# Factors to be Considered in Planning High Speed Rails: Time, Population, Economic Markets, and Track Mileage

**Curtis Bradley***
Graduate Research Assistant
Master of Science in Transportation Program
South Carolina State University
Orangeburg, SC 29117
Tel: (803) 536-8321
Fax: (803) 516-4693
E-mail: cbradley59@gmail.com

and

Judith Mwakalonge PhD.
South Carolina State University
Orangeburg, SC 29117
Tel: (803) 536-8321
Fax: (803) 516-4693
E-mail: jmakalonge@gmail.com

## ABSTRACT

In the last ten years, the United States has focused on the investment in high speed rails. With existing high speed rails (HSRs) and plans on reinvesting in high speed rail infrastructure, accurate planning and assessments are critical to make sure that these investments are spent wisely. Traditionally the investment in high speed rails is characterized by the infrastructure cost, operation and maintenance cost, and the overall revenue from ridership and savings. Studies have shown, that though these cost are accurate in determining the financial feasibility of high speed rails, the identified factors do not indicate the entire scope or potential of high speed rails. Additional factors should be utilized in determining whether HSRs are successful or not. The point of this research is to investigate additional factors of HSRs including time, population, the connection to economic markets, and the overall presence of HSR lines in a specific area in order to understand the significance of HSRs and to provide a platform on whether potential HSRs will be successful predicated off historical data. The net income or profit will be the determining factor on whether HSRs are successful or not being that this is the major concern on justifying the initial investment in HSRs. A regression model is utilized in order to determine whether investing in HSRs will be successful, by utilizing historical data of existing HSRs. This data shows the correlation between the noted factors (time, population, economic markets and track miles) and the profitability of existing HSRs.

## INTRODUCTION

The United States of America is making strides to accommodate its growing population while trying to adopt sustainable methods of travel. The sustainable initiatives include increased gas mileage, alternative fuel sources, and alternative methods of travel. One specific mode of transportation that has been taken into account is High Speed Rails. High speed rails (HSRs) are not foreign to the United States as the north east corridor is home to the Acela Express. The Acela Express is the only HSR in the United States and ranks number eight in HSR miles out of all the nations with existing HSRs.[i](International Union of Railways) One of the major setbacks for the United States in making the investment in HSRs is whether the benefits outweigh the cost. While this may seem to be a relatively easy issue to distinguish, arguments for and against this investment have proven to make this issue much more complicated. This has not been overlooked as one document explains "given the long lead time and inherent risk in high-speed rail investments, it is essential that the Federal Rail Administration (FRA) select corridors where the conditions exist to support strong passenger demand for high-speed services."(ix) (Hagler et al. 2010)

Problem Statement:

In the United States of America, there has been an ongoing issue with its transportation infrastructure. One of the investments that are under consideration and many times scrutiny is High Speed Rails (HSR). Initially under President George W. Bush's administration there has been consideration of the public and private investment of HSRs which is better known as the Passenger Rail Investment and Improvement Act (PRIIA).[ii](FRA, 2009) Now, under President Barack Obama's administration, this investment, along with a substantial initiative to invest in the United States' economy, has been more pronounced. On April 16, 2009, President Obama announced "A Vision of High Speed Rail in America" through the American Recovery and Reinvestment Act (ARRA) of 2009. This portion of the act required "the Secretary of Transportation to submit a strategic plan to Congress describing how the Secretary would use the $8 billion provided to the Federal Railroad Administration under ARRA to re-energize efforts to develop high-speed passenger rail systems in the United States."[iii] (FRA) This investment raised many supporters and critics. While supporters indicate that HSRs are a long overdue investment by America, critics explain that the investment of HSRs are simply too high and it is not worth the investment. The American Public Transportation Association (APTA) recently put out a paper that addressed many of the critiques and concerns about implementing additional HSRs in the USA. In this documentation they were able to address concerns regarding affordability, benefits, and rigidness of the system, along with the overall performance of HSRs.[iv] (APTA, 2012) The major concern seemed to be the investment of HSRs and more importantly, whether there would be a significant return on this investment. This is where the argument becomes complex as determining the success of HSRs has not been clearly defined and therefore it would be difficult to justify the investment.

