HOW FAST IS FAST ENOUGH? A COMPARATIVE ANALYSIS OF HISTORICAL TRANSPORTATION SYSTEMS AND THE CALIFORNIA HIGH SPEED RAIL

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by

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Summer 2016

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This study is to gain a better understanding of California's high speed rail by placing it in the context of transportation changes in the United States of America. America has been transformed by its transportation systems and there appears to be a rational progression in transportation modes. Historically, the three key factors in transportation systems in the United States are technology, subsidies, and routes. Each plays an important role within the transportation system and its development. New transportation modes have shown remarkable achievements creating cities to expand and prosper with new technology. Every new technology has been subsidized with government funding through bonds, land grants or right-of-ways. Along with subsidies, new modes of transportation have shared existing routes that was once carved by foot

paths, wagon routes, roadways, railroads, and highways. Underlying this progression, is the theoretical work by David Harvey. He believed the need to increase movement of transportation systems is sped up by a desire to get to businesses, locations and or commerce transactions quicker. In comparing U.S. transportation to the California High Speed Rail project, one emerging difference was concern for the environment. Although there were early conservation movements in transportation system building, the California high speed rail was subject to environmental legislation. The study shows that the California high speed rail is similar to other transportation modes by moving goods and passengers quickly to destinations. Technology advancements allowed for expedited travel however, the California High Speed Rail Authority scarified speed to save cost by choosing steel-wheel on steel-rail technology rather than faster maglev technology which is being used in European and Asian countries.

CHAPTER I

INTRODUCTION

Statement of the Problem

Article I, Section 8, Clause 3 of the United States Constitution states that the national transportation system will be the responsibility of the federal government under the interstate commerce clause. The United States has experienced a history of government officials exploring the movement of people and goods. An early push for railroad connections across the U.S. sparked a need for travel time to become quicker. It wasn’t until highway planning and construction, as well as commercial aviation, spurred a different mode of travel for travelers to get to their destination quicker, setting the railroad industry behind other transportation leaders. During the 1950’s and 1960’s, governmental leadership realized the need for sustainable long-term ridership in high density corridors. But with government regulations and funding that spurred transportation marvels, the government has also promoted dilemmas (Killian, 1994).

America has been transformed by its transportation systems and there appears to be a rational, historical progression through transportation modes. This thesis will attempt to counter the critics of California High Speed Rail by placing the project in the context of national passenger transportation changes (Mikhail & Horvath, 2010).The question to be asked: in what ways is high speed rail similar to previous transportations systems, and how is it different?

California Governor Jerry Brown's opposition believe that the high speed rail is a boondoggle, stating that what the voters approved in the original 2008 ballot is misleading with increased funding, a decreased number in employment figures from the original figure, and ridership revenue projections that are unpredictable and inflated. When Jerry Brown ran for office in 2010, one critic, Assemblywoman Shannon Grove, Republican Bakersfield nicknamed the Governor's idea "Browndoggle," and argued that high-speed rail was destined to be an unprecedented failure (California High Speed Rail, 2015). Some of the main components of the opposition are: the un-affordability of the project, building the train to "nowhere", taxpayer subsidies, and overstated benefits such as ridership revenue (Elkind, 2014).

Critics of High Speed Rail

Criticisms towards further intercity rail innovation and high speed rail construction has transpired. Opposition to the high speed rail has amassed in smaller numbers with tenacious individuals. The opponents do not represent the larger population overall but have stood out in their efforts to try and derail the project. But as Governor Brown said, "the opposition to the Golden Gate Bridge, the transcontinental railroad and the Panama Canal is similar to the California High Speed Rail Project" (California High Speed Rail, 2015; Elkind, 2014).

At the turn of the 19th century, major roads were transformed into railroad track lines, and travel times were further shortened. All of the transportation mode changes throughout history had critics that saw improvements as unnecessary as the mode was mature and large of sums of money needed for improvements was unthinkable.

Critics also believed that production of progressing modes overshot demand of the consumer (Garrison, 2003).

Unaffordable

Infrastructure in the United States, particularly in California, has been suffering from a lack of investment for several years. California's infrastructure is a vital component of productivity and competitiveness. People move to communities where trust lies within infrastructure for their children's schools, water systems for healthy water supplies, and moving goods and services faster. According to a 2012 American Society of Engineers Report Card on California, the GPA for California rated at an overall C with transportation infrastructure rating at a C- due to "inadequate funding and existing conditions," Vehicle Miles Traveled (VMT) increased 475 percent between 1955 and 2008 (California Infrastructure Report Card, 2012). California's population is projected to grow significantly in the next 20 years, putting an even further strain on the existing infrastructure. Cost estimates have fluctuated since the measure was approved (High Speed Rail Authority 2012 ; 2014 Business Plan) although major components of these changes have been the length and speed of system and construction time (Peterson, 2012):

2000 – $25 billion
2008 – $33 billion
2012 – Draft business plan $98.1 billion, Adopted business plan $68.4 billion
2014 – $67.6 billion
2016 – Draft $64.2 billion

Train to Nowhere

Opponents say that the high speed rail segment from Madera to Fresno is a "train to nowhere." The segment between Madera and Fresno is a 30 mile section and the first to be built with the initial funding package. The opposition says that building between these two locations have cost more than the initial funding allowed for. The authority awarded $1 billion to design and build and $160 million for unforeseen costs. However, construction costs increased and change orders approved giving this section another $14 million ($5 million was already included in the contingency funds). Furthermore, Democratic Representative Dennis Cordoza stated the initial train construction won't run with 29 miles of track but instead with 200 miles of track and reaching one major city (Peterson, 2012).

Taxpayer Subsidy and Overstated Ridership Revenue

Taxpayer subsidies were banned in the original language of Proposition 1A. The Authority states that additional funding will come from private investments and not taxpayers. However, private investors are unwilling to allocate money to a project that is based on estimated ridership figures and without government support due to high risk of losing initial investments. The Authority sought partnerships with firms in construction, engineering and equipment as backers of the project, which further raised concerns of potential investments. Current high speed rail consultants state that inflation adjusted costs will be $71 billion and as high as $93 billion. Wendall Cox, co-author of the *Due Diligence Report* on the high speed rail, stated that:

> Among intercity transportation modes, only Amtrak is materially subsidized. User fees pay virtually all of the costs of airlines and airports, which (together with connecting ground transportation) link any two points in the nation within a day. The intercity highway system goes everywhere, and nearly all of it was built with user fees paid by drivers, truckers, and bus companies. Virtually everywhere high-speed rail has been constructed; financial liability has fallen to the taxpayer. (Wendall Cox, 2013)

Opponents of the high speed rail also state that estimated ridership revenues are too low to sustain the system's operating costs. The projected fare amount would be averaging $86, which includes economy seats, premium seats, non-stop trains, multi-stop trains, and last minute ticket purchases equating to 20 cents per mile. Italy's bullet train fares from Milan to Salerno, about the same miles as the California high speed rail, are 25 cents per mile. China's train line from Beijing to Shanghai is 22 cents per mile. Paris from Lyon equates to 52 cents per mile. On Amtrak's Acela Express, fare sales equate to about 50 cents per mile. Former President of the National High Speed Rail Association stated that "the train will lose money and require a subsidy" unless ticket demands increase substantially as well as increasing ticket prices. Three other critics agree, stating that a yearly subsidy would be required "forever" of around $123 million to $1 billion (Peterson, 2012).

Purpose of the Study

Transportation systems in Colonial America started with paths formed by the foot traffic of pioneers, explorers and missionaries as they travelled from settlement to settlement along the Atlantic coast. Foot paths slowly evolved into roads able to pass horses and wagons shortening the travel time, a growing importance for those involved in trade and commerce. The transportation system followed settlers as they moved inland. Principal routes were established and improved as transportation technology advanced and government subsidies increased.

The purpose of this thesis is to gain a better understanding of California's high speed rail by placing it in the context of transportation changes in the United States. To answer my question, I will begin by reviewing the literature on the history of transportation in America, with particular attention to passenger transportation. I will develop a set of common themes that I believe unite the various modes. I will then describe the California High Speed Rail project and compare it to my set of themes, looking for similarities and differences.

Underlying my examination is the theoretical work of David Harvey a modern geographer that believed that the need to increase the movement of transportation systems is sped up by a desire to get to businesses, locations, and or commerce transactions quicker. The railroad brought a faster mode of transportation to passengers. But that faster mode gave way to changing perceptions of the surrounding world (Harvey, 1989). Harvey continued to say that changes in perception are fundamental to accelerating economic activities while capital moves faster particularly with transportation technologies.

Speed for the railroad and economic benefit symbolized progress that gave room for social acceptances, being punctual, and women traveling along (Schivelbusch, 1977). In 1837, Victor Hugo said “the flowers by the side of the road are no longer flowers but flecks of red or white; there are no longer any points, everything becomes a streak” (Schivelbusch, 1977). People no longer had the landscape relationship traveling on railways as they did when traveling by horseback. The space time compression brought an intrinsic loss; geographic expansion grew in size but the experience declined (Harvey, 1989). It also restructured landscapes while destroying others. Modernity became a culture of a fast paced life, and people rushed under industrial capitalism.

Limitations

There are limitations to studying a broad subject on transportation. It is not feasible to address all transportation modes. Only selected ground transportation modes were addressed to focus on detail and relevance for recommended further research and study. Although this thesis references air travel and steamboat travel, this thesis covers ground transportation modes only.

List of Acronyms

- ARB – Air Resources Board
- ARRA – American Recovery and Reinvestment Act
- CADOT – California Department of Transportation
- CALTRANS – California Department of Transportation
- CARB – California Air Resources Board
- CEQA – California Environmental Quality Act
- CHSRA – California High Speed Rail Authority
- CHSRA – The Authority CTC – California Transportation Commission
- EIR – Environmental Impact Report
- EIS – Environmental Impact Statement
- FHWA – Federal Highways Administration
- FPEIR – Final Programmatic Environmental Impact Report
- FRA – Federal Railroad Administration
- GHG – Greenhouse Gas Emissions
- HSGT – High Speed Ground Transportation

- HSPTB – High Speed Passenger Train Bond
- HSR – High Speed Rail
- NEC – Northeast Corridor
- NEPA – National Environmental Protection Act
- RTP – Regional Transportation Plan
- SJV – San Joaquin Valley

CHAPTER II

LITERATURE REVIEW

Introduction: Transportation Systems in the United States

America is changing rapidly. California's population in 2060 will reach to putting a strain on existing roads and highways 51,663,771 (California Department of Finance, 2016).

Transportation throughout the United States has evolved with settlement and innovation over the last century. Transportation has helped shape urban development; a city's success was dependent upon the location of transportation systems for that time. Historical and political patterns emerged from these systems with government and private/ corporate entities as key players. Corruption and prioritizing projects influenced these systems in both assured and unconstructive ways. Transportation systems, especially in California, are now impacted with no new federal investments in infrastructure and at capacity with growth. Changes in transportation systems have celebrated many marvels over time but that didn't come without its share of mistakes at all levels, even politically impacted with hidden agendas.

Wagons took place of the horse and railroad took the place of steamboats. Travelers could get to their destination quicker and cheaper. Automobiles were mass produced and made inexpensive so the average person could own one for city and suburb dwellers. Rural populations still depended on steamboat and railroad to move goods long distances. World War II impacted transportation carrying wartime passengers and military freight long distances. Canals and steamboats carried immigrants from Europe and Asia.

