HIGH(ER) SPEED RAIL RIDERSHIP INCENTIVES: EMPIRICAL EVIDENCE OF MICHIGANDERS TRAVEL PREFERENCES

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ABSTRACT

HIGH(ER) SPEED RAIL RIDERSHIP INCENTIVES: EMPIRICAL EVIDENCE OF MICHIGANDERS TRAVEL PREFERENCES

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Most high(er) speed rail studies have focused on transit-friendly societies such as Europe and Asia, rarely reporting high(er) speed rail (HSR) traveler incentives as related to car-oriented societies. A written survey was used to gain an understanding of HSR traveler incentives, based on preferences as well as expected community impacts, of residents with the greatest accessibility to the HSR service and communities with the highest passenger ridership along the Wolverine line. Michigan was chosen as a case study, as the car has been its god father economy for over 60 years. The study found ridership would increase the most, with direct rail connections to airports, either the Detroit Metro or the Chicago O'Hare airport. The second incentive for ridership was the increase in gas prices, which superseded a traditional incentive of shortened travel time. Within Michigan, traditional rail incentives were not strong motivators for increased ridership. Despite the importance of all incentives, a significant number of respondents said that no matter what incentive was provided, they would not ride more. This increases the need for disincentives of other modes of travel, or signifies that other incentives should be considered. This study informs HSR traveler incentives in order for decision makers to make lasting improvements on ridership, allowing states and communities to capitalize on rail investments for the long-term.

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Executive Summary

Most high(er) speed rail studies have focused on transit-friendly societies such as Europe and Asia. Academic studies have rarely reported high(er) speed rail (HSR) traveler incentives as related to car-oriented societies. A coalition of nine Midwestern states in the United States formed a plan for the introduction of high(er) speed rail in the Midwest Regional Rail Initiative. This plan informed and guided recent HSR initiatives within the states, as well as the funding investments by the federal government. The plan included objectives, ridership and revenue estimates, and economic development forecasts at full system build-out. A gap exists within literature for traveler incentives and their effect on those in car-oriented societies, in order to meet ridership forecasts in the Midwestern states, including Michigan. This study devised a written survey to gain an understanding of HSR traveler incentives, based on preferences as well as expected community impacts, of residents with the greatest accessibility to the HSR service and communities with the highest passenger ridership along the Wolverine line. Michigan was chosen as a case study, as the car has been its god father economy for over 60 years. The Midwest Regional Rail Initiative informed the basis of the study as well as interviews from local transportation officials. The results were followed with interviews of political decision makers within Amtrak and the Michigan Department of Transportation (MDOT) to provide a connection between the political decisions and the academic findings.

This study found ridership would increase the most, with direct rail connections to airports, either the Detroit Metro or the Chicago O'Hare airport. A consensus among political decision makers was the connection the airport was better served, more feasible, and cost appropriate via bus service or commuter rail and not the HSR service. Collaboration is

recommended as the most appropriate method of facilitating access to the Detroit Metro airport.

The results corresponded with existing literature in that Michigan ridership would increase if gas prices increased. Political decision makers verified that rail was designed to compete with alternative modes of transportation, and Michigan residents were sensitive to prices of competitive modes. Combining driver disincentives (such as gas prices, or road tolls and gas taxes) and marketing is of primary importance for ridership. Capturing a different or the ideal demographic includes marketing. The transportation planners agreed that changing public perception was an essential component of increasing awareness and ridership on rail.

Despite the importance of these incentives, a significant number of respondents said that no matter what incentive was provided, they would not ride more. This increases the need for disincentives of other modes of travel, or signifies that other incentives should be considered. Accessibility to rail within a car-oriented society needs more research, especially to the stations and combining rail into the transportation system. Particularly, increasing marketing of Amtrak services would increase ridership, if appealing to younger generations, and business travelers. The campaign could change public perception about public transportation, surmount the hurdle of attracting first time riders, or facilitate the change in perception as improvements in service are completed and increased frequencies, reliability and shortened travel times are realized. It could facilitate positive perception as actual service levels are improved. Passenger rail in the United States has been a source of contention politically, especially within the discussion of investment. This study informs HSR traveler incentives in

order for decision makers to make lasting improvements on ridership, allowing states and communities to capitalize on rail investments for the long-term.

Introduction

Within the United States, developing and upgrading rail systems has not been high on the agenda within the federal government due to a car-driven economy and subsequent societal dependence on the automobile. Michigan has been a car-driven economy for 60 years and thus preferences within the state have not been high for public transportation, especially traveling by rail. Yet, US states and transport agencies increasingly seek and receive funding to plan for and upgrade regular rail lines to high speed rail (HSR) status. The decision to do so is frequently motivated by the belief that HSR is a potential stimulus for economic growth (G. de Rus 2012; Martín et al. 2004) and can reverse the declining rail service and sharply decreasing ridership (Campos and de Rus 2009; González-Savignat 2004). On August 24, 2009, the Michigan Department of Transportation (MDOT) applied for a grant up to $800 million for improving rail infrastructure of the Wolverine line, from the Chicago, Illinois to Detroit, Michigan, to a 110 miles per hour (mph) train (MDOT, 2009). Within Michigan, the Midwest Regional Rail Initiative (MWRRI) collaborates with nine states on strategic corridor planning to upgrade to 110 mph and, at full system build out, realize benefits of substantial increased ridership and economic development, environmental cleanliness and decreases in foreign oil dependency and highway congestion (MWRRI, 2004). Especially in the United States, HSR has become a political issue that supersedes academically and technology-driven considerations (Minn 2012).

International studies have focused on highly successful rail systems in Europe, where the density of each community, gas prices, and ticket prices are high. The existing ridership of

each international rail system is different, usually within the millions, while the average ridership on any one United States intercity passenger rail service agency, Amtrak, corridor is in the thousands. Studies thus far on high-speed and higher speed rail (HSR) have traditionally focused on transit-friendly regions like Europe or Asia. In contrast, few studies have explored incentives for HSR in car-oriented societies[1]. Especially within the United States, car ridership is high, and rail ridership has experienced a long history of decline, and strategic elimination from the transportation system, due to funding cuts. Increasing rail ridership, and public transportation systems, is a priority among many state departments of transportations, as seen by continued investments. Methods for increasing rail ridership, especially within a society of combined car-orientation and rail systems, are not fully understood. Understanding incentives are important for increasing rail ridership in the United States, especially to fully capitalize on the billion dollar investments being made at the federal and state levels. The most often cited incentives to use public transportation, including HSR, are cost, time, reliability, convenience, comfort, safety, security, novelty and trust (Crockett and Hounsell 2005; Hsiao and Yang 2010; Ortúzar and Willumsen 2001). The goal of this study is to understand the impacts of traveler incentives on rail ridership within the United States, or a car-oriented society. Therefore, this study contributes to the literature in identifying the most powerful incentives for Michiganders in choosing high speed rail over other travel modes.

The study utilized a survey of residents with the greatest accessibility to rail stations in the top five cities in Michigan which draw the most passenger numbers from current rail service. Also, interviews were conducted with transportation planners of each of the five

[1] Car-oriented society is defined as a society in which the other modal alternatives have little opportunity to co-exist (Rodrigue et al. 2009).

communities before the survey to provide perspective, and also after the survey, to identify whether the political decisions made throughout the process that corresponded to survey results.