The United States currently has a HSR that it utilizes in the northeast corridor. While America is home to the Acela Express, which is the only HSR system in the United States, the technology and performance could be considered inferior in comparison to other foreign HSRs like the Alta Velocidad Espanola (Spain), Shinkansen (Japan), Train a Grande Vitesse (TGV) (French), along with other HSRs. Therefore, the success or failure of the Acela Express cannot be an indicator of the success of HSRs in the United States. The utilization of foreign HSRs will be necessary in determining successful HSRs. The point of this research is to investigate

additional factors of HSRs including time, population, the connection to economic markets, and the overall presence of HSR lines in a specific area in order to understand the significance of HSRs and to provide a platform on whether potential HSRs will be successful predicated off historical data.

## REVIEW OF LITERATURE

Value of Time:

The value of time is considered by some researchers to be more valuable than monetary gain. The reason being is that time is a nonrenewable resource that has the potential to be affected by outside sources.[v](Victoria Transportation Policy) This statement brings up questions about how HSRs compare to automobile and airline traffic. Some critiques state that public transportation has the potential to be a nuisance in reference to travel time as it is dictated and rigid in its design. Staley (2009) goes on further to explain "transit follows a fixed route to specific destinations based on a set schedule. Rail or bus transit is thus frequently an inferior alternative to the flexibility and mobility provided by the customized travel afforded by the automobile."[vi] Even though this references inner city travel, the critique on the public transit system of itself brings up concerns on the efficiency and convenience of HSRs. One researcher, Deluchi (2010), brings up some key points in reference to travel time and the pros and cons of each mode of travel. He states that while the airline industry and HSRs are rigid, they do provide a level of convenience and time effectiveness that are superior to automobiles. While the automobile could be considered the more convenient method of travel in comparison to HSRs and airlines, the limited regulation of automobiles in a specific area leaves the roadways in which it occupies subject to congestion which will impede on the convenience of the automobile.[vii](Deluchi, 2010) This is where the airline industry and HSRs have an advantage because they are limited by safety regulations that will not allow the system to be overcrowded. Therefore, these methods of travel have the potential to reduce the chance of late arrivals from one point to another.(vii) This does not mean that traffic congestions is the only model to delayed travel times, but it does bring into context alternative factors that can impact travel time and convenience. The other advantage that these two systems have is that they both are able to operate at faster speeds than the automobile. The reason for the concern of congestion stems from the overcrowding of a specific area, which then becomes an issue of population and not just the transportation system itself.

Population (Population Growth)

Studies like America 2050 have shown that the population or the population density is one of the key factors in the feasibility of HSRs. This is specifically observed when analyzing foreign HSRs. In countries like China, Japan, Germany, France and Spain, it is apparent that the populations of the cities in these areas are suitable for HSRs. This is supported by current studies conducted in America as it justifies why the Acela Express is located in the Northeast region of the United States as it is home to four of the top twenty-five most populated metropolitan areas in the United States. The existing population is a key factor in determining the feasibility of HSRs but it is not the deciding factor in implementing HSRs.(ix) (Hagler et. Al, 2010) According to recent census data the United States of America's population has grown 9.7% as the southern population has grown 14.3%, the northeast population grew 3.2%, the western population grew 13.8%, and the Midwest grew 3.9% from 2000 to 2010.[viii](United

States Census, 2010) This data shows that the southern and the western portion of the United States are growing significantly faster than the Midwest and the northeast portion of the United States. This shows that the population is shifting towards other portions of the United States and therefore there will be a potential need for transportation upgrades. The study conducted by America 2050 also suggests "metropolitan area size is a necessary prerequisite for high-speed rail, but not a sufficient indicator on its own for a successful corridor."[ix] What this statement explains is that the population of a metropolitan area cannot accurately determine whether HSRs are successful or not, as the accessibility to another (suitable) metropolitan area is an important factor as well.