In my review of the historical literature, I have found that transportation systems in the United States share three major commonalities and one emerging difference: transitions into new transportation modes are marked by changes in technology, the new technology receives government funding with a combination of private and business funding, and the transportation modes tend to share same routes/ corridors across the state and across the nation. As the technology shifted funding to transportation systems to increase faster modes, focus on the environment emerged as a new concern in the 20th century. Interest in the environmental damage the new transportation systems were causing caught the attention of the government with emphasis on conservation.

Technology

Rose and Mohl stated in a recently published book that the past several centuries have brought changes in transportation technology increasing mobility of commuters, passengers and commerce. The technological changes made mobility faster first with wagons on dirt roads, then paved roads, national railroad networks, highways, and high speed rail systems (Rose & Mohl, 2012).

Author John Stover stated that the United States has always challenged each form of transportation mode with newer technology, but it was the railroad that remained a constant trend of dominance. The technology advanced from horse operated rail cars to steam power engines by innovators looking to increase speeds (Stover, 1997). Stover continued to say that the railroad moved people and goods with decreased costs over long distances.

Stover stated that along with advancements in technology, construction of the railroad track lines paralleled with the pace of construction leading to an expansion from east coast to west coast. The funding companies realized railroad expansion became prosperous and furthered the technology with improvements to the engines/ cars with steam and track lines with steel. During the time of railroad technological advancements, roadways and highways were expanding their technology with the introduction of the Macadam tar (Stover, 1997). In the 1960's, high speed rail technology was being researched and developed in the U.S. under government funding (Stover, 1997; Perl & Goetz, 2013).

Tar Technology

Richard Weingroff's research article published by the Federal Highway Association studied John Macadam who was a Scottish road builder that experimented on road building materials on his local highways. Under government observation, Bessemer discovered that roads are best when raised above the ground for adequate drainage and cover with large angular rocks, followed by smaller rocks then covered in a mass bound with fine gravel making roads permissible and travel quicker. Later roads were covered with Tarmacadam using coal tar. Macadam took his discoveries to the U.S. and paved the first road in Maryland in 1823 known as the Boonsboro Turnpike. In 1830, the second road built with Macadam tar, known as the Cumberland Road, was 73 miles long known and the first U.S. road to be federally funded (Weingroff, 2015).

Steam Engine Technology

Author Lamb and other researchers concluded that steam engine technology works by burning coal that heat up a boiler of water to produce steam. Steam vents up through a large cylinder, creating a piston to move using an in and out movement and a back and forth motion attached to a valve, which pushes a crank connected to the wheels to power the train. The first use of steam engines used by American railroads, the Stourbridge Lion, was imported from England to the U.S. in 1828 but was ultimately too heavy for the existing railroad tracks. In 1830, the Tom Thumb became the first steam powered train to carry passengers with one train car. Additional advancements were made to the wheel fixations allowing improvements to railroad engines from going in a straight line to crossing over mountainous terrains and tighter curves (Lamb, 2012). The technological advancements made to the steam engines, whether for trains or steamboats, provided opportunities to cities and rural areas for settlements resulting in economic growth.

Steel Technology

According to Thomas Misa, steel production expanded using the Bessemer Process. Henry Bessemer was an English developer who manufactured bulk steel inexpensively with the invention of the Bessemer converter. Andrew Carnegie licensed the Bessemer Process and produced the steel for the railroad industry and for the transcontinental railroad. Up until the Bessemer steel, railroad track lines ran on wrought iron, which was too soft for heavy trains and had to be replaced every month. The

Bessemer steel process allowed for rapid expansion of the railroad (Misa, 1995). Andrew Carnegie, a Scottish immigrant entrepreneur and philanthropist, used the Bessemer process to manufacture the Bessemer steel at cheaper costs and quickly became a major U.S. steel producer. The lower costs of steel allowed railroad companies to build 30,000 miles of track in 1862 and expanded to 199,000 miles in 1900. The steel technology not only expanded railroad systems but the steel was also used for expanding bridges, buildings and other structures (Misa, 1995).

High Speed Ground Transportation Technology (HSGT)

The federal government passed the 1965 High Speed Ground Transportation Act, releasing $90 million funding to further explore HSGT Technology. Then in 1969, the NEC used the HSGT technology in two train sets, the Metroliner and the Turbotrain. In the 1970's, the NEC introduced long term planning efforts through the Railroad Revitalization and Regulatory Reform Act for intercity rail. The first state government involvement with HSGT technology didn't happen until a decade later in the 1980's when further funding was granted to study the technology for high speed rail (FRA). The idea behind the Acts was to establish high speed rail along the East Coast "megalopolis", study it and then move it to other corridors across the U.S. (Perl & Goetz, 2013). HSGT technology is a different technology than what is used for the California high speed rail project. Perl and Goetz defined HSGT technology as a mode of travel that upgrades existing railroad technologies to magnetically levitated (Maglev) railroad cars with speeds up to 240mph in densely populated areas that connects cities that are 100 to 500 miles apart (Perl & Goetz, 2013). Due to existing rail line infrastructure, Maglev technology is not compatible with current California railroad lines. The Authority's business plan recognizes that maglev technology is faster and more environmentally feasible however; there is no current data on revenue service or manufacturing of the maglev system available (California High Speed Rail Authority, 2014).

Subsidies

The technological advancements and the rapidly growing railroad network gained the attention of private investment. Author John Stover stated that business men and farmers realized the profitability behind buying land along the railroad tracks and establish shipping rates cheaper than stagecoach/ wagon (Stover, 1997). However, private investors wanted state financial help through capital stock options/ purchasing loans or through bonds. Passenger revenue was important in the mid 1800's significantly costing a passenger a large fee. As the railroad network grew passenger fares decreased, creating fare wars between the railroad companies that shared track lines competing for passenger service (Stover, 1997).

The World Trade Organization defines government subsidies as "a government transfer of money to an entity in the private sector." Subsides have been given by the government for many decades. Private companies that owned roadways collected funds from toll roads using turnpikes that were later ceded to state politicians using taxpayer subsidies to make the roads free to use at "no cost." It wasn't until 1916, that the government enacted the first federal law that granted funding to states for highways and in 1956 created the Federal Aid Highway Act that built the modern day interstate highway system. Government subsidies are not a new concept for the railroads either. The building of the transcontinental railroads gave private railroad companies land and money to encourage the speedy construction to carry passengers, mail and freight at reduced costs. States also contributed to the construction of the railroad. The states provided depots and tax exemptions to connect lines to their communities, which also encouraged more railroad building. Since the 1970's, the airline industry has also received government subsidies. The government pays a subsidy to an airline that guarantees "a specific level of service is provided" (Marlin, 2009). The subsidy is shared with service communities that are reimbursed if the communities are in compliance with their contract with the Federal Aviation Act (Marlin, 2009).

Routes/Corridors

Garrison and Levinson concluded that transportation routes shape a community and define where prosperity develops. The route has the capability to provide access and promote development. As transportation advances, existing routes or corridors are expanded to maximize movement of goods and people (Garrison & Levinson, 2005).

Before horses and wagons, people traveled on foot and created routes to follow. A few Mormons missionaries set across the Sierra Nevada Mountain's on foot to connect to California and traverse the mountain range back to Utah. The first missionaries in California carved the El Camino Real on foot and established missions along the coast line. The foot paths that were created were then used by horses and wagons that created opportunity for others along wider roads (Garrison & Levinson, 2005). The dirt roadways were then turned into rock roadways with later technology becoming paved. The El Camino Real is now covered and used as major highways and sections of city streets. Railroad track lines were laid over the Sierra Nevada Mountains covering over old wagon roads. The railroads made travel faster, granted opportunities to experience other landscapes, and provided mobility for settlement in other states using corridor communities to grow markets of agriculture, textiles, and goods and shipments across the U.S. (Garrison & Levinson, 2005).

Environmental Concerns

Deakin authored that one major difference in transportation systems is environmental concerns. Railroads sped through construction through the accumulation of not only government funding but through land (Deakin, 2010). As the railroad technology advanced, so did the resources it needed. The railroad tracks were laid through streams, tunneled through mountains, cut through hills. If the construction couldn't get through the landscape, the construction changed it. The railroad companies were able to cut timber and use land resources as needed. The time to see the economic benefit of the preservation of the environment came after the transcontinental railroad was built, when travelers wanted to experience the railways over the Sierra Nevada Mountains. That gave an indication of how great the West was for business (not for the environment) (Howard, 2000).

Stephen Fox wrote that one of the earliest accounts of preservation movements for the environment and not business due to the railroads was in Yellowstone. When Yellowstone was designated a national park, there was no language that hid the park from commercial exploitation. President Roosevelt, influenced by environmental philosopher John Muir, established the national park system. John Muir first addressed environmental concerns, but it wasn’t until the after the national highway system in 1969 and 1970 when National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) were enacted (Fox, 1986). NEPA and CEQA serve the purpose of preserving the environment from significant impacts from human activities (Bass, Bogdan, & Rivasplata, 2012).

Stagecoach/ Wagon: Technology, Subsides and Routes

Author Morris accounted for the first privately owned stagecoach was owned by an individual in 1718. In 1775, the stagecoach was used for baggage freight by George Washington and Edward Braddock, his English commander but it wasn’t until 1784 that the stagecoach could travel long-distance, two weeks, carrying passengers up and down the Boston Post Road – New York to Massachusetts. In 1785, the stagecoach was the main carrier of mail, overland mail and express mail in the United States and the only communication mode until the railroad and telegraph. The Post Office set up several “stages” that experienced exponential growth, extending routes in the eastern states. The stages of travel were located along turnpikes and post roads making it easier for travelers to dine and lodge as well as for the horses to rest (Morris, 2016). Traveling in the interior of the land was either done along rivers or narrow roads mostly used by Native Americans, however these roads were inadequate for true passenger wagon settlement. Due to the uneven and often treacherous narrow roads, an attempt was made to build a road during the French and Indian War through the Appalachian mountain to the west known as Wilderness Road.

In 1818 when the National Road was completed (the National Road was the first federally funded road to be used for western expansion) (Federal Highway Administration, 2015), use of the Wilderness Road declined (Vineyard, 2002). Stagecoaches grew in popularity forcing road improvements. Initially, the roads were funded by the federal government continuing until the Revolutionary War. After the war the government seized funding, compelling private companies to purchase right-of-ways and clear land for the coaches. Soon westward expansion along main routes made pioneer trails famous: the Oregon Trail, the Santa Fe Trail, and the California Trail. Several of the private companies made a route to the west as a preferred emigrant route (Morris, 2016).

Railroad: Technology, Subsides and Routes

Bain wrote that Baltimore, Maryland, was the third largest city in the United States in 1827 yet it didn't have a canal, although it had minor connections through waterways, author David Bain found (Bain, 1999). Merchants couldn't compete with other cities that had a canal so the states began investing in railroads. The Tom Thumb was the first steam locomotive built in 1830 allowing passengers and goods to travel quicker and over rough terrain by the Baltimore and Ohio Railroad at a speed of 18 miles per hour. Although the Baltimore railroad proved to be successful, the railroad experienced slow growth due to cost cutting by the contractors since the contractors provided their own funding in contrast to the canals which needed minimal upkeep, keeping the canals in demand. The railroad connected cities in the east but lacked the connection to the west (Transportation & Infrastructure Committee, 2016). The railroad grew in 1840 to 3,328 miles of track (Bain, 1999). Before the railroad expansion to the west, the government appropriated $150,000 and added another $20,000 to survey the topography in the southwest for possible routes. The final report, illustrated with maps, geological formations, animals, plants and Native Americans revealed routes from engineers and state representatives that would be encountered with choices and problems. The report provided information about the great possibility of building the railroad but raised economic questions (Bain, 1999).