This study contributes to existing literature by establishing the most important travel incentives for Michiganders. The results find that the most important travel incentive, increasing ridership at least 1 to 2 times more a month, is for a connection to the Detroit airport and the Chicago airport. At the same time, gas prices are strong incentive for more ridership, superseding a traditional incentive, as found in existing literature, of shortened travel time. Lastly, within Michigan, traditional HSR incentives are not strong motivators for increased ridership. Employing new strategies or community specific incentives and local preferences might show more potential in attracting riders to the newly implemented HSR. This case study of Michigan informs and provides findings possibly applicable to other car-oriented societies. The study concludes with recommendations based on the combination of desires, perceptions and responses from residents in the top five cities in Michigan expected to draw the most passengers, as well as opinions from transportation planners and political decision makers.

Literature Review

Traditional rail systems are currently undergoing a process of service decline causing a decrease in ridership demand and economical revenue (Gonzalez-Savignat, 2004(1)). However, high-speed rails (HSR), any speed above 200 km/h or any upgraded conventional rail system, have been considered a demand and revenue success since projects started in 1970's (Campos and Rus, 2009), which can improve the quality of rail service (Gonzalez-Savignat, 2004(2)). However, the initial demand and service is often overestimated on some public rail systems (Mackett and Edwards, 1998).

As well as the majority of travel demand in the United States, the demand for rail travel in Michigan is low compared to the demand for the mode choice of the automobile. Michigan has a long and robust history with the invention of the automobile and subsequent car culture which dominates Michigan economy. The internationally recognized automobile industry being the god father economy of Michigan led to influences on all aspects of Michigan's history, culture, planning and development. Reintroducing rail travel, especially introducing high speed rail travel, to Michigan was and is a unique challenge.

The Midwest Regional Rail Initiative (MWRRI) is a plan to implement a high-speed rail network in the Midwestern United States, using Chicago as the hub. As denoted in Figure 1, planned routes stretch across Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. The Midwest Regional Rail Initiative has produced reports and updates on a regional rail system, including this upgrade to the Wolverine line, since 1998. A cost to benefit ratio was found to be 1.7, including economic development predicted along the corridor and to the communities, justifying the vision for the system of rail in the Midwest (MWRRI, 2004). The forecast for the regional rail system is an increase of ridership to 13.6 million passengers annually by the year 2025 (MWRRI, 2004). For comparison, the existing ridership along the Wolverine line was slightly over 500,000 in 2011 (Hundt, 2012).

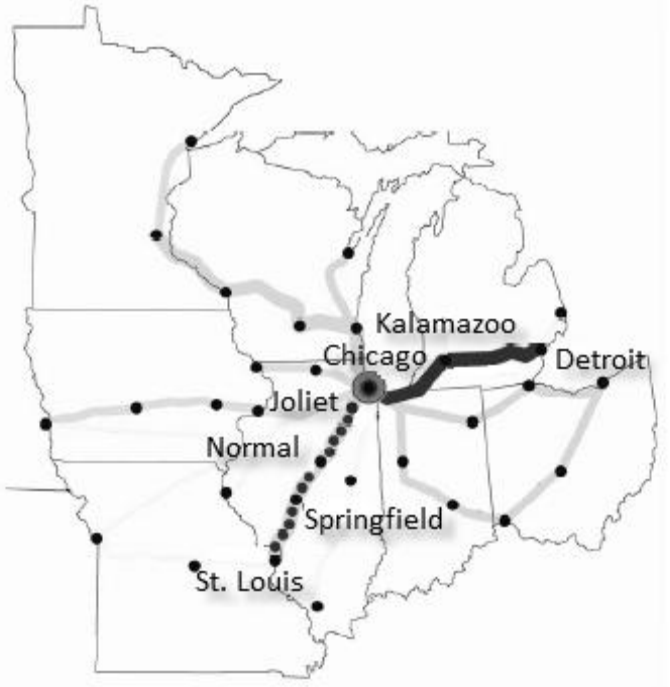

Figure 1 Midwest Regional Rail Initiative
Source: (Learner and Brubaker, 2009, slide 5)

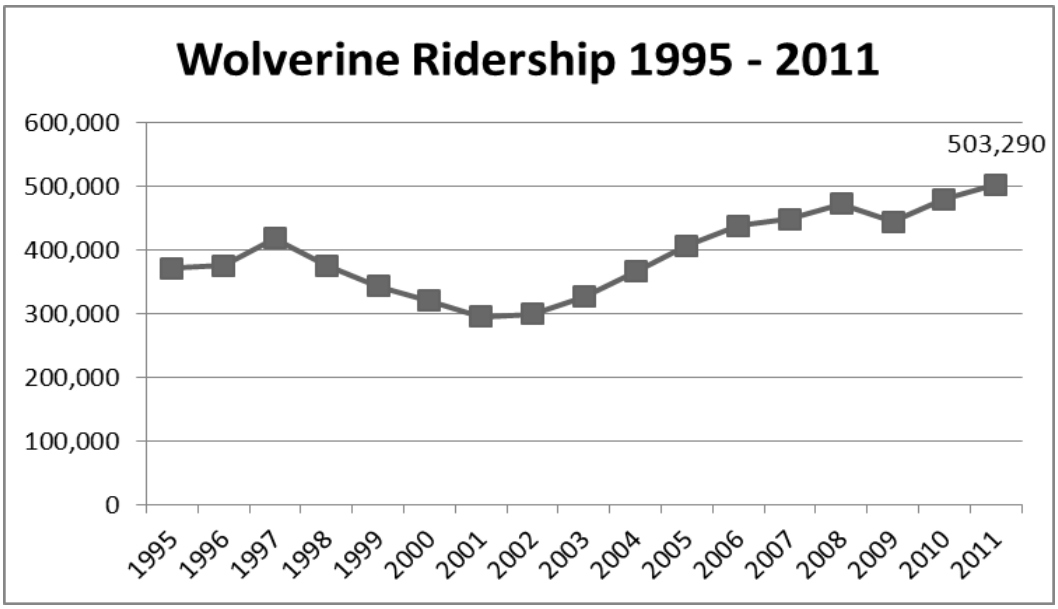

Figure 2: Existing Ridership
Source: (Hundt, 2012)

A milestone for Michigan's recovery could be an upgrade to a high-speed railway line of the existing Amtrak route called Wolverine, connecting major Michigan centers, Dearborn, Detroit, Ann Arbor, Battle Creek, and Kalamazoo to the Midwestern train network. These communities are those with currently the highest ridership. The MWRRI pledged shortened travel time, an increase in ridership, and economic benefits, among other long term benefits. Therefore, Governor J. Granholm announced on August 24th 2009, that Michigan had applied for $832 million in federal stimulus money for a high-speed rail link between Detroit and Chicago (thickest route in Figure 1) (Olander, 2009). The Wolverine Line – according to Granholm's speech in Dearborn – would play a significant part in Michigan's recovery by mastering the distance between Detroit and Chicago in 3:46 hours instead of 5:36 hours after the upgrades were implemented (MDOT, 2005, p. 5). The Governor's proposal primarily calls for an upgrade of existing tracks and stations along with major technological improvements, so

that trains would travel at about 110 miles per hour while avoiding conflicts with freight schedules. The predicted user, environmental, community and station development benefits include fostering regional economic development, creating jobs, lessening Michigan's dependence on foreign oil, improving air quality, reducing highway and airport congestion, reducing trip times, creating more convenient travel etc. (MDOT, 2005).

