United States have made significant improvement in their emissions. Through 'cleaner' fuels and more stringent emission controls, the electric companies in the U.S. have reduced their overall emissions by 21 percent since 1973 while increasing the use of coal to generate that power by 88 percent.
Also, as developments are made in superconductivity, we will be able to store more electricity with virtually no losses while saving 25 percent in electricity produced (Vranich 1991, 325).

Specific Harmful Effects of Petroleum Combustion

There are two specific environmental problems facing our planet today as a direct result of the combustion of fossil fuels. In the United States, the greatest source of poisonous exhausts is the automobile. The two pollutants in question are carbon monoxide and ozone. The Environmental Protection Agency (EPA) has set standards the emission levels throughout the country and in many cases, for



ICE = Intercity Bus
TGV = French Train A Grande Vitesse
ASEA = Fastrain HSR
MAG = German Maglev
MC = Motorcycles
ICR = U.S. Intercity Rail
CR = U.S. Commuter Rail
TR = Transit Bus
AUT = Automobile
PT = Personal Truck
A-C = Air-Commercial

Figure 5.4 - Passenger Energy Intensities - BTU to Move Passenger One Mile

Source: Vranich 1991

the areas in question are out of compliance with the regulations.

Ozone at higher elevations protects our earth from harmful ultraviolet rays, at lower levels it creates a major health concern. Elevated levels of ozone in the lower portions of the atmosphere create major respiratory problems for humans, especially in the lungs where it destroys tissue. Highway vehicles produce 40 to 45 percent of the ozone found in the lower atmosphere. In 1988, air pollution from motor vehicles caused $40 to $50 billion in annual health-care expenditures and caused over 120,000 premature or unnecessary deaths (Godar 1991, 331). The EPA has determined that the ozone standard was violated 60 percent more often in 1988 than in 1983 and added an additional 26 cities to the list of 200 areas that are in non-attainment for ozone standards. There have been some advances made in automobile pollution controls, but these are easily off-set by the increase in auto travel. The only realistic way to reduce auto emissions in the near future is to shift our modus operandi to mass transit, wherever and whenever possible. By shifting to trains versus cars, it would cut hydrocarbon emissions by 90 percent, carbon monoxide by over 75 percent, and nitrogen oxides by up to 75 percent (American Public Transit Association 1991, 333). Furthermore, it is estimated that the Florida HSR system would reduce carbon monoxide levels by as much as 5,417 tons per year, carbon dioxide by 62,805 tons annually, and nitrogen oxides by as much as 1,350 tons per year (Vranich 1991, 331-333).

The other major environmental area of concern is that of global warming or the greenhouse effect. It is accepted internationally that elevated levels of carbon dioxide and other associated gases are building up to such an extent in the atmosphere, they are trapping heat and thus elevating the overall temperature of the earth. If we were to burn less fuel, we would reduce the amounts of these hazardous gases entering our atmosphere. In terms of carbon emissions, Supertrains release approximately 25 percent of what airplanes release, and less than 50 percent of what automobiles release. Therefore, any transition to HSR systems will ultimately result in less harmful greenhouse gases being released into our atmosphere (Vranich 1991, 334).

Land Use

There are two main arguments concerning land usage and the development of HSR systems. The first argument concerns the amount of space that will be needed for the tracks to be built and the second concerns eminent domain. The latter is one of the main arguments against the proposed Texas TGV project.

First, many people believe that building a train system will require a significant amount of land and that wildlife and public access to lands adjoining the tracks will be negatively affected. The truth of the matter is that a train system takes up less space than highway expansion. HSR systems require a relatively narrow right-of-way. In France, the Paris-Lyon TGV system uses less land than the de Gaulle Airport near Paris. The Senate HSR advisory committee reported that HSR systems would only require 50 foot right-of-ways and can carry the volume of approximately 10 lanes of highway traffic. Building new highways requires hundreds of feet of right-of-way. Further, in some cases the HSR system could be built on existing highway right-of-ways although it is not appropriate for all HSR systems. In terms of wildlife, the French have built wildlife passages underneath the rail system and have found no significant impact on their wildlife populations. Also, due to the fencing that surrounds the system, they have had no track kills of wildlife or humans. The Texas TGV proposal incorporates fencing in its' design as well.