Roadway

Weingroff found that historically roads in America were made of dirt with deep ruts carved into the ground by stagecoaches and horses. The road conditions made travel long and slow, especially in the winter. The Boonsborough Turnpike Road in Maryland was the first road constructed of macadam material. Macadam material is made of small, crushed broken stones laid in layers and covered with a surface material that served as a binding agent. Today that binding agent is tarmacadam or tar (Weingroff, 2015).

Ohio entered the union in 1803, generating the first federal highway road project completed in 1818. The first government funded road known as the National Road or Cumberland Road, linked the Ohio Valley to the Atlantic Ocean reaching to Columbus Ohio in 1833 and far west of the Mississippi by 1852. The National Road was the second road in America to be built on macadam road material. By 1876, the first asphalt paved road was Pennsylvania Avenue in Washington D.C. (Weingroff, 2015).

In 1900, there were 1,800 gas powered vehicles on the road. In 1902, the first drafted federal aid bill was to fund roads for $20 million to create the Bureau of Public Roads. However, Congress believed the federal government didn’t have constitutional backing to enact the program, and the bill eventually died. Soon after, attitudes shifted when farmers pressured for road improvements to better move goods. In addition Henry Ford created the first low priced vehicle, the Motel T, available to the average person. In 1907, *Wilson v. Shaw* upheld the power of Congress with constitutional backing to create the interstate highway system, including canals (Sky, 2011). Another decision to create improved roads and a highway system brought about the creation of the American Association of State Highway Officials (AASHO) to help states' legislation with policy and standards to build roads (Marlin, 2009).

In 1916, the Federal Road Act, passed which established a national policy for federal and state governments to share the cost of road construction to be given to rural areas. This was followed by the 1921 Federal Aid Road Act which appropriated funding to build an interconnected interstate highway but focused more on forest highways. In the 1930's, Congress forged ahead to provide more funding for the highway system to alleviate the effects the Depression era was having on the economy. Congress thought more funding would create employment through more Public Works Departments (Sky, 2011).

<u>Highway: Technology, Subside,s and Routes</u>

Author Swift wrote that in 1930, there were approximately 26,750,000 vehicles (Swift, 2011). America's entrance into World War II in 1941 modified the focus on highways. Highway construction in parks and forests was suspended so more effort could be given to the defense projects and roads for military and war-related business. When President Roosevelt took office, he knew that military coming back from the war needed work and he appointed the National Interregional Highway Committee to center its attention on the need of an interstate highway. The Committee's report, Interregional

Highways, supported its findings of a highway system consisting of 33,900 miles, plus 5,000 miles of urban routes. In 1944, Congress signed the Federal-Aid Highway Act based on the report to “include 40,000 miles, connected by routes, metropolitan areas, cities, industrial centers, and serve the National Defense, and connect suitable points, routes of importance in Canada and Mexico” (Federal Highways Administration, 2016), (Swift, 2011). However, neither the 1944 Act nor the one before ever approved funds specifically for the interstate highway system or for when and where construction would be started.

As the war came to an end in 1947, assembly lines were packed and vehicle registration increased to thirty-eight million, an almost 60% increase in a five year period. The Bureau of Public Roads had the task of choosing the routes while the states chose the right-of-ways. The Census Bureau provided information for a population sampling by dividing cities into squares and determining the percentage of homes in each. Patterns emerged to build the interstate system in poor city neighborhoods, tearing down buildings, including dwellings, to clear space and forcing people elsewhere, which prompted the Housing Act of 1949 to replace slums with public housing. No federal funding was given to the states so the states started to build their own expressways, financing them with toll roads, turnpikes and bonds. It wasn’t until 1952 that the federal government earmarked a check to the interstate system for the future fiscal year of 1954-1955 (Swift, 2011).

In 1956, President Eisenhower signed the Federal Highway Act for $26 billion to build approximately 41,000 miles of highway over a thirteen year period, renamed to the National System of Interstate and Defense Highways (Swift, 2011). The new highway system was intended for “speedy, safe, and transcontinental travel” that was of national interest. The federal government would pay 90 percent that would come from a gasoline tax and the other 10 percent would be at the cost of the states. The Act also stated that the “design standards were to accommodate the forecast of 1975” (Federal Highways Administration, 2016). Similar to the high speed rail with estimated ridership revenue to repay the cost of the system, Eisenhower mapped out a new grid of highways with a more in-depth report on the highways, building in parts without a complete whole but making sure the parts fit into the whole (Swift, 2011). The interstate system had been in the making for years ahead of the 1956 Act; however the 1956 Act saw the interstate system through its funding appropriating, saw a nationwide system, and saw the systems completion. The Highway Fund is the Act’s source of revenue, which generates revenue from motor vehicle tax and gas tax. This was Eisenhower’s original plan for a self-sustaining system for national interest goals (Swift, 2011).

History of Railroads and Legislative Acts

Claude Wiatrowski wrote that there were 23 miles of railroad in the United States in 1830, owned and financed by private rail companies (Wiatrowski, 2012). In 1844, Samuel Morse sent the first telegraph from Washington DC to Baltimore, Maryland, opening a new form of communication moving to the western states alongside the railroad (Economic History Association, 2016). When President Fillmore was elected in 1850; he signed the first federal Railroad Land Grant Act. The Railroad Land Grant Act was signed into law to promote railroad development in undeveloped areas at a reduced rate that helped offset construction costs. The loans had to be paid back at an interest rate of 6 percent. The law also provided that a company could be given up to 20 sections of land for every mile of track laid. Most of these loans went to the first five companies that built the transcontinental lines: the Union Pacific, the Central Pacific, the Northern Pacific, the Southern Pacific and the Santa Fe. The railroad companies received a combined 130 million acres of land. The States added another 50 million acres of land grants, and local communities also subsidized railroad companies by giving them land for depots and rights of way and tax exemptions. This created a system expansion to 9,000 miles, bringing the total of public land grants given by the States and Federal Government to 180 million acres (Smith, 1990; Wiatrowski, 2012). In 1851, telegraphs were utilized for railroad use by dispatching the trains to coordinate train departures. By 1853, the railroad industry attracted immigrant employees, launching Andrew Carnegie's interest in the railroad industry. By 1856, the Bessemer converter was developed, making the manufacturing of steel inexpensive. In 1860, the railroad had 30,000 miles of track. One year later in 1861, the Civil War began, prompting the railroads to transport soldiers and equipment. Then in 1862, President Abraham Lincoln signed the Pacific Railway Act on July 1. The Act established land grants and governmental bonds to two companies, the Central Pacific Railroad and the Union Pacific Railroad, to build the transcontinental railroad. These grants and bonds amounted to $16,000 per miles of track built over easy grade, $32,000 per miles of track in the high plains and $48,000 per miles of track in the mountains. Shortly after the Act was signed, construction for both companies, the Union Pacific and Central Pacific Railroads, forged ahead on the West and East coasts (Wiatrowski, 2012).

Author Bain concluded that the Central Pacific built from Sacramento and moved east, and the Union Pacific built from Council Bluffs, Iowa, and moved west. Both parties respectively dealt with obstacles and by the end of 1868 both railroad companies had reached their way to Utah. Both companies maintained their track line driven by the monies per mile of tracks laid. There was no construction end point when the Act was initially signed. Seven years later, on April 9, 1869, Congress established a meeting point north of the Great Salt Lake in Utah at the Promontory Summit (Bain, 1999). One month later, on May 10, 1869, locomotive cars from each company, Central Pacific's Jupiter and the Union Pacific's No. 119, touched, signaling a joining of the two railroad lines with a nearly combined 2,000 miles of track, which formed the Transcontinental Railroad. The 6 month journey of people and or goods from Nebraska to California was reduced to less than 1 week. In August 1870, the last railroad connection was made making travel from coast to coast possible with a gold plated "golden" spike. In 1871, the land grants ceased to be public policy because reformers began to question the money and public properties were given to private companies; by this time the US now had 53,000 miles of railroad. Almost two decades later, in 1887, Congress passed the Interstate Commerce Act to control aspects of the railroad industry in response to local and state governments' protests over unregulated rate increases. This attempted to limit "preferential treatment to large shippers in the form of lower rates", giving farmers and other businessmen reasonable and just transportation rates (Bain, 1999). The Act also created the Interstate Commerce Commission to oversee industry compliance; however the railroad controlled the monopoly until 1902 when Roosevelt was president and signed in the Elkins Act and the Hepburn Act giving power back to the Commission (Smith, 1990; Bain, 1999).

Bain also found that rail mileage peaked in 1916 at 254,000 miles with 1.2 million passengers boarding 9,000 intercity trains and 47 million passenger miles every day. The next year the government nationalized railroads with the government run Railroad Administration to increase wartime efficiency and passed the Standard Act for the standard time zones for war time conservation efforts (Bain, 1999). The Railway Control Act was signed in 1918 for the duration of the war giving the government control again until 1920 when the Esch-Cummins Act/Transportation Act was signed to return railroads to private management and relinquish federal control. Author Rich stated that the Act sought to help the finances of the railroad by authorizing consolidations with a 6 month guarantee and authorized loans for various reasons. Congress also “provided for arbitration without power of enforcement and established voluntary adjustment boards to settle labor disputes” (Rich, 1920; Bain 1999).

The Depression in the 1930’s brought a decline in passenger rail service. Rail revenue fell by 50 percent from 1928 to 1933. By the 1940’s, at the end of World War II, the railroad had a short increase in rail service from the war traffic; however in 1949, rail service again decreased amounting to losses in passenger services and routes. When the highways brought competition to the railroads, funding shifted to highway construction, further contributing to railroad losses (Association of American Railroads, 2015; Rich, 1920).

Amtrak and Passenger Service

Perl and Goetz, two researchers from the University of Denver in Colorado both concluded that as the automobile and airline services grew in popularity, the railroad suffered from a deficit of passenger rail operations in the 1970's. The highways and aviation started receiving federal funding for planning and construction, which intrigued passengers. The Interstate Commerce Commission allowed railroad companies to abandon their passengers' routes that added no monetary value, leading to a decrease in total rail miles from 107,000 to 49,000 between 1958 and 1970 (Perl & Goetz, 2013). To revitalize the passenger rail system, Congress created the National Railroad Passenger Corporation (Amtrak) in1970, a private company, in hopes to create a profitable undertaking for certain busy Corridors. "In creating Amtrak, Congress sought to establish a single, for-profit corporate entity that, with initial Federal assistance, and with infrastructure, financial and other contributions from the freight railroads, would be responsible for providing all intercity rail passenger service over a unified national system" (Amtrak Reform Council, 2012). The first high speed rail built in the US was built by Amtrak and called the Acela Express. It traveled along the Northeast Corridor traveling between Boston and Washington D.C. with fourteen stops along the way (see Figure 1). The Acela Express can reach speeds up to 150 mph and per federal government standards, this is high speed, although the train has an average speed of 68 mph. To compare, the Shanghai maglev (magnetic levitation technology) tops speeds of 268 mph with an average of 143 mph. Portions of the track are shared with commuter and regional trains making travel time slower; grade crossings and turns also factor into slower travel times (Perl & Goetz, 2013).

Figure 1. Amtrak Northeast Corridor route.