The complications in realizing these benefits include changes at every level of government, including presidents, governors, and congressman, as well as relationships between the States, freight companies, and public interest. All these factors influenced the actual funding awarded and finally the decisions along the course of the project. The change in governors during the time frame of high speed rail projects affected the federal stimulus dollars awarded Michigan. Wisconsin and other state governors rejected money for high speed rail, causing a redistribution of funding among high speed rail ready States. Michigan received funding in stages including $196 million, for track upgrades and signal timing, and another $140 million for the acquisition of the Kalamazoo, Michigan to Porter, Indiana rail line from Norfolk Southern railroad, removing the passenger rail track from freight, drastically improving speeds and conflicts (Goldin, 2011). Previously in 2004, waves of funding were available for upgrading the stations along the Wolverine corridor. Currently, a $4 million study was awarded to the region for a comprehensive study including Indiana, Illinois and Michigan. Funding support for high speed rail is being provided at the federal level. The decisions made with the funding, based on the research available, is unclear. This study seeks to understand the decisions made within the Michigan high speed rail project, and the connection with Michigan academic research studies.

Previous Michigan research studies have analyzed the benefits of rail travel including one by the University of Michigan, Ann Arbor, and another by Grand Valley State University, both completed in 2009. The study completed by Grand Valley analyzed the benefits at a community level surrounding Michigan Amtrak rail stations (Taylor et al, 2009). The University of Michigan Intercity Bus and Passenger rail study identified travel patterns, trends, and compared and contrasted two modes, rail and bus (Grengs, 2009). The Midwest Regional Rail initiative studied benefits to the region for upgrades in speed to the existing system. The gap in Michigan passenger rail studies is the applicability to Michigan's car culture, and Michigan riders' choices and preferences. The current study is to assess the expected impacts specifically focusing on what *high speed rail* would bring to the top five cities along the corridor.

Therefore, this paper will examine rail ridership incentives to meet the predicted ridership on the Wolverine line, traveler preferences concerning making travel decisions, and lastly, this paper will further examine additional impacts of a high-speed rail on surrounding communities. The research questions include:

1. What are the travel incentives for increasing ridership along the Wolverine line and sustaining its growth in the long-run?
2. What is the passenger travel preference within the top five cities in Michigan if high-speed rail service is fully implemented?
3. What are the community impacts in the top five cities in Michigan which are expected to draw the most passenger numbers for high-speed rail service?

4. What, if any, is the connection between the political decision makers and the results of the survey and why do the results of the survey differ from the decisions that were made?

Traveler Incentives for Travelers Using Rails

Per the predicted traveler demands as stated by MDOT, an understanding of what drives passengers to choose rail above more attractive travel options is in question. Incentives for travelers to use public transportation have often been studied. Ortuzar and Willumsen, (2001) found five factors that can influence modal choice for travelers, which include:

- Cost
- Time
- Reliability
- Convenience
- Comfort

A sixth incentive for travelers can include security (Crockett and Hounsell, 2005). To better understand this concept, each category will be examined. Per all these incentives, which of these options contributes to the greatest incentive for high speed rail travel? The MWRRI study found “the greatest failures of [rail is] the lack of reliability, infrequent service and travel times equal to or greater than the auto mode” (MWRRI, 2004). For the entire network, the Midwestern planning committee expects 13.6 million annual riders by the year 2025 (Bay-Lake Regional Planning Commission Work Program Committee, 2008). A study done by Grand Valley University claims that “major Michigan stations would receive 3-4 times the amount of daily

train service compared to the current situation" (Taylor et al, 2009). The research question focuses on ridership, and which incentive has the potential to increase ridership the most, especially to fulfill this predicted ridership. The research is unique, as the context is based on communities, as well as a country, that are car oriented. Specifically, in an economy that is driven by the manufacture of the automobile, such as Michigan, which incentive is the greatest?

Cost Incentives

According to Littman, when examining cost incentives for travelers, it is important to examine ticket prices patterns. When ticket prices increase, rail will only maintain ridership of the dependent travelers; for ridership to attract non-dependent travelers, ticket prices need to decrease (Litman, 2004). If the high-speed rail attracts enough non-dependent travelers, HSRs systems will possess low marginal cost, potentially creating the cheapest and most efficient modal choice (Thompson, 1994). To create the lowest marginal of cost and highest revenue, HSR need to maximize the elasticity of fares so that the resulting yield is between 0 and -1 (Paulley et al., 2005); which is "the ratio of the proportional change in patronage to the proportional change in fares." From a study in Europe, the author warns about increasing transit fare prices to recoup the cost of expensive high speed rail infrastructure (Sanchez-Borras 2010). It is recommended that the government strategically decide how to recoup the costs while maximizing the benefits (Sanchez-Borras 2010).

For providing cost incentive for travelers to choose rail, the most important mode to consider is the car. The price of rail is in competition with other more convenient modes of travel which has long been viewed as the automobile. In Michigan, how important is the

incentive of cost compared to the benefits of car travel? People are more willing to shift from air or car travel to rail use when infrastructure costs are not factored into rail pricing (de Rus 2008). Infrastructure costs are usually not factored into the price of ticket fares, or of the general cost of providing the rail service. How much would Michigan residents be willing to pay for the high speed rail service?

External factors, though not co-linearly related, influencing one's decision to travel by rail summarized in a report by Wardman (2006) are GDP, car time, fuel cost, population, car ownership. The car culture of Michigan is heavily dependent on these factors, especially gas prices. Historically, higher gas prices have sparked a rise in public transportation and transit ridership (Yanmaz and Ozbay, 2010). In Europe in 1984, correlations were found, that "the elasticities of monthly transit ridership with respect to the real gasoline price [were] positive and inelastic…" (Wang and Skinner, 1984). In a more recent study, the largest rise in public transportation due to gas prices was in the demand for commuter transportation by rail (Haire, 2010). However, the amount of demand increase is highly dependent on subsequent factors, including the location of the area of study, the time lapse between when prices rose and when changes in transportation choice were observed (Haire, 2010; Yanmaz and Ozbay, 2010). Also, in the Haire (2010) study the demand depended on the availability of E85 ethanol. Holistically, if gas prices fluctuate, transit ridership corresponds. How high would gas prices have to rise to influence Michigan drivers to choose public transportation, specifically high speed rail?

Time Incentives

The most notable change of introducing high speed rail is the duration of travel time between destinations. With the additional upgrade in train speed, the high-speed rail would be

able to travel from Chicago to Detroit in 3:46 hours compared to the original travel time of 5:36 hours, decreasing travel time by approximately 1 hour and 50 minutes (MDOT, 2005). This shortened time allows high-speed rails to be most attractive for medium trips 1-3 hours in duration or 248 - 746 miles (400 - 1200 km) (Martin et al., 2004). At approximately 300 miles, the trip from Detroit, Michigan to Chicago, Illinois falls within this category. For an upgraded high speed rail line (29 mph greater) from an average of 43 mph to 72 mph (70 km/hr to 115 km/ hr) and a 72 mile (115 km) distance in Sweden the travel demand increased by up to seven times its previous ridership (Froidh, 2005), although this direct correlation is debated. De Rus and Nombela (2007) argue the most increase in economic activity is seen if the high speed rail line can reach speeds between 155 to 217 mph, with a track mileage of 186 to 372 miles. The current speed of trains on the Wolverine line fluctuates greatly, and will continue to during the years of construction of the HSR, with the highest speed being 110 mph.