Connecting Markets

The main purpose behind improving intercity travel is to connect economic markets. By improving the travel time, expense, and overall feasibility of the travel, in theory this would allow for increased incentives to travel and partake in these markets. The issue in trying to achieve this concept is to determine which modes of travel are best for moving from market to market.

The other issue to take into account is how to determine which markets are suitable for being considered for HSRs. Hagler provides insight to this issue as she explains that the markets must be considered a mega region. By definition "mega regions are networks of metropolitan regions with shared economies, infrastructure and natural resource systems."(ix) What is essential about this statement is that it expresses the importance of the population along with a substantial market from which there is a need to move from one area to another for economic benefits.

David Levinson (2010) research on the economic impacts of HSRs supports this concept by explaining that HSRs are most successful in a hub. A hub is defined as "a center of activity, from which multiple (at least three) spokes (links connecting the hub with other locations) emanate."(x)(Levinson, 2010) Levinson explains HSRs have an effect on economic markets, as it shows how people and goods are transported through specific areas, that are capable of connecting to other economic markets. His research also shows that in investing in HSRs the short term economic benefits include more (temporary) jobs for design and construction work, but permanent jobs can be created through connecting two established economic markets as well as decreasing the amount of time to travel from one market to another. Decreased travel time is one incentive that will draw consumers to HSRs but the reduced cost of travel is a key factor that could draw consumers to HSRs.[x](Levinson, 2010) This is where HSRs draw the contrast to competing modes of transportation including the automobile and the airplane. While studies show that the automobile may be considered more flexible than HSRs to consumers, HSRs have been shown to have increased travel time and are also less likely to experience delays because of its negligence to be impacted by the increased quantity of consumers.(vii) The same argument cannot be made for the airplane as this technology has the capability of operating at higher speeds than HSRs. HSRs do have an advantage over the airline industry as it is able to access the inner city directly, which in turn provides immediate access to the amenities of the specified area. Either way, the efficiency in connecting two economic markets seems to be the key factor in the goal of creating additional jobs.

The other issue in connecting economic markets is how to determine which cities or hubs are suitable to be connected. Traditionally, this is determined by the population density of the metropolitan area, but the population density does not specifically address whether the

metropolitan area is a suitable market to be connected to, as to allow increased jobs and essentially revenue.

**METHODOLOGY**

Logic:

In researching the data and the overall success of HSRs throughout the world, it would be important to set a standard on what would be considered a successful HSR. In the United States the main concern is whether HSRs would generate enough revenue and profit to compensate for the substantial initial investment (the amount to be invested has many different variables). In researching HSRs throughout the world we were able to collect data from Japan, France, Spain, Taiwan, and the United States. The data that was collected is population, time (duration of travel time from one area to another), Gross Domestic Product (GDP), GDP growth rate, and the track miles. These factors have all been shown to have a direct or indirect effect on the effectiveness of HSRs which in turn affects the profitability of HSRs. The HSRs profit will essentially be the deciding factor on whether a HSR line is successful or not as this is the area of concern for most critics in the United States.

Population:

According to the study conducted by America 2050 there must be a suitable population in the metropolitan area in order for HSRs to be effective and usable. Not only does the population need to be suitable, but the metropolitan area that the HSRs are servicing all need to have suitable populations.(ix) In order to obtain this information data was collected from the United States Census, www.citypopulation.de, The Europa World Year Book: 2011 52nd Edition, along with additional sources in order to obtain the existing metropolitan populations in Japan, France, Spain, Taiwan and the United States. In taking the data from the metropolitan areas of these countries, we will be able to derive whether the populations in these areas have a substantial effect on the success and potential profit for these HSR lines. With limited annual data on each of the metropolitan areas in these countries (with the exception of the United States), certain assumptions had to be made, so the data was kept consistent (the same) from year to year as this was the latest census data for each metropolitan area.