Source: Amtrak. (2012). *The Amtrak vision for the Northeast Corridor*: *2012 update report*. Retrieved from https://www.amtrak.com/ccurl/453/325/Amtrak-Vision-for-the-Northeast-Corridor.pdf

Until the Act of 1970 was signed, the railroads were owned by several railroad companies. The Act gave the railroad corporation a singular, unified managed network across the national railroad network. One May 1, 1971, Amtrak served 43 states with 21 routes totaling 457 miles. The Northeast Corridor (NEC) is the largest railway by way of ridership and service frequency in the United States. The NEC runs between Boston, New York City, Baltimore, Philadelphia and Washington D.C. with 899 miles of track. The NEC was built by two railroad companies, the New York, New Haven and Hartford Railroad (NYNH&H) and the Pennsylvania Railroad (PRR) (Perl & Goetz, 2013).

Peterman, Frittelli, and Mallets authored that the NEC's main track lines were built between 1830 and 1917 (almost a century to build) with modern portions rebuilt in 1965 under the High Speed Ground Transportation Act. The Act established funding for developing and upgrading the high speed ground transportation (HSGT) technology to improve travel time and performance. The Act also gave the NEC, some HSGT equipment, such as the Metroliner cars and Turbotrain (Peterman, Frittelli, & Mallets, 2013).

Leading up to the Act was a push from Congress to allocate funding to research intercity non-commuter passenger rail to determine if the corridor could handle existing and future service demands as well as a self-sustaining funding source. During the time the Act was signed, two transportation shifts were happening. Traffic was primarily (1) commuters traveling to and from work regularly and (2) traffic of commuters were traveling further distances not on a regular basis. Federal aid came in the form of the Urban Mass Transportation Act of 1964, matching funds with states to provide mass transportation, but the Act didn't include intercity transportation modes (DeGood, 2016; Perl & Goetz, 2013).

In 1976, Amtrak bought the NEC, and most other intercity rail lines in the US, initiating funding for further improvements due to the disrepair that the NEC was under for HSGT technology. The funding helped to electrify 155 miles of railroad lines as well as introduce the first high speed rail in the US, the Acela Express in the year 2000 at a cost of $4 billion (U.S. Federal Railroad Administration, 2014). Since the introduction of the Acela Express, the region has grown with congestion on highways. The region in the NEC accounts for 17 percent of the nation's population on 2 percent of land area, operating on 20 percent of its GDP. Eight percent of the Northeast corridor population lives within 25 miles of the NEC, increasing demand on rail service (Amtrak, 2012), (DeGood, 2016).

Author DeGood concluded that the role of the Amtrak train routes has proven to be as efficient as driving, accumulating 37 percent of trips between Washington D.C. and New York City of highways and airlines combined and from New York to Boston, Amtrak train routes have accumulated 20 percent of combined modes growing in 2011 by 53 percent. Sales from passenger tickets paid for 93 percent of Amtrak's operating costs, earning $2.8 billion in revenue and expenses at $4 billion. Federal subsidies funded 30-35 percent of the total budget equaling the subsidy amount to the highways. Although passenger service sales show adequate measures of ridership, Amtrak lacks a steady funding source for further development or planning (DeGood, 2016). In a seven year period, funding for the highways is equivalent to the amount of funding Amtrak has received since its inception in the 1970's. When Congress sees tickets sales increase, it gives members more reason to cut federal funding. Furthermore, in 2008, Congress adopted positive train control technologies but didn't allow any more funding for installation, making Amtrak choose these mandates over maintenance (DeGood, 2016). Amtrak also operates on privately owned train tracks owned by freight railroads, the states, and other public entities. Amtrak owns 28 percent of the total 21,300 track miles, which gives little to no control to Amtrak over track maintenance and performance schedules (DeGood, 2016).

High Speed Rail in United States: Technology, Subsides and Routes

Authors Peterman, Frittelli, and Mallets concluded that in the 1940's, the automobile and airlines competed with passenger rail service and passengers began to turn away from the railroad as a feasible transportation mode. Railroad cars diminished in upkeep, the train schedules became unreliable and the journey was unpleasant. Shortly after the high speed rail in Japan was completed, the Shinkansen, President Johnson signed the High Speed Ground Transportation Act of 1965. The Act was part of Johnson's Great Society programs. The Act would allow the government to explore high speed rail in the U.S. The Act of 1965 created a regular route on the Metroliner between New York City and Washington D.C. with average speeds at 90.1 mph faster than the Acela. During these times, momentum was building towards high speed rail (Peterman, Frittelli, & Mallets, 2013).

Several items impeded the building of more high speed infrastructure in the US: Geography, layout of cities, and competition with automobiles. However, several countries have built with these same issues, such as Germany, Russia, the United Kingdom and France. The U.S. lacks federal political commitment, having relinquished its decision making to the states. Some states didn't see the national interest and priority over one project to the next. Part of the national interest back in 1956 was the federal gas tax with the highways, decision rested on the states of routing but the connections were made on the federal level with 90 percent funding (Federal Highway Administration, 2016), (Peterman, Frittelli, & Mallets, 2013).

Harvey Theory: Technology, Subsides and Routes

Before the railroad, perception of the world was perceived differently that what was familiar. What was unfamiliar were the faraway towns and landscapes that remained unseen. Distance meant taking time to travel, the modes to do so and the limiting effects of movement of people and goods, compartmentalizing the consequences of those perceptions. The railroad not only changed the landscape but the way travel depicted the world (Harvey, 1989).

Economic acceleration of activities, such as the high speed rail, leads to an alteration of people, space and time. The distances between locations, specifically along the high speed rail system with travel and cost effectively makes each place closer. David Harvey believed that the acceleration is due to a shift in capitalist economy and not necessarily the result of technological advancements leading to a time-space compression. The frequency in consumption shifted in this country from the result of more flexible production – mass production in multiple places and not in a single place creating faster consumption guiding those spaces and distances to compress. The process of globalization reconstructs capitalization into a geographic movement that has been going on since the 1400’s. Capitalism survives on geographic expansion and the products that are moved; major technological innovations are necessary components for the expansion (resulting in speeding up time and travel) (Harvey, 1989).

Like Harvey, Wolfgang Schivelbusch stated that railway travel changed the human experience and perceptions by new technology advances changing the way we experience the journey. The change in perceptions developed from the old way of experiencing landscape into a new sensing mode that took speed as the core perception. Perceptions were faster movements between locations. In today's market, with high speed rail, the focus of place for the attraction of passengers gives the perception of familiarity in travel changing the actual perception of the landscape. Schivelbusch wrote:

> [Supposing that railroads, even at our present simmering rate of traveling, were to be suddenly established all of over England, the whole population of the country would, speaking metaphorically, at once advance en masse, and place their chairs nearer to the fireside of their metropolis…At distances were thus annihilated, the surface of our country would, as it were, shrivel in size until it became not much bigger than once immense city]. (Schivelbusch, 1999)

Transportation systems have experienced a high demand for movement in faster travel times and lower costs. Globalization has placed the movement of people and products on these systems impacting the already congested systems. High demand on poor infrastructure changes innovation for new modes of travel, one being the high speed rail. Unfortunately, highway and airline expansion would require more space. Funding and opposition for more highways has creating instability within the government increasing demand for other transportation systems (Harvey, 1989).

Hakim authored that John C. Calhoun said "Let us….bind the Republic together with a perfect system of roads and canals. Let us conquer space" (Hakim, 2003). But the space of roads and canals extended an already existing system of the natural landscape and or resource, Macadam paved over existing roads – although still considered a technological advancement. The building of the railroad conquered space by reinventing the landscape by blasting tunnels, carving through hillsides, and plowing over streams. Railroads formed towns conquering nature and men, it had authority and prospered areas that would have otherwise been overlooked bypassing if opposition arose, reorganizing time with the conquest of space (Hakim, 2003; Stover, 1997).

Need for Speed

Author Kellermen recognized that a need for time can be shortened and saved with innovations in transportation. Benjamin Franklin once stated, “time is money” and passengers, especially those involved in commerce, want to quickly get to their next destination. The increase in speed of travel has brought distances closer by changing human perspective. As the modes have changed, speed has remained a constant prevailing factor. The desire by business for faster modes of transportation has been a driving factor in shifting modes of travel. Marchetti said that a concept of buying distances and saving time is when passengers begin to place value on the travel and not the location. Buying back place and value for faster commerce times contributed to the formation of daylight savings time by the railroad industry (Kellerman, 1989).

Population growth has spurred a new transportation mode shift to high speed rail. David Harvey states in order for spatial expansion to solve capitalism, technology alone cannot solve it but rather it must be together with the physical environment. Population increases in mega regions, such as the Northeast corridor with high speed rail has seen an upswing in density size. These areas prosper economically yet lack infrastructure to maintain the population shifting the spatial fix to accommodate is expanding the high speed rail network allowing distances to become closer in proximity to city centers giving people connection with changing their perception on valuing a given place (Harvey, 1989).

CHAPTER III

METHODOLOGY

In my review of the literature, I have found three common modes of transportation throughout United States history that connect passenger service to travel destination. Changes in transportation modes led to improving technology, government subsidies, and following existing routes/ corridors. The modes allowed for quicker time travel by shifting focus to subsidies to fund the advancement in technology. As new modes of transportation emerged, the government allowed expanding changes but without regard to the environment. Although environmental issues were intrinsically valued, the need to travel faster extrinsically took the lead until after the building of the national highway system.

I will answer my question by reviewing literature on transportation modes in the United States and reviewing the three commonalities that connect each mode and one emerging factor with environmental issues. Although John Muir recognized conservation efforts early in the 20th century, no other mode of transportation system accounted for environmental damages.

California transportation systems are similar to the rest of the United States' transportation systems. Modern California highways have often followed existing roads. The existing paved roads followed the path of wagon roads, and the wagon roads were created from existing footpaths. Early accounts of North American exploration often relied on surveying of land on foot and progressed to horses, stagecoaches, roads, paved roads, railroads, highways and currently in California, the high speed rail project.

Similar to U.S. history, California had no regard for environmental concerns until NEPA and CEQA were enacted the 1960's/ 1970's. Similar to United States' history, I will compare California transportation history by reviewing the three common transportation modes and one emerging difference of environmental issues with the California high speed rail to see if the commonalities fit within the rail project.

CHAPTER IV

HIGH SPEED RAIL AND TRANSPORTATION IN CALIFORNIA

Early Land Routes

Establishing missions in California helped colonize Spanish Americans in the 1760's. San Diego became the first settlement location and mission by the Spanish government and the President of the Lower California Missions, Father Junipero Serra. Father Serra's goals were to establish Franciscan missions in the northern part of California, and Don Gasper de Portola and sixty four soldiers were selected to lead a land expedition to find the Monterey Harbor. Although initially unsuccessful in finding Monterey, Portola found the San Francisco Bay and set back out on a second journey in finding Monterey. By 1770 Father Serra began work on a second mission in Monterey, and by 1783, seven additional missions were established. Portola's footpath established a connecting foot trail between San Francisco and San Diego is known today as the El Camino Real or US 101 and State Route 1. There are 21 missions in total spaced one day apart by horseback from San Diego to Sonoma. Between 1774 and 1776, an overland route was established by Juan Bautista de Anza connecting Sonora to Monterey; his trail is closely related with portions resembling State Routes 78, 79, and 60 in the Imperial Valley and San Diego (Forsyth & Hagwood, 1996).

In 1822, Spain's independence in California decreased Mexico's restrictions that allowed an expedition, led by Jedediah Smith and fifteen mountain men, to explore the Great Salt Lake in the southwesterly direction across the Colorado River, crossing the San Bernardino Mountains through the Cajon Pass. Although men were denied passage, The men went on to cross the range to Oregon. The exploration led to paths and trails are portions of today's modern highway system: Highway 5, 6, 12, 14,15, 41, 43, 80, 93 and many others crossing over to the Midwestern and Eastern states (Forsyth & Hagwood, 1996).