Another main concern for Texans is accessibility to property once the system is in place. Many farmers are concerned their land will be divided and they will be unable to farm in a cost-efficient manner or they will be forced to relocate. The Texas TGV proposal addresses these specific issues by offering to purchase not only the land through which they will have to construct, but the houses that lay in the path as well and at a fair market value. It is true that some rural residents will probably have to move, but highway expansion would definitely affect more individuals than the construction of the Texas TGV. It is obvious that many people do not want to move, but throughout the history of our country people have had to move for many types of major construction projects.

The development of this project will divide cropland and also inhibit the farmers' ability to move their machinery and livestock from one area to another. Under the current proposal, there will be 10' by 10' box culverts built every mile. However, one of the concerns of farmers is that these culverts are insufficient in size to allow the passage of farm machinery or large herds of livestock. If the Texas TGV were to make some concessions and build byways for the farmers, this impact would be reduced. If the current plan is not changed, the farmers will experience a net overall increase in production costs which would obviously diminish their profitability. So, there is some validity to this argument if the situation doesn't change.

Another major concern relates to eminent domain. People want to be recompensed fairly for their land and would rather that it not be divided. Most people would prefer a complete buy-out as opposed to simply selling a corridor through their property. Construction of this train will result in a short-term decrease in property values, with the potential of an overall increase in the future. The rate and method of recompensation is something that needs to be more thoroughly addressed by the Texas TGV Corporation.

Foreign Investment

As we progress towards the year 2000, economies of most nations have become very interdependent. The European Countries have allied themselves in an economic partnership, just as the United States has recently decided to join Mexico and Canada in the North American Free Trade Association (NAFTA). Unfortunately, in some areas of Texas, there is this xenophobic, isolationist sentiment that requires all products and technology to come from or be built in Texas. Well, that may have been an appropriate sentiment in the past, but in today's world things are changing and so must we all.

The entire notion that Texas or the United States cannot benefit from "foreign" technology and equipment is one that is based on emotion, not logic, and most people do not realize the extent to which "American made" products are actually produced, at least in part, by other countries. The argument against implementing French technology via the French TGV Supertrain holds absolutely no water for several reasons.

To illustrate this point one can examine many "American-made" products on which people in this country have great reliance. First, there is no such thing as an 'American-made' airplane. Virtually all of our planes are at least partially made elsewhere. Major portions of all of our Boeing airplanes, which supply the majority of our airliners and military planes, are made in France, Italy, Brazil, Japan, and other countries. They are then shipped to the United States for finishing touches. Boeing is a larger contractor in France for jet engines than the European Airbus consortium. As a matter of fact, as time progresses into the 1990's, Boeing is now importing a larger percentage of its componentry and structures from overseas suppliers than it ever has in history. Fuji, Kawasaki, and Mitsubishi are joint-development partners in the new Boeing 777 which is being touted as the plane of the future and they collectively own as much as 23 percent of this venture. This is of no surprise to industrialists in the United States, but they certainly do not openly advertise these facts.

Closer to home, the Department of Energy solicited money from Japan and Korea to aid in the development of the Superconducting Supercollider outside of Dallas. As we all know, this project is now defunct, but the point is that we were willing to solicit aid from foreign investment. There are numerous cases of such foreign investment activity. The Space Station that the United States has been threatening to try and build is no longer a solo effort. It was reported in the news recently that both Russia and Japan have been solicited for both funding and scientists. Our automobile manufacturers surely have no problem dealing with foreign companies and virtually no cars are completely 'American-made' anymore. Chrysler has had a financial relationship with Japan since 1971 (Vranich 1991, 124). It has been profitable for both parties to work together in the development of automobiles to be sold here in the United States. Almost 9 percent of the cars sold by Chrysler were actually made solely by Mitsubishi or were produced at their jointly-owned plant in Illinois. The all-American Dodge Raider four-wheel drive off-road vehicle is actually a Mitsubishi Montero and all that was changed was the name (Blustein 1991, 125).