Time:

The main purpose of transportation is to move people and goods from one space to another space in a safe and efficient manner. One of the arguments for implementing HSRs is that it is a mode of transportation that is capable of providing travel times that is comparable and more efficient than the airline industry and the automobile industry. In order to prove whether the travel times are a part of the success of HSRs we will utilize the travel times of the metropolitan areas in the listed countries to support whether or not the HSR lines are successful because of these entities. Providing some sort of consistency with these variables can be challenging as not all of the lines run in the same format. This is apparent in a comparison between the Shinkansen (Japan) HSR and the TGV (France) HSR as noted below.

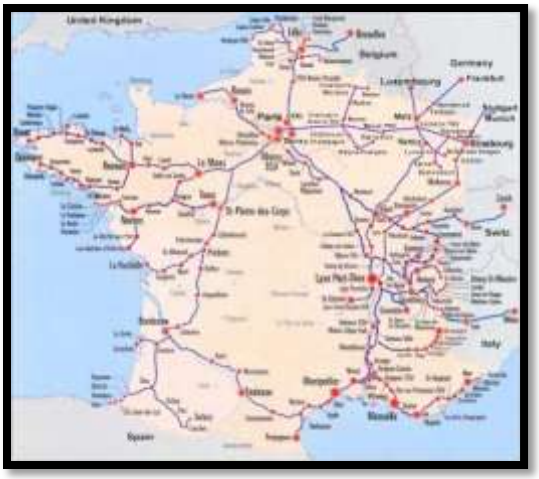

Figure 1[xi]

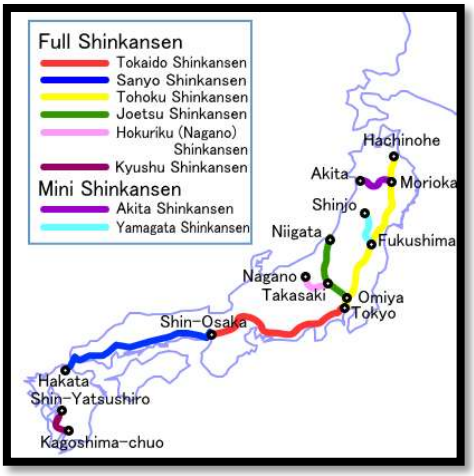


Figure 2[xii]

The TGV, located in France, tends to run around the hub which is Paris (Figure 1), but the Shinkansen (Figure 2) runs in a linear format therefore the lines do not branch out in the same manner. Therefore, we applied the total travel time of each line as to provide the maximum travel time for the HSR service as to provide consistency between each country and HSR.

Economic Markets

The purpose behind utilizing HSRs is to connect economic markets between specific areas and distances. In order to determine this factor it will be necessary to document the GDP of each area or country. According to www.investopedia.com "GDP is the monetary value of all the finished goods and services produced within a country's borders in a specific time period, though GDP is normally calculated on an annual basis." The website goes on further to explain that the "GDP is commonly used as an indicator of the economic health of a country, as well as the gauge of the country's standard of living."[xiii] With this information, we will utilize the GDP of specific areas and countries to determine whether the markets are suitable for HSRs to be profitable. This concept also lines up with the concept of connecting two mega regions as it has the potential to justify whether the population and the economic market could be suitable for HSRs at the same time.(ix) It is to be noted that the United States of America was the only region where we separated the country's GDP and consolidated it to the metropolitan areas of the Northeast Corridor as that is the only place where the Acela Express services. The GDPs for the other countries were taken from the entire country as the HSR lines typically service most of these countries. It will also be important to determine the growth percentage of the GDPs for each region as it will be essential in establishing whether profitability is determined by the growth of each market, or whether it has a limited effect on HSRs profitability.