While this aspect of time represents the raw time between origin and destination, it does not provide an aggregate of the total trip time. The shortened trip time could be crucial, as well as the time of the whole trip. Bhat and Sardesai (2006) found the ability to make a stop (for example to run an errand) as a determinant to use transit for commuting. In order to reduce the travel time, or complete the trip in a reasonable about of time, knowledge of specific arrival and departure times of a train, or the train schedule, is desired. As Litman (2004) points out, “transit riders are found to be more sensitive to changes in travel time, particularly waiting time, than to cost of transit fares”. Chang (et al 2000) reiterates the need for strategic planning of the train schedule and amount of stop making (number and length) on a high speed rail line. This aspect of time is related to frequency of the train. Analysis of the London rail rapid transit

showed its ridership was more sensitive to frequency changes than bus ridership was (Evans 2004, p 9-12). Frequency is seen as an important factor in all these ridership incentives, especially strategic trip planning. The authors imply that the time incentive (in terms of shortened travel time, total trip time and frequency) is more important than cost to rail travelers. Ranking shortened travel time against other measures, including frequency and on-time arrivals as incentives for Michigan travelers using rails could provide clarity to the debate.

Reliability Incentives

Time has a close relationship to frequency and reliability. Reliability is one of the critical factors in effecting travel demand by rail. A contrasting opinion, however, from new travel demand modeling has shown that lateness and reliability have little effect on rail demand at the market level (Batley et al 2011). At the individual level, reliability, or being on time, has been found to still hold high importance with rail travelers (Bhats and Sardesi 2006; Bates et al 2001; Batley et al 2011). Bhats and Sardesi (2006) suggest that unreliability of a train determines mode choice in some cases. The University of Michigan Intercity Bus and Passenger rail study found that reliability was rated highly, as "rail respondents indicated a strong desire for improved on-time arrivals", while also rating scheduling needs higher than cost for making the decision to travel by rail (Grengs 2009). One of the most important incentives for travelers to use the train included the train schedule meeting the passenger's schedule (Grengs 2009).

When determining ridership of various public transportation modes it is important to consider the availability of each mode however; availability is often ignored because of the difficulty of determining the availability of a particular mode for a specific trip. However, the problem can be resolved by increasing the available public transportation schedules, station

locations, destinations served, arrival times, or departure times (Ben-Akiva and Morkiawa, 2002). Information is critical to the transit rider, such as providing real time information of the train schedule (Turnball 2003). Real time information would improve train reliability. With the current rail system lacking reliability and real time information, what is the value Michigan travelers place on train reliability as a travel incentive?

Convenience Incentives

High speed rails in America fail to provide convenience because the automobile is still a more attractive mode of transportation due to the convenience of "door-to-door" travel with minimal to no toll road (Thompson, 1994), thus leading to the minimization of travel impedance (Martin, 2004) and maximization of convenience (Crockett and Hounsell, 2005). Crockett and Hounsell (2005) have defined five attributes influencing overall convenience including access to and from station (accessibility), waiting time at stations, interchange (if necessary), fare charged to travel, and terminal cost (car or bike at station).

While there are numerous attributes associated with convenience, the literature strongly focuses on accessibility. Convenience is defined by authors Crockett and Hounsell (2005), Wardman and Tyler (2000) and Brons et al (2009) in terms of accessibility. Accessibility used in urban planning and geographical studies typically examines the extent to which land use and transport systems enable individuals to reach activities or destination through the means of integrating various transportation modes (Geurs et al., 2006; Chang and Lee, 2008) into an interaction of modal connectivity (Martin et al., 2004). This integration of various transportation modes needs to be coordinated, to minimize wait time in stations and provide quality transportation (Pucher and Kurth, 1996). The two end stations of the Wolverine line are

extreme in the differences of integrated transportation modes. The line begins in Detroit, Michigan, with the primary mode of transportation being the car and ends in Chicago's Union Station, the center of the city's transportation system. Michigan stations have limited intermodal connectivity, with few feeder buses and low quality information on public transportation schedules. The intermodal connectivity compared to other systems in the United States and around the world is low. Improving the convenience factor through the integration of transportation services, could be a primary travel incentive. However, even by integrating transportation services together, accessibility can still be difficult to achieve.

The integration of modes of transportation is important, especially when attempting to create a 'seamless journey' for a traveler. Wardman and Tyler (2000) describe this 'seamless journey' as accessibility, but express the complications of calculating accessibility in rail travel demand. Due to the difficulty in knowing all the needs, trip times and journey of each traveler, only approximate generalizations can be made about who has accessibility and when. Instead of measuring a community or person's accessibility, Brons et al., (2009), measured the perceived benefits that various dimensions of accessibility can have on the overall satisfaction of travelers, which can help officials determine which factor of accessibility is most important to travelers. Brons et al., (2009) found the factors to be: "the importance of each dimension[s of the rail journey] for the passengers, their current satisfaction with its level, and the likely cost of improving the quality of each dimension." Improving the quality of each segment of the trip could mean improving the convenience. Among these authors there is debate on a current definition of convenience and accessibility for travelers, especially if used as a travel incentive.

Finally, the simplest definition of accessibility is proximity. Does the distance to railways matter to people? From a study centering on two Korean high speed trains, access to the station was found to be one of the most important factors to customer satisfaction (Chou et al, 2011). In a recent survey of 328 pedestrians in California and Oregon, researchers found people would walk an average of half a mile to train stations (Agrawal, Schlossberg et al. 2008). Most preferred to shorten their walking distance as much as possible. Distance to stations was the most important factor in choosing rail transit (Agrawal, Schlossberg et al. 2008). However, research suggests that people will go out of their way to use rail transit when it is available to them. They will walk farther to get to train stops than bus stops (O'Sullivan 1996). In a survey of Calgary residents, O'Sullivan (1996) found that people will walk an estimated average distance of 649 m. By contrast, people would only walk an average of 326 meters to get to a bus stop (O'Sullivan 1996). When rail stations are located closer to residential areas (one's home) or commercial centers (one's place of work), people are more likely to use this mode of transportation (Tsai 2009). When they live within 300 feet of commercial centers (like grocery stores), people are more likely to use transit or walk rather than using a car (Cervero 1996).

Despite the complex definition of accessibility, convenience can be defined as proximity. Our research strives to understand if convenience is a traveler incentive, questioning those that live within 2 miles of the train station. However, the integration of travel modes or connectivity and its effect on convenience or accessibility would be an item for further research as a travel incentive. Convenience certainly plays a role in determining what mode of transportation traveler's use, but how much? What are the choices made by the individuals with the highest accessibility to the high speed rail stations?