The list goes on and on and it simply is not logical to base opposition to the proposed Texas TGV project on the xenophobic few who lack the education and understanding to see the benefit of building such a system utilizing existing technology. John Riley, who is the Minnesota Transportation Commissioner and previously served as the administrator for the Department of Transportation's Federal Railroad Administration, has had to address this issue many times. His answer is that to invest billions of dollars duplicating existing technology is a waste of time and money. It would be much wiser and cost-efficient to purchase these technologies and adapt them to our specific environmental needs. He further states:

> Since the systems (sic HSR) are going to be built her, it's evident that jobs are going to be here. Have no fear of the issue of importing technologies. It's going to be raised politically, but it's a false issue. People want service; they want jobs. There's nothing in the importation of technologies that's inconsistent with either of those concepts (Riley 1991, p. 132).

It is of my opinion that the logical choice in this matter is to utilize the existing technology and maximize our benefits. If the state of Texas is the first to implement this technology, we will obviously have an advantage over states which would wish to do the same, in that we could build factories to assemble the systems, provide engineers to design the systems, enlist environmental consultants to ease the impact on the environment, and all it would take is one small step forward and away from fear of the unknown.

Conclusion

In conclusion, it should be obvious to the reader that there exists an unfair playing field for introduction of a HSR system in Texas. Other industries receive a substantial amount of government funding and are less efficient, more costly, and less safe than the proposed HSR system. Though Amtrak receives a substantially subordinate amount of government funding, they have been shown to be cost-efficient and given a chance, a preferred mode of transportation. In terms of land acquisition, it has been shown that the amount of land needed for HSR is much less than would be required for additional highway construction. Further, as world economies become more intertwined, it is ridiculous to assume that everything we do must be entrenched completely in American technology and industry. It isn't the modus operandi for other transportation modes and it certainly shouldn't make a difference for the proposed Texas TGV project. Finally, it is blatantly obvious to any objective observer that rail travel is safer and less environmentally demanding and destructive than any of the other current modes of mass transportation.

Chapter 6
Conclusions

In conclusion, this thesis has shown the Texas TGV proposal to be a relatively sound proposal. High Speed Rail is something that will, in my opinion, come to the United States in the very near future either here in Texas or in one of the many other states that are currently studying the feasibility of such a project. HSR is currently being utilized in many countries. As discussed in Chapter Two, they all have had positive experiences with it as a mode of mass transportation.

In virtually all of the countries where HSR is in operation today, the respective governments have seen and understood the need for an environmentally-sound and economically-feasible mode of mass transportation. The United States is rapidly losing ground in the mass transportation arena and the potential for economic gain that will be enjoyed by leaders in this field. By not supporting, investigating, and implementing HSR technology immediately, we are only hurting our country economically and our people financially. These systems have been shown to be efficient, effective, and successful in every country where they have been implemented. In an era where economic security is relatively non-existent in the

United States, this is a transportation mode that would not only create jobs and potentially generate economic security, but offer one of the most efficient mass transportation systems available.

In addition, if there is going to be a HSR system built in Texas, whether it be the French TGV technology or any other type of rail technology, it should be built as an independent system. Such a system would be more cost-effective and safer than upgrading existing track. Also, it would allow for upgrading to newer technologies in the future. Furthermore, the financing should encompass a private and public backing that would be phased in over a period of time. All of the systems that are in operation today around the world have had some sort of government funding. In my opinion, the Texas High Speed Rail Authority really did a disservice to the citizens of Texas by not allowing any government subsidization of this project. It simply makes good business sense to undertake a project that will do nothing but bring money and a more efficient and effective transportation system to the state. Both of the reports analyzed in this thesis come to the conclusion that this system is viable, cost-effective, and an economic generator of both employment and financial security.

It should be obvious to the reader that there exists an unfair playing field for introduction of a HSR system in Texas. Other industries receive a substantial amount of government funding and are less efficient, more costly, and less safe than the proposed HSR system. Though Amtrak receives a substantially subordinate amount of government funding, they have been shown to be cost-efficient and given a chance, a preferred mode of transportation. In terms of land acquisition, it has been shown that the amount of land needed for HSR is much less than would be required for additional highway construction. Further, as world economies become more intertwined, it is ridiculous to assume that everything done in this country must be entrenched completely in American technology and industry. It is not the modus operandi for other transportation modes and it certainly should not make a difference for the proposed Texas TGV project. Finally, it is blatantly obvious to any objective observer that rail travel is safer and less environmentally demanding and destructive than any of the other current modes of mass transportation. It is therefore the recommendation of this thesis that HSR not only become a reality in Texas and the United States, but that the people of this country financially aid in building a HSR network that will ultimately benefit us all.

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