Track Miles

The track miles for each country were taken to determine the significance HSR lines in each of the countries. The data from the International Union of Railways will be utilized to determine the existing track miles designated for HSRs in order to correlate the significance of this factor compared the profitability of the line.

Cost & Profitability

The major concern regarding HSRs is the initial investment of implanting this technology along with whether this system will be profitable. The initial investment of HSRs cannot be disputed as research shows that HSRs are always expensive. This is consistent with the United States Government Accountability Office's (2009) assessment of two HSR lines in Spain and in Japan. In Spain, the cost of constructing HSR ranged from "$37 million to $53 million" and in Japan the cost ranged from "82 million to $143 million" per mile.[xiv] These two costs are predicated off of the topography of the land along with land acquisition costs which inherently affect the overall cost of the construction of HSRs. With such a substantial investment, the overall profitability will be an important factor in determining whether or not the investment of this system will be worth it. Therefore, the net income will be the determining factor of whether each HSR is successful for an annual period or not. Net income can be defined as "the excess of revenues and gains of a business over expenses and losses during a given period."[xv] The net income will be used interchangeably with profit throughout the data.

Multiple Regression Model

In order to verify whether the investment in HSRs is worth the risk, we will utilize recent historical data in determining which factors are able to contribute to the profitability of HSRs. In order to accomplish this, it will be necessary to utilize a Multiple Regression model. Dr. Miller (2008) states that a "multiple regression analysis is a method for examining the relationship between one continuous variable of interest (the dependent criterion variable) and one or more independent (predictor) variables.[xvi](Miller, pg. 100) The following formula will be utilized:

$$Yi = \beta 1Xi1 + \beta 2Xi2 + \cdots \beta kXik + \beta 0 + Ei$$

Where "Yi is the score obtained for individual I on the dependent variable, Xi1…Xik are scores obtained on k independent variables, β1…βk are weights (regression coefficients) of the k independent variables which maximize the relationship with the Y scores, and β0 is the constant (intercept) and Ei is the error for the individual i."(xvi)(Miller, pg. 100)

Hypothesis:

According to the research documented in this paper, it can be determined that the population, economic market, time, and the significant presence of HSR lines would be significant factors to the profitability of HSRs. To further elaborate, according to this research the greater the population, economic market and the greater HSR lines present, the more profitable HSRs can be. At the same time, the less time it takes to get from one area to another, the greater the profitability for HSRs will be as it should provide greater competition between the automobile and airline industry.(vii)

## DATA ANALYSIS

Table 1

| Country & Year | Pop. | Time | Net Income | GDP | GDP Growth | Track Miles |
|---|---|---|---|---|---|---|
| Japan 05 | 97925737 | 13.5 | $3,465,527,000.00 | $4,025,000,000,000.00 | 2.60% | 1533 |
| Japan 06 | 97925737 | 13.5 | $4,244,643,000.00 | $4,218,000,000,000.00 | 2.20% | 1533 |
| Japan 07 | 97925737 | 13.5 | $4,986,899,000.00 | $4,272,000,000,000.00 | 2.00% | 1533 |
| Japan 08 | 97925737 | 13.5 | $4,382,989,000.00 | $4,329,000,000,000.00 | -0.70% | 1533 |
| Japan 09 | 97925737 | 13.5 | $4,782,336,000.00 | $4,149,000,000,000.00 | -5.20% | 1533 |
| Japan 10 | 97925737 | 13.5 | $3,078,868,000.00 | $4,310,000,000,000.00 | 3.90% | 1533 |
| USA 08 | 37509350 | 7 | $220,200,000.00 | $2,414,948,000,000.00 | 2.93% | 226 |
| USA 09 | 37793855 | 7 | $59,600,000.00 | $2,394,316,000,000.00 | -0.85% | 226 |
| USA 10 | 37706000 | 7 | $100,600,000.00 | $2,511,095,000,000.00 | 4.88% | 226 |
| France 08 | 15609400 | 5.75 | $1,489,969,500.00 | $2,094,000,000,000.00 | -2.50% | 1170 |
| France 09 | 15609400 | 5.75 | $1,184,467,500.00 | $2,145,000,000,000.00 | 1.50% | 1170 |
| Spain 09 | 12766836 | 7.75 | -$32,155,380.00 | $1,359,000,000,000.00 | -3.70% | 1,003 |
| Taiwan 09 | 16256259 | 2 | $272,146,350.00 | $734,300,000,000.00 | 10.80% | 216 |