El Camino Real

The El Camino Real road means the Royal Road. During the Spanish colonial era, the road served as the King's highway (camino real is used to mean crude road that is used mostly by wagons) and connected the twenty one established Franciscan missions, sub-missions, military bases (forts), and towns (pueblos) along a 600 mile stretch from San Diego to Sonoma serving as a stagecoach route. The Spanish Americans established many camino reals linking roads to settlements. The southern route connected Mexico City to Sonora. The Portola expedition was the first exploration along the coast in Alta California to find Monterey and the San Francisco Bay, subsequently leading to further exploration and mission establishments. The Spanish colonized California from 1769 to 1821. When Mexico took victory from Spain in 1821, it marked an ending of European power in California. By the 1830's, Mexico weakened the Spanish missions and increased farming and trade (Bain, 1999).

In 1846, the Mexican American War started, with occupation quickly taken by the Americans in Northern California. In Southern California, Americans combined forces against the Mexican fighters ending the war in 1848 and Mexico ceded Alta California to the United States. Two years later, in 1850, California became the 31st state in the United States (Forsyth & Hagwood, 1996). In 1902, the Real road was made into one of California's first highway's and this began a revitalization process with bell shaped guideposts along the original route (Bain, 1999; Forsyth & Hagwood, 1996).

After California was granted statehood, Californians wanted improvements to roads. The State Highways Act of 1910 brought technological advancements in construction of a paved road along the original route. Portions of the original route remained a dirt road but was eventually paved and completed in 1925. Most of the original route was built into city streets, such as Mission Street in San Francisco. However, other sections of the route are covered with major highways with a portion of that as US 101 from Los Angeles to San Jose, and most of the original route misses the twenty one missions (Rice, Bullough & Orsi, 1996).

Stagecoach/ Wagon: Technology, Subsidies and Routes

Prior to the Mexican war in 1848, California attracted emigration by wagon settlement. The most famous was the Donnor Party crossing the Sierra Nevada Mountain ranges, Donnor Summit, in 1846. After California ceded to the U.S., the discovery of gold triggered a huge influx of migration to California, mostly by sea. By 1849, emigrants moved by wagon along existing Native American trails (Howard, 2000). Thousands entered into California using several routes that crossed through Donnor Pass; some went through Beckworth Pass headed toward the Feather River Basin. The emigrants also used West Walker River to cross the Sierra Nevada Mountains. Wagon settlers also came into California from the north in Oregon along the Oregon trail. Highway construction of Interstate 80 and 84 paved over and follow the original trail westward and pass through towns established along the Oregon Trail. The trail declined when the advancement of the railroad was completed in 1869 (Rice, Bullough & Orsi, 1996).

Legislative pressures mounted once California's statehood was granted in 1850 to improve roads, providing $105,000 for a wagon road to be built from the Sacramento Valley over the Sierra Nevada Mountains to the eastern California border. However, the funding failed prompting franchises to build toll roads and bridges (Bain, 1999).

The first toll road was the Lake Tahoe Wagon Road, which became the first state highway known today as Route 50. Due to the encroaching transcontinental railroad, backers for the Central Pacific successful built the Trans-Sierra toll road, 90 miles long, with completion in 1864 (Howard, 2000). The Trans-Sierra Toll Road was built on earlier emigrant trails to avoid slow construction. Funds recovered quickly from stage and freight businesses and shaved one year off railroad construction for the Central Pacific, further proceeding with government subsidies. In 1857, the largest 6 year contract awarded by the federal government was issued to the Butterfield Overland Mail service for $600,000 per year to deliver mail twice a week from St. Louis, Missouri, to San Francisco in 21-1/2 days. Prior to the Butterfield mail service, U.S. mail was transported by steamboat or ship from the Gulf of Mexico to Panama through the isthmus to the Pacific Ocean around Cape Horn and into California taking about 5 or 6 months for final delivery (Bain, 1999).

Railroad: Technology, Subsides and Routes

The first railroad in California was completed in the 1850's. The Union Wharf and Plank Company built 2 miles of tracks with train cars pulled by horse to haul lumber to the ocean schooners. In the 1870's, the line was upgraded with a steam train engine. Also in the 1850's, the Sacramento Valley Railroad laid its first track lines between R Street and 17th Street in downtown Sacramento. This train was the first common carrier of goods in California and carried passengers in 1856 on a 22.9 mile track line (Bain, 1999).

In 1866, Leland Stanford purchased the Sacramento Valley Railroad, which had already acquired the Central Pacific Railroad. The Pacific Railroad Act was signed in 1862 giving the Central Pacific Railroad land grants, right-of-way and dollars per mile to build from Sacramento east through the Sierra Nevada Mountains and backed by the 'Big 4' investors: Leland Stanford, Collins Huntington, Mark Hopkins and Charles Crocker. The Central Pacific started construction in Sacramento in 1863 and built its first 690 miles of track. Other railroad track lines were being built around the same time as the Central Pacific project. The Western Pacific Railroad and the San Francisco Bay Railroad connected lines of the Central Pacific from Sacramento to San Francisco. Although passenger rail didn't start until the 20th century, San Francisco and San Jose Railroad incorporated in 1859 with construction of five total depots (Rice, Bullough & Orsi, 1996). San Francisco incorporated two other railroads from Oakland and Alameda, both consolidated into the Central Pacific in 1870. The Napa Valley Railroad was built in 1865 but foreclosed in 1869 and bought by the California Pacific Railroad and eventually consolidated in to the Central Pacific. Soon southern California railroads followed: Los

Angeles and San Pedro Railroad and the Los Angeles and Independence Railroad resulting in short railroad lines throughout the state (White, Bain, & Rice, 1996).

The valley railroad was constructed quickly but soon the Sierra Nevada Mountains posed challenges due to weather conditions, strikes, corruption, material and funding delays. It took three years over the Sierras to get to Nevada and finally joining the Union Pacific in Utah. The California railroad had 2,340 miles of track in 1870, eighty five percent owned by the 'Big 4' investors. The railroads created expansion and economic growth in urban areas connecting rural areas and increasing land values and incomes creating a decrease in travel times. Roads improved and small towns expanded with shops, churches and schools, such as in the San Joaquin Valley (Bain, 1999).

Although benefits from the railroad were substantial and progress was the forefront of California, this also became a time for concern of rapid change. John Muir was the first conservationist to save the Sierras from poachers and farmers who wanted to exploit the land. In 1890, he convinced Congress to preserve the land around Yosemite into a National Park and back into federal protection, launching the first environmental protections in California (Rice, Bullough, & Orsi, 1996). John Muir also foreshadowed other concerns in the 20th century. The industrial revolution sparked a growth in population and nonrenewable resources used at an unsustainable rate. Transportation industries plowed through building and manufacturing systems at the cost of the environment with no control in legislation.

One of the subsidized companies to build the railroad from the west over the Sierra Nevada Mountains was the Central Pacific Railroad owned by Leland Stanford. Stanford was Governor of California and President of the Central Pacific Railroad and persuaded the California Legislature to permit county governments to invest in the railroad through bonds in exchange for stock, which would bring in $16 million but would have to be approved by public referenda. The Central Pacific Railroad won with three counties voting to exchange bonds for stock and deed land to the railroad (Bain, 1999). After the vote, the Central Pacific Railroad was granted 162 commissioners to solicit stock subscriptions, 10 alternate sections of land, the ability to issue first mortgage bonds, and a 30 year government loan in bonds. The loan amount varied per mile of track from $16,000 per mile across the plains, $48,000 per mile for the high mountain area, and $32,000 per mile for plateau areas between the Rockies and the Sierras (Stover, 1997). But shareholders started to withhold funds and plead to Washington to receive more government aid; time was wasting and citizens were criticizing. Contractors were paid in cash and bonds and acquired more bonds than the Associates. Trades were made outside the 1862 Act. The Directors had to buy additional shares to meet their goal and placed high values on anticipated revenues that were thought to attract investors – similar to the high speed rail (Rice, Bullough & Orsi, 1996).

Similarly to California's Governor Jerry Brown's opposition of the high speed rail; Leland Stanford's opposition argued that the railroad had no intention in being built through the Sierra Nevada Mountains but wanted to swindle the funds and only build to Dutch Flat northeast of Auburn, then known as the "Dutch Flat Swindle." When the Central Pacific railroad company finished the transcontinental track lines, it turned its attention to the freight business that was constructing a wagon road to haul miners and materials to and from Nevada mines as well as using a railroad track line to carry passengers to and from Sacramento and Dutch Flat (Howard, 2000). With all the back door deals and outside spending, the Central Pacific Railroad still emerged and remained chartered in 1861.

The second subsidized railroad company emerged in 1863. The Union Pacific Railroad was owned by Thomas Durant to build tracks over the Rocky Mountains westward. The government granted $100 million to the Union Pacific. Durant broke ground in Omaha, Nebraska, in 1863 but made little progress as labor was scarce and stock subscriptions were slow creating a need for federal government subsidies. Durant hired “amendable” engineers that melded to his back door dealings with corrupted shareholders but forged on to build as much subsidized track as possible. By 1868, 450 miles of tracks were laid. This hurried approach made the Union Pacific Railroad work flimsy and the track ended up paralleling lines with the Central Pacific Railroad (Stover, 1997). The two rail lines met in Promontory Utah in 1868 driving the golden spike to complete the Transcontinental Railroad connecting the east to the west (Stover, 1997). The Central Pacific built 742 miles and the Union Pacific built 1,038 miles. However, more work followed soon after the meeting because the railroad had to repair mediocre work of relocating, regarding and reconstructing the lines. Construction companies that worked on the rail lines found themselves involved a congressional investigation affecting the Vice President, the Speaker of the House and others who were making millions outside of their initial profit. After the two trains connected, the Northern Pacific Railroad was chartered and given a land grant. The first rail lines were laid in Minnesota in 1870 with the company’s first president seeking $100 million in government aid. But the government, still reeling from the last scandal with the Union Pacific, didn’t grant any funds and construction came to a halt (Stover, 1997).

Roadway/ Highway: Technology, Subsides and Routes

As mentioned in the previous section, “stagecoach/ wagon,” the first state highway in California was Lake Tahoe Wagon Road constructed in 1895 (Forsyth & Hagwood, 1996) and known today as Highway 50. In the same year the Bureau of Highways was created by the Legislature to connect neglectful conditions of the existing highways and to provide a true funding source dedicated solely to the highways. The commissioners appointed to the Bureau reported 16,500 miles of each California County and recommended a highways system composed of twenty eight different routes (Forsyth & Hagwood, 1996).

In 1907 the existing Bureau was dissolved and the Department of Engineering was established. Initially there was slow growth, and most of the minimal funding went towards maintaining the existing road. In 1910, an $18 million state bond was granted to the Engineering Department to acquire land and build a connecting highway system (Forsyth & Hagwood, 1996). In 1913, motor vehicle registration spurred the funding to be divided between the counties and the following year through a motor vehicle gas tax (Forsyth & Hagwood, 1996).

Caltrans (California Department of Transportation) began testing in a maintenance facility for construction material approval to widen and resurface roads and highways. Initial bonds were deemed inadequate from underestimation of road work that needed to be done. The states petitioned for additional monies granted at $15 million in 1916. In total, California completed important projects: Ridge Route and Yolo Causeway, Kings River Canyon, Alturas-Cedarville, Emigrant Gap and Imperial County roads by

1918 with federal aid funding receiving $151 million. In 1919, voters approved additional bonds totaling $73 million. The gasoline tax was enacted in 1923 giving funding to the state highways and to county road improvements (Bain, 1999).