Comfort Incentives

For rails to be used, they must be comfortable in terms of smooth riding, quiet, and attractive (George, 1968). This smooth ride is enhanced by the perceived comfort of its mechanized train control systems and lack of interference from competing automobile traffic (Ben-Akiva and Morkiawa, 2002). From a study by the University of Michigan, one of the most important incentives for travelers to use the train included traveler comfort while traveling (Grengs 2009). Having available wireless internet was not a top incentive for passengers (Grengs 2009). Rail users prefer clean facilities, comfortable seats, proper lighting and security, signs**,** and parking availability (Grengs 2009). Not only do train rides have to be comfortable but the rail stations need to be upgraded and modified to promote the comfort of passengers waiting at stations; including waiting time for interchanges (Pucher and Kurth, 1996). These services and facilities become increasingly important as travel distance increases (Crockett and Hounsell, 2005).

Security Incentives

From a study by the University of Michigan, one of the most important incentives for travelers to use the train included safety while traveling (Grengs 2009). How does the demand or feeling of security incentivize travel by HSR? Car travel is known to carry the risk of accidents, while rail travel diminishes if not eliminates these risks. However, as seen by the current demand for car travel, simply avoiding this risk through train travel is not enough incentive for drivers to change modes.

Station safety has been measured among rail research, and is of concern among travelers (Agrawal, Schlossberg et al. 2008). Stations are the first and the last stop of a journey, or the final interaction with the rider. They thereby can affect ridership, the overall mood of the trip and can give an incentive for further travel by rail. According to Ben-Akiva and Morikawa (2002), stations are considered safe because the stations are usually concentrated with people in addition to the availability of installed cameras. However, if stations are, for the most part, empty, poorly lighted, or in economically depressed areas, crime rates or vandalism may increase (Smith and Clark, 2000). In other words, rail stations should be installed with cameras while exhibiting vibrant activity. Even with these additions, what level of incentive for travel is security and safety, and does it vary by demographic?

Traveler Preferences

The travel preference within Michigan has been established as the car. For the preferences to shift to a different mode of travel, the costs, incentives and travel demand decisions need to be determined. De Rus (2008) researches the social costs and willingness of travelers to pay for a high speed rail transportation system. De Rus (2008) outlined three social cost concerns for high speed rail. They are user costs, producer costs, and external costs. User costs are defined as how much time it takes to travel by rail, reliability and comfort of the services, and the probability of accidents (de Rus 2008). Producer costs refer to infrastructure and operation costs and external cost concerns include the impact on an environment (air quality, noise pollution) and construction of the rail lines and stations (de Rus 2008). The most

important social cost within the current research question studied below is user costs. The traveler weighs all the issues of concern for them before making a decision. The focus of the current research is determining how travel decisions are made and the external factors in choosing. In Michigan, the decisions are usually based on the car. What is needed to shift traveler preference to rail, and specifically high speed rail? Demographics are also a defining factor with riders of public transportation, especially rail travelers, and shifting their preference from the car. To build the case for shifting Michigan resident's travel preferences, the following literature was divided into three sections: making travel decisions, and shifting preferences, specifically from rail to higher speed rail, and the demographics of travel preferences.

Making Travel Decisions

The literature again focuses on themes of cost and accessibility. Crane (2000) outlined some of the factors that go into travel decisions as personal resources, access to a car, bus, or commuter rail system, needs, demands, desires of one's family, demand for the goods that travel can access and price of gasoline, and bus fares.

Transit-oriented development (TOD) is defined as high density development, usually mixed use, that occurs around public transit in order maximize accessibility, walkability, and more. Accessibility is a key theme within TOD. Transit oriented and auto-oriented neighborhoods attract rail ridership differently and affect travel decisions. Holtzclaw (1994) offered a consideration about travel decisions: neighborhood characteristics. Neighborhood characteristics are defined as "residential density, household income, household size… transit accessibility, pedestrian accessibility, and neighborhood shopping" (Crane 2000). In Crane's (2000) study, neighborhood characteristics were used to predict the number of cars per

household and vehicle miles traveled. When population density is doubled, both cars per household and vehicle miles traveled decrease by 25% (Holtzclaw 1994). When available transit seating per hour (buses and rail) is doubled (and weighted by population living ¼ of a mile from the transit stop), cars per household and vehicle miles traveled is reduced by 8% (Holtzclaw 1994; Crane 2000). Studies comparing San Francisco and southern California communities designed around public transportation (transit-oriented neighborhoods) to surrounding areas where the car is the main source of transportation (auto-oriented neighborhoods) indicate that people living in areas with public transportation are between 10 to 45 percent more likely to use the rail systems as compared to those in neighboring auto-oriented communities (Cervero and Gorham 1995). People are more likely to use transit systems like rail when they own fewer cars (Cervero 1996).

Recent studies concerning transit-oriented development (TOD 201), indicating that housing and transportation choices are linked. Choice of housing determines the location or distance to transit stations. Housing location affects the distance and access to areas of destination (employment, grocery stores, etc). Thus, the choice of housing influences the amount spent on transportation, and therefore the frequency and use of public transportation. According to the Center for Transit Oriented Development, housing and transportation costs are consuming an average of 57% of household income (TOD 201). The average family that has transit access spends 9% of their household budget on transportation costs, while those in auto dependent neighborhoods spend 25% (TOD 201). Therefore, the demand for housing near transit is growing (TOD 201). This suggests people are making rail choices depending on costs.

What other factors affect the decision to travel by rail? GDP, car time, fuel cost, population, car ownership are a few external factors, though not necessary co-linearly related, summarized in a report by Wardman (2006). The travel cost could include the proliferation of tollways and the cost of parking on each end of the trip. Tollway and parking fees were found to be correlated to the commuter choice of transit (Bhat and Sardesai, 2006; Kuzmyak et al, 2003). Parking fees influence the amount of parking available in central business districts. If parking fees are high, the fees are relative to the scarcity of parking available. Parking supply is a concern for rail travelers, influencing their mode choice. The study by Kuzymak (et al, 2003) found a direct correlation between the downtown parking supply and the use of transit by commuters. Transit riders respond to transportation system changes, or the parking available and its price (Kuzmyak et al, 2003; TRACE, 1999; Hess, 2001; Litman, 2004). The concept of cost influences travel preferences.

Shifting Preferences

Of the multiple factors determining transportation mode choice, one of the most common explanations for a shift in traveler preference to rail is on the basis of cost and time. Travel demand decisions are primarily based with a balance of cost and time. Therefore, does high speed rail achieve or become a competitive option for Michigan travelers? People prefer car travel, especially within a car-oriented society. Does eliminating, or improving the travel time, do enough to improve or shift traveler preference to rail?

Shifting Preferences to Rail

People have certain travel incentives, perhaps shortened travel time, frequency of service, on-time arrivals or departures, or others of connections, accessibility, and costs, among others that affect their travel decisions. Rail attempts to provide these services, but ridership has not been realized. The incentives of time and costs are currently provided with the car. The relationship between cost and time however, is not simple. When the cost of other modes of travel is more expensive, this would give incentive to use public transportation or an alternative mode, despite the slower time. When the first option reaches a certain threshold, the next best option is chosen. Historically, however, it is rarely a simple matter of defining variables and their influence on the preference of certain modes of travel. Cost and time are important factors, but complications exist.