The data presented in Table 1 shows the country, population, time, net income, GDP, GDP growth percentage and the existing track miles (HSR) for each country. Based on these observations, it looks as if the Shinkansen (Japan) has the greatest population, net income and GDP in comparison to the other regions. One factor that should be taken into account is that the United States currently has the largest GDP in the world, but as stated in the methodology the GDP for the metropolitan area in the northeast corridor of the United States was taken instead of the entire country as this is the area that is serviced by the Acela Express. In comparison, the northeast corridor (USA) has the greatest GDP growth percentage in comparison to the other countries, but it also has the slowest time compared to the track miles in comparison with the other countries listed. This is consistent with current research that determines that the Acela Express on operates at average speeds of seventy nine miles per hour.(xiv)

Table 2

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Population | 13 | 58,500,000 | 38,900,000 | 12,800,000 | 97,900,000 |
| Time | 13 | 9 | 4.104699 | 2 | 13.5 |
| Profit | 13 | $2,170,000,000.00 | $2,020,000,000.00 | -$32,200,000.00 | $4,990,000,000.00 |
| GDP | 13 | $3,000,000,000,000.00 | $1,270,000,000,000.00 | $734,000,000,000.00 | $4,330,000,000,000.00 |
| GDP Growth | 13 | 0 | 0.041408 | -0.052 | 0.108 |
| Track Miles | 13 | 1033 | 588.7608 | 216 | 1533 |

Table 3

| Correlation | Population | Time | GDP | GDP Growth | Track Miles | Profit |
|---|---|---|---|---|---|---|
| Population | 1 | | | | | |
| Time | 0.9497 | 1 | | | | |
| GDP | 0.9613 | 0.9590 | 1 | | | |
| GDP Growth | -0.1038 | -0.3365 | -0.2357 | 1 | | |
| Track Miles | 0.7012 | 0.8002 | 0.7443 | -0.4127 | 1 | |
| Profit | 0.9015 | 0.8785 | 0.8916 | -0.2413 | 0.8622 | 1 |

Table 3 shows the correlation between each factor, but more specifically it notes the correlation between each factor in comparison to the profit. The data shows a strong correlation between each variable in comparison to the profit except for GDP growth. This data shows that all portions of the hypothesis were correct with the exception of GDP growth. With this information, it can be determined that an area with suitable population, GDP and track miles with a HSR line that is capable of reducing travel times is capable of reaping significant profits. Unfortunately, this information is not enough to determine whether a HSR line will be profitable or not as this data just shows the correlation between each variable. In order to further determine whether a line will be profitable or not, we must determine which variables are usable in predicting the profitability of HSR lines.

Table 4

| PROFIT | Coef. | Std. Err. | T | P>t | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| Population | 74.65067 | 22 | 3.36 | 0.012 | 22.1131 | 127.1882 |
| Time | -5.57E+08 | 212000000 | -2.63 | 0.034 | -1.06E+09 | -5.57E+07 |
| GDP | 0.0001543 | 0.0005341 | 0.29 | 0.781 | -0.0011087 | 0.0014174 |
| GDP Growth | -9.80E+09 | 5930000000 | -1.65 | 0.143 | -2.38E+10 | 4.23E+09 |
| Track Miles | 2070423 | 464230 | 4.46 | 0.003 | 972694.2 | 3168151 |
| _cons | 6.16E+08 | 944000000 | 0.65 | 0.535 | -1.62E+09 | 2.85E+09 |