When the 1956 Federal Highway Act, known as the National System of Interstate and Defense Highways, was passed it allocated 2,135 miles to California. California had already built access highways prior to the 1956 Act totaling 1,938 miles by 1947, and by 1955 additional bypasses were added (Rose & Mohl, 2012). The gasoline tax and motor vehicle registration fees increased to create a fund to keep the highway program financed. The 1956 Act allowed for 40,000 miles of highway over a 13 year period at a total cost of $25 million. (Rose & Mohl, 2012)

Background on California High Speed Rail

In the year 2030, the population of California will reach 400 million (Census Bureau, 2010). Resulting in an estimate, doubling the negative effect on the state's crumbling transportation infrastructure (CA Department of Finance, 2016). In order for the state of California to address the states' infrastructure problem, the state was granted funding to propose a high speed rail system.

In 1996, the state legislature created the California High Speed Rail Authority to "develop a plan for construction, operation and financing of a statewide, intercity high – speed passenger rail system" that is both economically viable and environmentally friendly to connect major city hubs. The Authority estimates that in 2028, a passenger will be able to ride the high speed rail from San Francisco to Los Angeles/ Anaheim for under $100.00 on a total of 520 miles of track.

On November 4, 2008, voters approved by 52.7%, Proposition 1A, The Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century. The measure, authorized by the California Transportation Commission (Commission), "would allocate funds for capital improvements to the intercity rail lines, commuter rail lines and urban rail systems that would provide direct connectivity to the high-speed rail train system and its facilities, or that part of the construction of the high speed rail system" as set forth in Streets and Highways Code, Division 3, Chapter 20, Section 2704.04 subdivision (b) requires the Commission to program and "allocate the net proceeds received from the sale of $950 million in bonds authorized under Proposition 1A" for the High Speed Passenger Train Bond (HSPTB) Program (California Transportation Commission, 2014). Of the $9.95 billion, $9 billion would be used with other funds to develop and construct a segment from San Francisco Transbay terminal to Los Angeles union station. The remaining $950 million in bond funds would be used to fund capital projects that improve other passenger rail systems. Of $950 million, $190 million would be used for intercity rail lines and the remaining $760 million would be used for other passenger rail services along the urban and commuter rail (California High Speed Rail Authority, 2015).

The California High Speed Rail Authority has spent $60 million on pre-construction activities, such as environmental studies, planning, and development. The Authority estimated the total cost would be approximately $45 billion (2006 estimates) with construction funded by federal, private, local and state monies. Similar to the Federal-Aid Highway Act of 1956, the American Recovery and Reinvestment Act (ARRA) was signed in 2009 to "stimulate the economy", create new jobs, and reinstate development of new rail manufacturing giving opportunity to view high speed rail in the U.S. again (U.S. Federal Railroad Administration, 2014).

California received $3.3 billion in ARRA funds for planning and environmental work. It was the interest of the Governor to be aggressive with building a high speed rail system in California. Governor Brown signed into law SB 1029 to secure $8 billion in federal and state funding for construction. Currently the high speed rail is projected to cost $68 billion (California High Speed Rail Authority, 2015).

Under Phase I, California high speed rail will link San Francisco with Los Angeles in 2 hours and 40 minutes (current travel time by motor vehicle is 5 hours and 48 minutes; current travel time by airline is 1 hour 25 minutes at $257.00) by 2020, then extend further east to Sacramento and south to San Diego by 2029 with a total of 800 miles of rail and 24 train stations carrying up to 1,000 passengers per day. Ticket prices from San Francisco to Los Angeles are estimated at below $100.00. The high speed rail would utilize existing route track lines in areas (San Francisco to San Jose corridor) that align with current Caltrain operations under the Caltrain Modernization Program (see Figure 2) as a blended system. The plan would electrify existing track, install a communications based overlay signal system positive train control and replace diesel trains with high performance electric trains.

The rail project requires eight finalized EIR/EIS documents, one for each section, addressing environmental issues before construction begins. Two EIR/EIS have been done: Merced to Fresno in May 2012 and Fresno to Bakersfield in June 2014. The high speed rail will be developed in two phases. Before the first phase is initiated, the high speed rail authority has begun the modernization of existing rail lines and systems

Figure 2. Projected blended and modernization high speed rail system.

Source: California High Speed Rail Authority. (2015). *California high-speed rail: A statewide rail modernization plan.* Retrieved from https://www.hsr.ca.gov/docs/about/doing_business/Regional_Consultant_PPT_PresentHS13_43thru45RFQ.pdf allowing Amtrak to utilize the new system by 2018. Upgrades include electrification of Caltrain's corridors, linking other train systems with Caltrain and closing a passenger gap between Bakersfield and Los Angeles basin. The first phase will implement the upgraded blended system with Metrolink connecting to Anaheim and intercity Los Angeles rail lines. The second phase will link Sacramento to San Diego completing the 800 mile statewide system. The first phase ridership is projected between 35 million and 58 million passengers per year. The passengers at final completion of Phase 2 are projected at 100 million passengers per Year (California High Speed Rail Authority, 2015).

The high speed train would be capable of going to speeds up to 220 miles per hour and travel 800 miles of track along the valley from Sacramento to San Diego with 24 train stations. The train system is expected to be completed in 2030 carrying approximately 120,000 riders per day. Construction on one of the twenty four total train stations along the high speed rail corridor began in an industrial section of downtown Fresno in early 2015. The first train station will be located along the existing Union Pacific Railroad tracks between Mariposa Street and H Street in Fresno, a major road corridor next to Highway 99 and Highway 41 (California High Speed Rail Authority, 2015).

Passenger Service

To estimate the ridership and farebox revenues for the high speed rail, the high speed rail authority forecasted the estimates using a modeling system called Monte Carlo simulation. The Monte Carlo simulation model uses analytic techniques to quantify risks that may impact future revenues, costs, and if impacts did occur what would the impact be. Sources were used as a base from existing datasets and new data was added to the new model: the Department of Finance, University of Southern California Price School, Caltrans household surveys, Revealed/ Stated Travel Preference survey - 4500 questionnaires, and California Statewide Travel Demand model. The estimated modeling system the Authority concluded was scrutinized over a two year period by experts in travel demand forecasting, the Ridership Technical Advisory Panel, the Government Accountability Office, and academic professionals (CA Department of Finance, 2016).

Senate Bill 1029 was created to account for solid methods of estimating ridership and farebox revenues. The forecasts developed were based on a high, medium and low scenario. Phase I ridership which is from San Francisco to Los Angeles, using the medium scenario, would result in 40 percent of long term ridership potential in the first year after the first year of rail completion. The second year would result in 55 percent, the third year would result in 85 percent and the 5th year measured to be 100 percent. Eleven years after full completion of Phase I, the medium scenario resulted in 35 million trips in 2040. By the same year in 2040, riders from personal vehicles riding the high speed rail will be 77%, 16% from other rail and buses and 7% from airlines. In 2040, farebox revenues calculated for the medium scenario in Phase I are estimated at $3.5 billion and rising $3 billion every year after (2014 Business Plan).

High Speed Rail in California

The first HSR was built in 1964 in Japan with other countries proceeding in their HSR development. Defining HSR development is important to clarify. There is no one definition that railways use. The European Union defines HSR as: “separate lines built for speed of 155 mph, or existing lines upgraded to speeds up to 124 mph, or upgraded lines whose speeds constrained by circumstances such as topography or urban development” (International Union of Railways, 2008). The U.S. Federal Railroad Administration (FRA) defines HSR as rail service that is “time-competitive with air and or auto for travel markets in the approximate range of 100 to 500 miles” (Peterman, Frittelli, & Mallets, 2013). The FRA went further with its definitions of HSR by defining speeds, track characteristics and service frequency with three categories of rail: Emerging, Regional and Express. The California rail lines will be meeting the Express category with top speeds of at least 150 mph and a separated track dedicated for passenger service. Using the FRA definition; HSR systems are intended to meet many economic goals: reducing environmental impacts, job creation, a positive return on investments (ridership revenue), and promoting economic development as well as, especially for the California rail, to relieve congestion of roadways and airways (California High Speed Rail Authority, 2015).

The Public Policy Institute of California released its 2016 survey findings. The question posed was “How important is high-speed rail to the future quality of life and economic vitality of California?” Likely voters still support the project at forty four percent. The percentage of likely voters increased when the question of the project was if costs were reduced to fifty nine percent. The survey went on to state that residents in San Francisco rate the high speed rail as very important at sixty three percent, views have remained steady since the same question was posed in 2012 (Public Policy Institute of California, 2016).

High Speed Rail San Francisco to Los Angeles

What is high speed rail? “Service that is time-competitive with air and or/ auto for travel markets approximate range of 100 to 500 miles” (Peterman, Frittelli, & Mallets, 2009).

There is a need for high speed rail especially in the San Francisco to Los Angeles corridor area. In 2015, the San Francisco airport had over 42 million passengers with projections in 2035 at 100 million passengers. In 2022, the Los Angeles airport expects over 78 million passengers. This makes San Francisco to Los Angeles one of the busiest short haul flights in the US, with one in every four flights delayed by at least one hour. Demand has increased for intercity rail in California. Between 1997 and 2012 ridership has grown by 256 percent for the Capitol Corridor rail line all the way from Auburn to San Jose, the San Joaquin rail line by 66 percent from Sacramento to San Francisco to Bakersfield and the Pacific Surfliner by 61 percent from San Luis Obispo to San Diego ranking these rail lines the second, third and fifth largest in the US (Puentes, Tomer & Kane, 2013).

A portion of Proposition 1A funds go to the electrification of existing rail lines that serve existing railroad for freight use, existing Caltrain passenger service and the new high speed rail as a blended system. The blended system concept was agreed upon with nine parties involved that uses funds from local, regional, and federal levels. The Caltrain Modernization Program will be an electric based system with advanced signaling systems that reduce traffic flow, closer train allotment, reduce greenhouse gas, reduce subsidy intake, and increase ridership revenue (Caltrain, 2016). The HSR San

Francisco to Los Angeles track will blend the bookends of the track lines with the existing track infrastructure that serves regional and local passenger operations corridors. Currently the High Speed Rail Authority is working on implementation of defining further details about the blended system (Caltrain, 2016).

CHSR Technology

In 1900, the railroad industry's first attempt for speed shift in technology was to move railroad engines from steam power to electric. The electric technology, combined with dedicated railroad track lines allowed the engines to move faster. The faster the railroad engines moved the quicker engineers designed and developed aerodynamic engines and train cars (Misa, 1995). The Authority will draw on the design of the Shinkansen (Series 500 and Series 700) in Japan with 1,300 ft long train cars, quiet cars, play cars, bar cars, and conference cars. The rail system will be built using steel-wheel on steel-rail electrified technology (California High Speed Program EIR/ EIS).

The steel-wheel on steel-rail technology will be able to share existing track lines at reduced speeds when needed in heavily urbanized areas and higher speeds in less populated areas, causing less friction keeping noise levels low (California High Speed Rail Authority, 2008). Steel-wheel on steel-rail continuously welded track allows very high speed rail trains be capable of going over 155 mph (California High Speed Rail Authority, 2015). The technology provides for a quicker, smoother, comfortable ride not affected by inclement weather. The technology will draw power from renewable sources of electric power connecting to a commercial power grid (2012 Business Plan).