Davidov (et al 2003) concludes that travel demand and choice are affected by time, as time has a value associated with it. However, he has proved in his studies that it is not only time and costs (Davidov et al 2003). Travel decision factors, as well as reliability and frequency of the train are used as explanations of the shift in preference (Wardman 2006; Bhat and Sardesi 2006; Batley et al 2011; Bates et al 2001). Of the multitudinous factors determining transportation mode choice, one of the most common explanations for a shift in traveler preference to rail is on the basis of time and cost and balancing the two. Cost must decrease in proportion or to compensate for an increase in time (Davidov, 2003). Cost is most important to users when balanced with time (Joewono, 2007). Cost is one of the main factors in choice of travel mode, as can be seen by changes in the fare prices for rail travel and transit effecting the demand and ridership (Paulley et al 2005). Litman (2004) argues cost, as in transit fare, effects

ridership, although the ability to shift or maintain transit ridership is relative. As explained by Litman (2004), transit elasticities are determined by many factors including user type, trip type, geography, and type of price change, direction of price change, time period, and transit type. There are price elasticities in the willingness of consumers to pay due to the service provided. Litman (2004) stresses the elasticity of transit prices in order to maximize use and profits, finding a price the rider can afford and one they are willing to pay for the service provided. When the Los Angeles Metropolitan Transportation Authority (MTA) first considered expanding its Gold Line light rail (*Gold Line Rail Extension- Pasadena, CA*) through Los Angeles County, reasons for light rail preference included cost of gasoline and traffic congestion on the freeways and at Los Angeles International Airport (LAX) (Ortega 2008, April 25).

Although the evidence of cost determining transport decisions is clear, time is a key component in travel decisions. Road travel time has an effect on the demand for rail travel. The effect of travel time to shift traveler preference to rail is suggested with the increase in commuter trips during peak hours of traffic congestion (Wang and Skinner 1984). Bel (1996) claims that the longer the road travel time the greater the demand for rail travel. From looking at incentives, cost and time are two of the largest factors, leading into the mode choice preference for Michigan travelers. This study argues that the shift to rail is embedded within travel demand decisions, thus traveler incentives and preferences. Rail must compete with other mode choices, such as air and car travel. How can rail shift travelers mode choice?

Shifting Preferences to High Speed Rail

The main goal of high speed rail (HSR) is to improve the competitiveness of rail against other mode choices, such as car and air travel. The primary purpose of HSR is to decrease travel

time, through increasing train speed. With this advantage alone, HSR can be the most important incentive for ridership. However, increasing passenger demand depends on when a new technology is implemented, the quality of the services and a perception of 'modernity' (Kottenhoff, 1999). This study desires to solidify passenger preference, as related to the benefits of HSR.

High speed rail has the potential to draw passengers away from traveling by air and car. Gonzalez-Savignat (2004(1) and 2004(2)) determined the potential was based on time and cost, and the valuation of each, as well as trip purpose. Historically, HSR, introduced in an existing rail corridor, reduces the travel demand for air travel within the corresponding route (Bonnafous, 1987). The largest effect for attracting passengers is when high speed rail is in direct competition with an air route of 310 miles (500 km) or less (Park and Ha 2006). The distance between Detroit to Chicago is just over 300 miles. In a stated preference survey in Korea, after a HSR line was fully operational, reliable, and fares were at their lowest, the HSR promoted the reduction of air travel by approximately 85% (Park and Ha 2006). Bonnafous (1987) found the French TGV (or HSR) replaced 18% of road travelers. Subsequent research has reported fluctuating percentages, with the highest being a 52% diversion from air travel (Gonzalez-Savignat 2004(1)).

The quality of the rail services against the alternatives (car travel, air travel) and the degree of urbanization (congestion on roads, population density) are also driving factors in demand for high speed rail (Kottenhoff 1999; de Rus 2008). Joewono (et al 2007) and Chou (et al 2011) found that user satisfaction, and people's preferences and perceptions mattered in decisions to use public transportation or HSR. Past stated preferences surveys reveal that

people would be more willing to pay for high speed rail services under the following conditions (Kottenhoff 1999): travel times are shorter, noise levels are low, travel is smooth, the rail cars are well ventilated, seats can reline, are comfortable to sit in, and have access to radio or music ports, and eating and drinking is permitted. An examination of the new high speed rail line in Shanghai found that many of these conditions were met (Antlauf, Bernardeau et al. 2004). Traveling to the airport from Long Yang station now takes 8 minutes rather than 45, seating is said to be comfortable and remarkably smooth. "The maglev's [high speed rail] ride is so smooth that travelers would be unaware that they were leaving the station if they did not look out the window" (Antlauf, Bernardeau et al. 2004). Trains are also on-time 99.7% of the time (Antlauf, Bernardeau et al. 2004). Simply put, people will respond more favorably to rail travel (where cost is concerned) when they believe that the commodities are modern (Kottenhoff, 1999).

The perception of modernity could also be applied to new construction versus using existing infrastructure. Couto and Graham (2008) analyzed the demand of passengers when two types of high speed rail technology were introduced, specifically when it was not present previously and when it was applied to existing infrastructure. Both technologies increased passenger demand however building new lines with high speed rail technology increased the new passenger demand by a larger percentage (Couto and Graham 2008).

HSR is needed within Michigan to fulfill traveler incentives. The Midwest Regional Rail Initiative (MWRRI) verified the quality of service could attract new passengers within their stated preference survey in 2004 (MWRRI, 2004). Can HSR, in Michigan, provide the benefits that would change preferences, especially for those who have never chosen or considered rail

as a mode option in the past? The literature does not speak specifically to a car culture. Since the car gives Michigan travelers current level of convenience, would HSR be enough to drive passengers to shift to rail travel? This study seeks to contribute to quantifying the potential of HSR from personal preferences of the top five cities in Michigan, closest to the HSR line.

Demographics of Travel Preferences

Does the population of rail users differ demographically from the population of car drivers?

Income, Education, and Age

Public transportation can be time-consuming. People make valuations of time and money every day. Research about attitudes toward travel suggests that as income increases, public transportation use will decrease unless the travel time can be reduced (Davidov, Schmidt et al. 2003). Davidov, et. al. (2003) pointed to the recent increases in income and gasoline usage as evidence and further suggested that, because education, age, and professional status are indicators of income, these variables should be considered secondary determinants of travel choice. Looking solely at income, we would expect that people with higher incomes would choose to travel by car rather than rail or bus (Davidov, Schmidt et al. 2003). As pointed out by the Center for Transit Oriented Development, the demographics of seniors, singles, smaller households and nonwhite households historically prefer transit (TOD 201).

As age is correlated to income, it also is correlated to rail travel. Novelty seeking, trust and attitude, were concepts researched by Hsiao and Yang (2010) focusing on college's students travel decisions and high speed rail users. It is expected that those who have a favorable attitude and trust toward high speed rail will be more inclined to ride or attempt a

trip however; it is noteworthy that college students are more likely to ride because of the attitude called novelty seeking that would lead to a favorable attitude toward riding trains (Hsiao and Yang, 2010). It is also made clear that those who previously ride the bus, train or take public transportation are likely to ride or increase their ridership on high speed rail (Hsiao and Yang, 2010). Positive perceptions of HSR are important and not exclusive to college students or age. Shifting the perceptions of train travel, especially among American users is important.