Table 5

| | |
|---|---|
| Number of Observations | 13 |
| F( 5, 7) | 32.34 |
| Prob > F | 0.0001 |
| R-squared | 0.9585 |
| Adjusted R-squared | 0.9289 |
| Root MSE | 5.40E+08 |

Tables 4 and 5 shows the significance of the independent variables (population, time, GDP, GDP growth, and track miles) and how it is able to predict the dependent variable which is profit. The data in table 4 shows that population, time and track miles are all usable data that can be formulated to predict the profitability of HSRs predicated on historical data as the probability of "t" is less than .05. It is to be noted that the GDP was not listed as usable data which could be attributed to its close correlation between population and time. This is known as multicollinearity which is "a condition occurring in multiple regression where some of the predictor or regressor variables are nearly linearly dependent. This condition can lead to instability in the estimates of the regression model parameters."[xvii](Montgomery & Runger, pg. 757) Therefore the only variables that will be utilized are population, time and track miles.

Listed below is the legend for the formula that will be utilized to predict the profitability of HSRs:

- Y=Dependent Variable (Profit)
- β= Coefficients (74.65067, -557000000, 2070423)
- X= Independent Variable (population, time, track miles)
- β0= Constant (616,000,000)
- Ei= Error (±540,000,000)

From this information and the data in table 4 and 5 the formula would be:

- $Profit = 616{,}000{,}000 + 74.65067 * (\text{Population}) - 557{,}000{,}000 * (\text{Time}) + 2{,}070{,}423 * (\text{Track Miles}) \pm 540{,}000{,}000$

The formula shown indicates the profitability of HSRs based on historical data, which can then be utilized to predict future HSR lines. The formula also shows a significant standard error which is predicated on the data that was presented. With the limited data on HSRs profitability of different lines, it is difficult to reduce the margin of error in this formula. It will be necessary to acquire additional data for different HSR lines to reduce the error in this formula. In spite of the limited data, the formula does support the theory that significant population and track mileage along with reduced travel time are significant factors is HSR lines being profitable. This in turn provides key indicators on the design and the vision in which HSR lines should pursue in determining a suitable market and technology for HSRs.

## CONCLUSION

The research in this document supports that the population, economic market, time and the significant presence of HSR lines will improve the probability of the profitability of HSRs. This research also shows that the correlation between the population and GDP are so closely related that the population has the potential to be a clear indicator for whether an HSR line can be profitable or not. This data essentially shows that HSR lines have the potential to be profitable as long as it is able to service two significant megaregions within suitable times that are capable of rivaling other transportation industries like the automobile and the airline industry. This information also shows how planners can forecast areas that will be able to utilize this technology and therefore can make an informed decision on whether this technology is worth the investment or not. As stated earlier in this paper, it cannot be disputed HSRs are an expensive investment, even though certain factors contribute towards the cost of the line more than others. What this research shows, is that there are clear indicators that have the potential to show not only whether HSRs can be profitable, but also how profitable the line can be. There are also other factors that have to be considered in determining whether HSRs should be implemented in specific areas but this research provides insight to which factors should be focused on in the success of HSRs. With more data and further research, it will become clearer what factors and which areas would be suitable for the success of HSRs.