The Authority considered using maglev technology for the high speed rail system. Maglev is proven to be faster, quieter and smoother over steel rail however, maglev technology would not allow for the high speed rail to use historically existing routes (track lines). The maglev technology would need dedicated lines to allow the railroad engines and cars to suspend, levitate and propel the vehicles on a straight set of tracks, which steel-wheel on steel-rail on continuous tracks can move through cities and around tighter turns. (2008 Business Plan; U.S. Federal Railroad Administration, 2014).

Maglev technology is faster; the Authority chose to use traditional technology that moves slower and costs less because the existing technology will allow the high speed rail project to use existing track lines therefore continuing using existing routes (2008 Business Plan).

Japan – Tokaido – Sanyo Shinkansen

Comparing California high speed rail to other countries' modern technology, Japan started its high speed rail, Tokaido Shinkansen, in 1964 under the Central Japan Railway Company (JR Central) with three main connecting rail lines linking the major metropolitan areas of Tokyo, Nagoya, and Osaka. There are 342 daily departures with 1,323 passengers per train, annual delays of 0.9 minutes, and Japan is developing new technology to reduce external noise and energy consumption. Over the years the train cars have improved with further technology and environmental maturity (Series N700/N700A) currently producing 19% less (1/12th of the $CO2$ emissions of an airplane) than the previous train car model. The train can travel to speeds up to 270 km/h for the Sanyo Train and 300 km/h for the Tokaido Train. Since inception there have been no fatalities or injuries (JR Company, 2014). Today, Japan Railways is made of six independent groups separated by region for passenger rail service: Kyushu, JR Shikoku, JR West, JR Central, JR East and JR Hokkaido with 27,268 rail lines and hundreds of stations for high speed rail and intercity rail. Shinkansen plans to further its operations with service between Tokyo and Nagoya in 2027 (JR Company, 2014).

CHSR Subsidy

In 1965, Congress passed the first high speed rail act making contributions to the fastest rail service in the Northeast Corridor (NEC), the Metroliner on the Washington DC to New York City portion. Part of the act was supported to research high speed rail technologies and studies of potential high speed rail outside the NEC although most of the funding contributed to the improvement of the NEC between 1990 and 2007.

On November 4, 2008, voters approved by 52.7%, Proposition 1A, The Safe, Reliable High-Speed Passenger Train Bond Act (HSPTB) for the 21st Century, authorized by the California Transportation Commission (Commission) to allocate $9 billion in funds for capital improvements to the “intercity rail lines, commuter rail lines and urban rail systems that provide direct connectivity to the high-speed rail train system and its facilities, or that part of the construction of the high speed rail system” (California Transportation Commission, 2014). This requires the Commission to program and “allocate the net proceeds received from the sale of $950 million in bonds authorized under Proposition 1A.” Of the $9.95 billion of general obligation bonds, $950 million are available for capital projects on other passenger rail lines to provide connectivity to the high speed train system and for capacity enhancements and safety improvements.

Part of the high speed rail funding is allocated to the Statewide Rail Modernization for work on existing railroad infrastructure using a blended system. The blended system will update regional and local railroad track lines in certain corridor areas with heavy railroad usage. This will allow commuter rail systems to coordinate their systems and operations with the high speed rail.

In 2009, Congress passed the American Recovery and Reinvestment Act that dedicated federal funding of $8 billion to high speed rail programs and intercity rail programs; this created the launching pad for the California HSR. California was granted $2.25 million in ARRA funds with an additional $901 million from FRA funds. Phase I of the HSR is projected at $68 billion (2014 Business Plan) along with 25% of future cap and trade auction proceeds.

California high speed rail still needs private funding from investors. When Californians initially voted for the HSR, the language in the ballot measure didn't specify how much private investment is needed. However, the chairman of the Authority, Dan Richard, states that about one third is needed in private funds for the project's cost. Private investors are concerned with guaranteed revenue contingent upon ridership. However, Richard states that guaranteed revenue "won't be necessary once the project can demonstrate strong ridership" (California High Speed Rail, 2015). The Authority submitted proposals to private companies for financial advice with offering of any funding. Thirty companies responded concluding that the HSR is too early in the project to submit private funds; however a formal request has not been submitted publicly (High Speed Rail Authority, 2015).

<u>CHSR Route</u>

The California High Speed Rail will travel along existing railroad corridors. Part of the project plan is to update existing rail tracks to hold the weight capacity of the new train cars as well as update heavily used corridors in the Los Angeles area to an electrified system with upgraded safety features (California High Speed Rail Authority, 2015). Project sections, phases, and train stations are as follows (See Figure 3):

- San Francisco to San Jose
- San Jose to Merced
- Merced to Sacramento
- Merced to Fresno
- Central Valley Wye
- Fresno to Bakersfield
- Bakersfield F Street Station Alignment
- Bakersfield to Palmdale
- Palmdale to Burbank
- Burbank to Los Angeles
- Los Angeles to Anaheim
- Los Angeles to San Diego

CHSR Environment

A high speed rail project has to address both federal and California laws in its environmental review process. The California high speed rail broke their Environmental Impact Report/ Environmental Impact Statement process into 10 separate sections with each section having its own individual EIR/ EIS. For the purposes of this thesis, this paper examines the statewide EIR/ EIS (High Speed Rail Authority, 2015). The CA rail EIR/ EIS cover an extensive range of potential impacts. The National Environmental Protection Act requires “a preparation of a statement of the environmental effects that

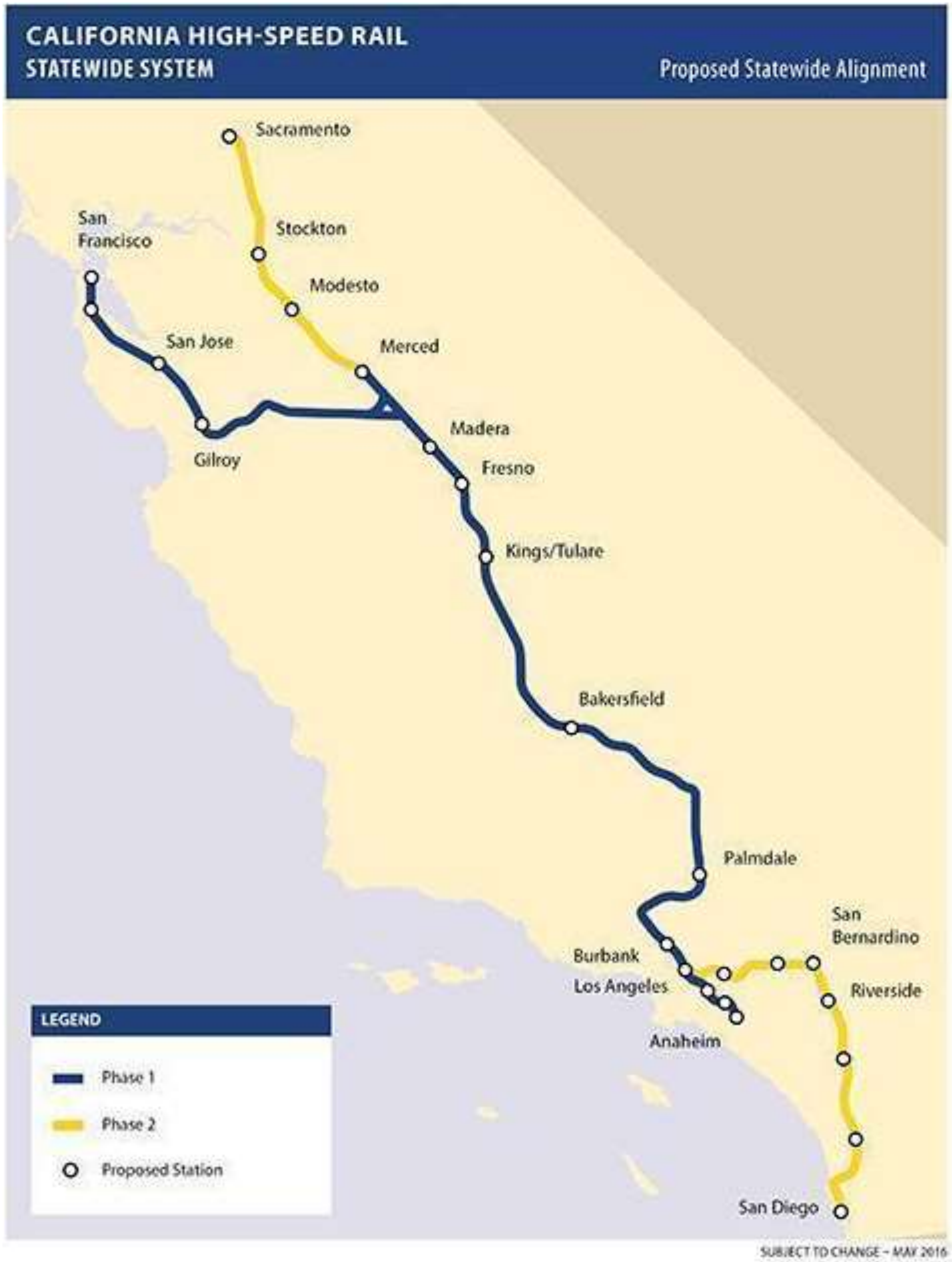

Figure 3. Proposed high speed rail corridor.[1]

Source: California High Speed Rail Authority. (2015). *California high-speed rail: A statewide rail modernization plan.* Retrieved from https://www.hsr.ca.gov/docs/about/doing_business/Regional_Consultant_PPT_PresentHS13_43thru45RFQ.pdf

[1] The NEC also started in phases/ sections and didn't link multiple cities unlike the California high speed rail that will link multiple cities in the first phase and link the rest of the cities in phase II.

rise to significance.” The California Environmental Quality Act goes beyond that requiring “mitigation of adverse effects” (Deakin, 2010) addressing short term and long term impacts both beneficial and negative.

In 2000, the Authority generated its first business plan and an Environmental Impact Report/ Statement (EIR/ EIS) detailing potential statewide environmental impacts. The EIR/ EIS received over 2,000 comments from the government and public and determined the California corridors and stations. The study determined that the high speed rail would provide environmental benefits such as decreased energy consumption, reduced air pollutants, use less land needed for expansion, overall fewer environmental impacts on sensitive habitats and water resources and other benefits (California High Speed Rail EIR/ EIS, 2015).

Six of the top thirty congested urban areas in the United States are located in California and the top five worst air communities in the country are also in California (American Lung Association, 2015). In 2006, California passed the Global Warming Solutions Act or AB 32. Assembly Bill 32 requires California to reduce its greenhouse gas emissions (GHG) to 1990 levels by 2020 and by 2050 to further reduce GHG emission to 80 percent of 1990 levels (California Air Resources Board, 2014). One of the key strategies the state is employing critical to reducing GHG emissions is an integrated alternative to single-occupancy vehicle trips - the high-speed rail system. The high speed rail combined with existing transit, commuter, and intercity rail systems, as well as strategic land-use decisions, will result in significant reductions in GHG emissions, improving air quality statewide, unlike the railroad or highway prior to the 1969 Act. In the High Speed Rail Authority’s 2008 Scoping Plan, the California Air Resources Board

(CARB) listed the high-speed rail system as “one of the significant state projects to make a positive contribution on the issue of global climate change.”

Together, AB 32 and Senate Bill 375 support the state’s climate action goals with regional targets for 2020 and 2035 through transportation and land use planning efforts to achieve more sustainable communities by reducing greenhouse gas emissions.

Before the rise of environmental concerns and before the passage of NEPA in 1969 and CEQA in 1970 and long before Muir’s conservation movement, engineers’ main commitment was building the interstate highway system placing value only on construction. Highways cut through parks, housing, and public areas (Rose & Mohl, 2012; Lewis, 2013). Postwar momentum expedited processes and funding to keep the highway system going by maintaining existing roads by widening or paving a dirt road. Influence had been building to keep aesthetic and environmental concerns at the forefront of building the highway system by environmental groups and activists and some officials.