Gender

Analyzing travel preferences in Germany showed that women ride buses (public transportation) more than men (Davidov et al 2003). Davidov et. al. (2003) explains that because women typically make less money than men and, if the household only has one vehicle, the man is more likely to use the vehicle. The impact of gender on HSR in the literature is limited.

Marital Status

Unmarried people are significantly more likely to use public transportation as compared to married people (Davidov, Schmidt et al. 2003). Research explained that this could be due to the fact that unmarried people make less money than married couples. They also suggest that married people may live in more suburban environments where public transportation choices are limited (Davidov, Schmidt et al. 2003).

Community Impacts

The five communities along the HSR corridor in this study differ greatly in their built environment, planning, and economic markets. Detroit is the most extreme in built environment, with wide boulevards and a city culture and history of celebration of the car. The public transportation system, as well as city economics as a whole, is currently in a state of disrepair. Ann Arbor's economic activity, comparatively, is flourishing, although it supports a smaller population. Ann Arbor's built environment is compact, with a variety of transportation modes highly utilized. The other community's demographics and transportation systems fall within the extremes of Detroit and Ann Arbor. However, a commonality in each is the transportation system design, and the popularity of the car.

HSR has potential to compete with the car in these communities, because of the incentives provided. The ridership incentives for travelers to use a high-speed train could potentially be rewarding; based on cost, time, reliability, convenience, comfort and security. HSR can benefit each community. Due to the uniqueness of each community, they could respond in different ways to each ridership incentive and have different travel preferences. This study seeks to understand on a community level the benefits of HSR on each community, quantified using economic development. Based on existing literature, six items emerge as constituting community impacts. They are:

- Tourism
- Regional Impacts
- Transit Oriented Development
- Increased Property Values

- Increased Employment
- Decrease in Car Ownership

All these benefits interrelate, but are divided within this analysis to provide clarity and further meaning as related to the HSR study.

Tourism

Detroit is attempting a renaissance, both economically and socially. High speed rail (HSR) could be an impetus for this city revitalization, and tourism could be a tool. The tourist industry requires supplemental policies that accentuate the benefits of high-speed rail. An increase in tourism will not independently be caused by improving transportation; instead tourism requires local or regional areas to establish political and business policies that help integrate various tourist activities (Masson and Petiot, 2009). For example, a locality might create an incentive for the integration of tourist businesses' ideas; of which the resulting integration will lead to a program that may consist of numerous activities. By integrating tourist-like activities into a single tourist package, the locations can become more attractive because tourist will understand all of the activities of an area (Loannides and Debbage, 1998). As an example, the French TGV drew tourism to the region due to the introduction of high speed rail, and saw more growth when 'tourist packages' emerged (Bonnafous 1987).

Regional Impacts

High speed rail (HSR) provides regional impacts for economic development (Crockett and Hounsell, 2005; Chen and Hall, 2011). The regional impacts are described in terms of growth (population, employment, etc), connectivity and accessibility. Blum (et al, 1997)

explains the high speed rail corridor becoming an “extended functional region or…an integrated corridor economy” and the repercussions from such. The new patterns of employment distribution and population are seen on a micro level in a HSR corridor in Asia. HSRs can produce shock waves throughout the region, although the degree of change is debated. Economic development can occur through the enhancement of local areas accessibility to regional jobs (Leck et al., 2008). Givoni (2005) offered a rebuttal in that economic development could not always be an assumed benefit of high speed rail. High speed rail allows for the connectivity of regions, and gives cities along the high speed rail greater connectivity, which can be an advantage as well as a disadvantage, putting cities in competition with one another (Chen and Hall, 2011), and disadvantaging those not being served (Vickerman, et al, 1999). It is assumed that accessibility would increase as a natural result of implementing rail, as it would give an alternative mode choice (Chen and Hall 2011, Givoni 2005, Gutierrez et al 1996). Givoni (2005), when studying the impacts of a European high speed rail line, was convinced that accessibility was a natural improvement and anticipated benefit. This accessibility enhancement usually benefits the socio-economically depressed areas since they do not have immediate access to these areas because they do not own cars (Pickup and Giuliano, 2005) thus, HSR provides better access. In addition, creating greater accessibility can cause jobs within local areas to migrate into peripheral areas that offer agglomeration and financial benefits in addition to comparative and competitive advantages (Banister and Berechman, 2001). While high-speed rails provide access to job markets, they have limited ability to solely stimulate local or regional economic development within the constraints of a developed country, such as the United States. High speed rails cannot solely create sustained economic stimulation within

developed countries (Banister and Berechman, 2001); instead, public and private policies need to act as a catalyst to create additional economic attractiveness (Masson and Petiot, 2009; Martin and Reggiani, 2007).

Transit-Oriented Development (TOD)

The community benefits of higher speed rail include "impetus for new station and station-area development opportunities and retail opportunities and improved transportation choices for regional travelers" (Midwest Regional Rail System, 2000). Transit oriented development (TOD) concepts encourage development around the stations, business development, higher quality of life, more options for convenient travel, among a few (TOD 201). Locations that currently offer attractive tourist activities are expected to experience TOD, especially if the station is located in the downtown area. For TOD to occur around the stations, tourist activities need to be available, and then the HSR can act as a catalyst. However, cities that focus planning efforts on a downtown area separate from the HSR stop, these cities will experience development not supported by TOD literature. High-speed rail provides the means to which economic development arrives to a locality or region, but the locality or region must provide additional business opportunities or incentives to supplement the quicker transportation.

Property Values

From the literature, simply having a high speed rail stop contributes to "high status" of the city and thus promotes new activity around stations (Van Den Berg and Pol, 1997). This new activity can lead to an increase in property values, along with the development. Property values

are assumed to rise in, near and around transit oriented development. Large infrastructure investments, such as HSR, increases property values around the rail stations. In New York the exact property value increase was $2.31 (using geographical straight-line distance) and $0.99 (using network distance) for every foot closer to the station (Hess and Almeida, 2007). A model focused on three areas in the Netherlands, amended this "[finding] that prices of real estate are influenced more by the most frequently chosen station than by the nearest railway station to the dwelling" (Debrezion, et al, 2011). A rise in property values surrounding rail and high speed rail stations are common. This pattern is expected be exemplified in Michigan, as indicated in Table 1.

City	Property value increase (in $ million)
Detroit	$76-$114
Dearborn	$36-54
Ann Arbor	$48-72
Battle Creek	$40-57
Kalamazoo	$53-$80

Table 1: Property Value Increase
Source: (MDOT, 2004, p. 2)

Increased Employment

Per a comprehensive study of the region surrounding the Michigan Wolverine line, the Midwest Regional Rail Initiative calculated the system of rail improvements would bring 2,000 new permanent rail operating, equipment maintenance, and track maintenance jobs to the region and approximately 4,000 construction jobs (Midwest Regional Rail System, 2000). The study also expects an additional $138 million in household income (MWRRI, 2004). Within studies of development effects of high speed rail, population, within the region the rail serves,

and employment rates, above the statewide average, could and have increased (Givoni, 2005; Sands, 1993).

Decrease in Car Ownership

A decrease in car ownership and traffic is a benefit from HSR, as seen in a successful high speed rail line in Sweden (Froidh, 2005). The effect was most dramatically seen in the vicinity of the stations (Froidh, 2005). "[Travel by high-speed trains] includes some commuting, essentially into national capitals, over shorter distances and leisure travel (short breaks) over longer distances" (Greengauge, 2006). A decline in traffic congestion is a direct benefit to the surrounding region.