**REFERENCES**


1. American Public Transportation Association. *An Inventory of the Criticisms of High Speed Rail: With Suggested Responses and Counterpoints*. January 2012.
2. Central Japan Railway Company. http://www.english.jr.central.co.jp/company/ir/brief-announcement/index.
3. Delucchi, Mark, McCubbin, Don. *External Costs of Transport in the U.S.* 2010.
4. East Japan Railway Company. www.jreast.co.jp/e/investor/index_year.html.
5. Federal Railroad Administration. *Federal Railroad Administration Overview, Highlights and Summary of the Passenger Rail Investment and Improvement Actor of 2008 (PRIIA).* March 10, 2009.
6. Federal Railroad Administration. Vision for High-Speed Rail in America: Frequently Asked Questions. http://www.fra.dot.gov/downloads/FAQ%20Plan%20ARRA%20050709%20FINAL.pdf.
7. Hagler, Yoaz, Todaoravich, Petra. America 2050: Where High-Speed Rail Works Best. http://www.america2050.org/pdf/Where-HSR-Works-Best.pdf.
8. Index Mundi. http://www.indexmundi.com/g/g.aspx?v=65&c=fr&l=en.
9. International Union of Railways. http://www.uic.org.
10. Levinson, David. *Economic Development Impacts of high Speed Rail.* May 27, 2010.
11. Miller, William G. Ph.D. Statistics and Measurement: Using OpenStat. Copyright 2008.
12. Montgomery, Douglas C., Runger, George C. Applied Statistics and Probability for Engineers: Fifth Edition. 2011.
13. Routledge Taylor & Francis Group. The Europa World Year Book: 2011 52nd Edition. Routledge 2011.
14. Staley, Samuel. *The Business Journal: Ridership No Factor in Transit-Oriented Development*. May 28, 2009.
15. United States Government Accountability Office. "High Speed Passenger Rail: Future Development Will Depend on Addressing Financial and other Challenges and Establishing a Clear Federal Role." March 2009.
16. West Japan Railway Company. http://www.west.jr.co.jp/english/ir/financial-data/.
17. www.andregate.blogspot.com/2011/01/shinkansen.
18. www.bonjourlafrance.com/france-trains/tgv-map.htm.
19. www.dictionary.com
20. www.investopedia.com

## END NOTES

[i] International Union of Railways. http://www.uic.org.
[ii] Federal Railroad Administration. *Federal Railroad Administration Overview, Highlights and Summary of the Passenger Rail Investment and Improvement Act of 2008 (PRIIA)*. March 10, 2009.
[iii] Federal Railroad Administration. *Vision for High-Speed Rail in America: Frequently Asked Questions*. http://www.fra.dot.gov/downloads/FAQ%20Plan%20and%20ARRA%20050709%20FINAL.pdf.
[iv] American Public Transportation Association. *An Inventory of the Criticisms of High Speed Rail: With Suggested Responses and Counterpoints*. January 2012.
[v] Victoria Transport Policy. *Transportation Cost and Benefit Analysis: Travel Time Cost*. www.vtpi.org.
[vi] Staley, Samuel. *The Business Journal: Ridership No Factor in Transit-Oriented Development*. May 28, 2009.
[vii] Delucchi, Mark, McCubbin, Don. *External Costs of Transport in the U.S.* 2010.
[viii] United States Census 2010. Residential Population Data. http://2010.census.gov/2010census/data/appointment-pop-text.php.
[ix] Hagler, Yoaz, Todoravich, Petra. America 2050: Where High-Speed Rail Works Best. http://www.america2050.org/pdf/Where-HSR-Works-Best.pdf.
[x] Levinson, David. *Economic Development Impacts of High Speed Rail*. May 27, 2010.
[xi] www.bonjourlafrance.com/france-trains/tgv-map.htm
[xii] www.andregate.blogspot.com/2011/01/shinkansen.
[xiii] www.investopedia.com
[xiv] United States Government Accountability Office. "High Speed Passenger Rail: Future Development Will Depend on Addressing Financial and Other Challenges and Establishing a Clear Federal Role." March 2009.
[xv] www.dictionary.com
[xvi] Miller, William G. Ph.D. Statistics and Measurement: Using OpenStat. Copyright 2008.
[xvii] Montgomery, Douglas C., Runger, George C. Applied Statistics and Probability for Engineers: Fifth Edition. 2011.