One such revolt proceeded from the San Francisco Embarcadero Freeway in 1953. The revolt let to a 30,000 signature petition from neighbors that were in the way of freeway construction. The San Francisco Board of Supervisors cancelled 7 out of 10 freeways for the first time in the Board’s history. The section of freeway was constructed to 1.2 miles and then stopped and stood there until 1985 until several groups, including environmental groups, wanted to revitalize the waterfront area. By this time in order to remove the section of freeway, the Board of Supervisors had to study the EIR at a cost of $171 million. The Board initially declined the removal, only for the freeway to be damaged in the 1989 earthquake including damage to the central freeways deeming the freeways unusable for a period of time. Again, the groups petitioned to remove the freeway rather than repair it. The groups ultimately had an edge. The Board could no longer claim that displaced traffic would create a gridlock since the damage was too extensive and repairing was not feasible leading the freeway section to be surface boulevard and opening room for development along the waterfront at a cost of $50 million (Mohl, 2004).

Travel Time and Congestion

Every year in California, congestion on roadways and highways from automobiles equates to $18.7 million in lost time and wasted fuel. By 2030, the high speed rail system will save $12.7 million barrels of oil, reducing carbon emissions by 3 million tons (American Public Transportation Association, 2015).

In order to meet the requirement of the initial ballot measure Proposition 1A, the train would have to go between San Francisco and Los Angeles in 2 hours and 40 minutes. If the estimated travel time doesn’t meet the time limit, future funds may be blocked. If Proposition 1A funds get blocked, that could also put a block on future cap and trade funds, which amount to $3.1 billion (California State Budget 2015-2016). The cap and trade funding program establishes carbon credits to trade in order to reduce greenhouse gas emissions to 1990 levels by 2020.

High speed rail systems are more scalable that other transit systems increasing mobility from community to community while relieving congestion on highways and airlines. A benefit-cost analysis was done for users of savings for travel time, reduction of auto and air congestion, fewer emissions and others. For Phase I time travel, the savings economic rate of return was 12.54 percent. This means that for every one hundred dollars spent, the benefit would be more than $112.00 of savings (2012 and 2014 Business Plans). Over the next 40 years, approximately 320 billion vehicles miles traveled will be reduced by completion of the high speed rail. That is a savings of 146 million hours of congested travel time on highways (2012 Business Plan). The Legislative Analyst Office projected that the California high speed rail project would have a net impact of greenhouse gas emissions for the first 30 years of service.

David Harvey suggests transportation doesn't relieve congestion but recreates it at a different speed. The speed congests privacy, social interactions and the movement of goods (Harvey, 1989).

CHAPTER V

CALIFORNIA HIGH SPEED RAIL

FINDINGS

Similarities and Differences

In what ways is the high speed rail similar to previous transportation systems and how is it different? The high speed rail system is similar to other transportation modes by moving goods and passengers quickly to destinations.

Subsidies

Federal and State Governments allowed funding through bonds and subsidies to build roads, highways and railroads to advance passengers and commerce. Similarly, the high speed rail system in California has received government subsidies to construct the first phase of the rail project (California High Speed Rail Authority, 2015). The Authority proposed after Phase I is built and has acquired passenger service, the revenue generated from Phase I will go towards building Phase II (California High Speed Rail Authority, 2015). Part of the rail system funding will be used for upgrading the existing track lines to be capable of holding the weight and make the existing system safer for existing regional trains. Cities located along the track lines have also received funding for improvements to existing tracks along the Highway 99 railroad corridor.

Routes/ Corridors

Transportation modes were built on top of one another. Stagecoach/ wagons carved out land across the United States by altered existing foot paths with widening and restructuring capabilities. The wagon roads were then paved that created smoother and quicker rides to get to locations faster. Similar to historical routes, the California high speed rail system will travel along existing railroad track lines along the Highway 99 corridor (Garrison & Levinson, 2005).

Technology

Advancement in technology allowed for the shift to high speed rail for the expedited travel not just to relieve congestion on highways and airlines but for time. Harvey states that capitalism survives on geographic expansion and products that are moved; technological changes are necessary components of that expansion. Passenger travel is part of that expansion, going from place to place, having new experiences, and changing the way people perceive the travel (Harvey, 1989).

Historically, transportation technology followed existing routes while constantly pressing for time, to get to the next location quicker. Every new transportation technology project balances between choosing speed and geography over the need to use existing lines.

The California High Speed Rail Authority surrendered the faster need in order to save funding. The Authority also ceded with modern maglev high speed rail technology in order to use traditional steel-wheel on steel-rail technology at medium based speeds, thereby sacrificing speed by choosing traditional technology to use existing track lines (Schivelbush, 1977). The speed of the train is dependent upon surroundings, needing to go through towns and cities or around tighter corners at slower speeds. High speed rail trains are designed to travel above grade, literally above the landscape. The surrounding California terrain doesn't allow for the high speed rail to pursue the top speeds of 220 mph.

Maglev technology would allow the high speed rail to travel at top speeds however; the maglev rail would be completely separated from the surrounding landscape. Author Schivelbusch would view the maglev technological advancement as an annihilation of the landscape (Schivelbush, 1977). Furthermore, Schivelbusch would state that the maglev technology would create new space by changing the entire structure and perception of time and space and would lose "its accustomed orientation" - leading to even more annihilating time and space technology such as the proposed hyperloop.

Environment

One major difference between historical transportation modes and the current California high speed rail is environmental concerns. When the 1970 NEPA and CEQA Acts were passed, engineers designed and planned for states' transportation systems solely focused on building the systems and regarded the environment with no priority. No regulations or laws were passed up until the 1960's/ 1970's Acts that understood environmental consequences of transportation systems (Rose & Mohl, 2012; Lewis, 2013) The NEPA and CEQA Acts allowed for transportation planning to address environmental damages and mitigation measures before any construction started. Until the CEQA and NEPA legislation no other legislation for the environment had been enacted for large transportation projects. The high speed rail went through extensive CEQA and NEPA review processes when the project was initially funded (some of the environmental impact benefits of the high speed rail project are addressed in the Methodology section).

CHAPTER VI

CONCLUSIONS

Technology, subsidies, routes and the environment are the four key factors in transportation systems both historically and currently. Changes in transportation modes have been met as both successes and failures. Time and money have been at the forefront of these changes. Progression in changes of the systems is inevitable as seen in history and stated by scholars. But these changes are met with opposition. Opponents of the high speed rail are correct: the technology is old, funding has fluctuated and is unpredictable for future funding needs, the routes could possibly change, ridership is unpredictable, and a possibility of an unfinished project.

However, opponents are also incorrect. Throughout history, progression in transportation modes have shown remarkable achievements. The stagecoach/ wagon brought settlers to California to find gold. The Transcontinental Railroad brought travelers to new locations throughout the United States. The national highway system connected smaller cities with larger cities. These modes shifted in technological innovation that moved goods and people faster, creating cities to expand and prosper. As David Harvey said, in order for capitalism to survive technological advancements are a natural component for the expansion.

The high speed rail system allows for movement of passengers/ commuters to travel to their destination quicker allowing for more time to create commerce.

Technological advancements allowed for quicker travel time. Historically, passengers created population growths along transportation corridors creating a need for further technological advancements in transportation modes. California has experienced a shift in congestion on highways and airlines due to the need for quicker travel time and business that has driven the high speed rail project.

Historically technological advancements have not been funded; there is a need for government funding. Every transportation system in the U.S. is subsidized by public funds. As history has shown, the new technology receives federal and or state government funding whether through bonds, land grants or right-of-ways. When the Transcontinental Railroad was being built, the federal government allocated subsidies for every mile completed which pushed the railroad companies to build faster. The need to build the railroad faster created states to provide tax exemptions and provided more access to the railroad if they connected track lines to their communities. The 1956 Federal Aid Highway Act also encouraged building quickly so states could receive federal subsidies if the highway connected to their city. The California high speed rail is viewed similarly.

Focus on the environment emerged as a new concern in the 20th century. Interest in environmental damage new transportation systems were causing caught the attention of the government with emphasis on conservation in the late 1960's with the establishment of the National Park System created by John Muir and President Roosevelt. Until the 1960's no focus had been shifted towards environmental damage of the transportation systems, only concentration on building faster. The California high speed rail predicts a net impact in greenhouse gas emissions once the project is completed which will contribute to the California's greenhouse gas reductions to 1990 levels, without bringing further environmental damage.

Transportation system focus is a need to build quicker and to get to locations faster providing economic and social opportunities by moving goods, people and information. Transportation modes do not act alone in playing responsibility for viable communities. Transportation modes are linked to the geography in the growth that takes place in the communities and support of economic functions driving modes to develop faster and move people and goods quicker.

The California high speed rail project is set to move commerce and people faster than any other transportation in California. Yet the high speed rail still won't be fast enough. Private transportations companies and investors are proving another technological advancement in transportation systems. Elon Musk, a private businessman has proposed building a hyper loop in California. Using maglev like technology, the steel tube would get passengers, in pod like structures; from Los Angeles to San Francisco in 35 minutes at 760 mph. Plans to develop a test track in Hawthorne, California, have been in place since 2013. The track will be a smaller version than the original plan with a 1 mile track and the pods will be 4-5' in diameter. Musk stated that the hyper loop would only be built with private investor funding and not government funding. Musk also stated that California is building "a bullet train that is both the most expensive per mile and one of the slowest in the world." Will the California hyperloop be regarded as transportation advancement and how disconnected will maglev like technology move from the Landscape? Elon Musk would disagree but the Authority acknowledges, the California high speed rail is fast enough.

Areas of Future Research

Researching maglev technology to be implemented in California or in another state is an area of future research. The NEC's Acela high speed rail runs from Baltimore Maryland to Washington DC in 1 hour and 15 minutes. If maglev technology was implemented, the train route could reduce the travel time down to 15 minutes. Japan has tested maglev technology for the Tokyo and Nagoya route. The Tokyo and Nagoya route would connect the two cities in 40 minutes. Japan's current high speed rail, The Shinkansen, uses traditional steel-wheel to steel-rail technology, exactly like the California high speed rail, and travels the route of Tokyo to Nagoya in 90 minutes.

Phase I ridership of the California High Speed Rail is predicted to fund Phase II. The Authority's Business Plan developed a framework of possible ridership revenue however, the ridership revenue is a prediction with no true United States high speed rail to model after. Once Phase I and Phase II of the California high speed rail project is completed and years of service has been implemented; further research to aid in the revenue predictions can be tested for accuracy.

Private investments for the California high speed rail project has yet to be determined. What role will the federal and state government have once private ownership is involved? What other subsidies will be found if private entities do not invest? If no other subsidies exist, will the California high speed rail project be completed? Critics predict the project will run out of money and never fully be built.

The Authority's business plans and EIS/ EIR reports address figures of reducing greenhouse gas emissions that play major role in California's Global Warming

Solutions Act. Environmental concerns should be further explored either before or after the high speed rail project is completed.

The California hyperloop project has been constructed as a 5 mile test track with plans to have full completion in 2020 with a cost between $6 billion and $7.5 billion. There are multiple areas to explore such as a lack of infrastructure, regulatory and legislative issues, and high density populations.

Maglev technology requires new track lines and cannot use existing railroad technology. Construction of new track lines would be subject to CEQA/ NEPA review processes due to new environmental damage. How will society handle a new technology that will create new environmental damages?

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