Gaps in Literature

However, these impacts depend on certain incentives. The expectation that jobs will flourish, and income and population will rise with the construction of a HSR station or train is not guaranteed. There has been no substantial correlation yet to increased population growth because of high speed rail. Ohasho and Ando (1997) found some correlation of population and economic activity moving from developed regions to less developed. Additional factors, besides HSR, need to be factored into the debate in order to analyze this type of projection. However, developmental effects, do contribute to increased population.

From the literature concerning high speed rail, increased development can be expected along the Wolverine due to high speed rail. This could be caused by greater accessibility, the competition between cities, or the new "integrated corridor economy" formed around the corridor, including more job growth, or more tourism (Blum et al, 1997; Chen and Hall, 2011;

Banister and Berechman, 2001). However, these need to be accompanied with strong policies and coordinated planning efforts from the communities, in order to maximize the benefits. The impacts of transit oriented development explain many of these benefits. This study attempts to determine the expected impacts of residents, especially those with the greatest accessibility, living within 2 miles of a rail station, due to high(er) speed rail coming to the community. The research is framed/ conducted within a unique demographic of communities based on a car economy, and car culture. The following research contributes to the literature in that it establishes the expectations or assumed repercussions of the top five communities. The goal is to assist the planning efforts of the communities for the high speed rail.

Methods

Estimations and expectations are drawn on the statewide level, whereas the greatest improvements and changes this rail network, and particularly the Wolverine line will bring, are on the local communities adjacent to the rail stations. It is crucial, especially when analyzed under a long-term sustainable development framework that these communities continue to use the train and leverage the benefits these upgrades will bring to the region. Hence, to sustain the economic benefits continuous ridership of the line is essential in reaching operational profitability of the route and ensuring its future operation. The Federal Railroad Administration's (FRA) assumes that 40% of the ridership increase will be diverted from car travel, 30% from air travel and 8% would be induced (Federal Railroad Administration, 2003). These estimates seem fairly high, given the quality of public transportation services in Michigan has ever since lacked well behind most other states of the USA. Hence, Michiganders do not prioritize public transportation and overall prefer car travel (Kaplowitz and Lyles, 2008; MDOT, 2006). The god father economy of Michigan has been the car. Local communities have been designed for the car as the primary mode of travel. Due to the anticipated benefits and changes to the communities along the Wolverine line because of high speed rail, methods of sustaining train ridership in the future are needed. For these research purposes, communities with the highest train ridership in Michigan were chosen. The current ridership for 2011 is seen in Table 2 below.

Corridor Station Activity Summary	
Ann Arbor	141,522
Battle Creek	38,654
Dearborn	79,985
Detroit	66,378
Kalamazoo	86,942

Table 2: Detroit-Chicago Calendar Year 2011
Source: (Hundt, 2012)

The hypothesis of the current research is that incentives exist for increasing ridership, and can be determined at the local level, from those who live closest to the rail stations. Travelers have preferences that would encourage them to use or attempt travel by alternative modes. Finally, Michigan travelers have perceptions of high speed rail and expectations of the impacts on their specific community.

Interviews

Pre-Survey Results

Information collection began with interviewing local communities with the highest expected ridership along the Wolverine line. City planning offices were identified within the communities, whom had the highest ability to affect or observe the changes that would occur. Interviews with local transport planners of the five cities provided in-depth knowledge on their individual communities and their needs and expectations in regards to the high(er) speed rail. The interviews were conducted in January and February 2010. The interviews expanded the hypothesis and research questions and formed the base content for the survey questions. The interviews with the Michigan transportation planners were used to verify, create new ideas,

and support a draft survey design. The questionnaire design and survey structure was developed after these interviews were complete.

Post-Survey Results

The previously mentioned survey was conducted approximately during the same time frame as construction was progressing on the project. By the completion of the survey results, the HSR project made significant political decisions. Obtaining high(er) speed rail (HSR) for the state and the region is and was a lengthy process. Within this process, decisions and relationships were formed between many partners and collaboration was extensive. These partners could have included but were not limited to politicians, freight companies, rail manufacturers, all transportation officials, local communities and advocates. It was desired to learn more about the relationships established, formulated, and encouraged with the state and its partners that influenced the decision to implement HSR within Michigan. Furthermore, an understanding of the factors that contributed to its implementation, especially the reasons based on policy, be it Amtrak's, the City's, or MDOT's was needed. The purpose of the interviews of political decision makers, including MDOT and Amtrak transportation specialists, and previous MDOT Bureau Directors and staff involved in HSR, was to expand on the results of the survey, and provide a connection between the political decisions and the academic findings.

Questionnaire Design

A survey was developed in close collaboration with the Office of Survey Research at Michigan State University. The questionnaire was designed for riders and potential riders to better understand the most important factors that influence mode choice and would attract

them to this particular high(er) speed rail (HSR) corridor. It contained 22 questions including sub-sections, which surveyed the residents on three topics: current ridership, potential ridership (through incentives), and expected impacts on the communities. The final section determined ridership characteristics. The current ridership questions focused on the means of travel for each respondent, for travel to and from Chicago for work or leisure, and also trips within Michigan. Options of modes were given (train, car, bus, plane, motorcycle, walk, bike, etc), to attempt to cover all available opportunities available to the respondent. However, in the majority of questions, respondents were given the option of 'other' and a blank line to describe their unique response. The potential ridership questions attempted to discover the preferences of riders as related to rail travel on the Wolverine line. All questions but the question that ranked the importance of frequency, reliability and shortened travel time were given categories of the number of times per month they would ride if a certain change (incentive) occurred. The incentives were a predetermined list, with no option for an additional incentive to be written in. The answer selections were given categories, instead of being open ended, to allow for a more comprehensive and straight forward analysis of the responses in relation to each other. The community impact questions were given categories of does the respondent expect more, no change or less of the predetermined community attribute, such as traffic, noise, access to job opportunities, etc. Both questions were given a choice of 'other' and a blank to fill in an alternative expectation of a change to the community because of the introduction of high speed rail. Expected changes to a community could vary greatly, but the common expectations were given to structure the question and provide a base for the responses. The answer options for the respondent characteristics section were divided into two

types: categories (for age, number of personal vehicles own in leased in the household) and open-ended (for the number of people living in the household). The specific questions asked in the survey are embedded within the "Survey Analysis" section below or the actual survey can be found in the Appendix. The survey was pre-tested by several local transportation planners and MDOT employees.

Data Collection

In order to test our hypothesis, the research team conducted a large-scale survey in communities living close to rail way stations in Detroit, Dearborn, Ann Arbor, Battle Creek and Kalamazoo that identified their interest, preferences, and willingness to pay for high speed rail service between Chicago and Detroit. These communities were chosen based on their history in drawing the most passengers (MDOT, 2009), and as of 2011, were the communities along the corridor to have a high(er) speed rail (HSR) stop. The number of surveys mailed to each community was based on their population, and the random sample of people chosen. Anonymity of each responder was given high priority and explained within the instructions. Names were not written on the surveys, and addresses, except for the community in which they were from, were not recorded per survey. Through a stated preference survey, the researchers tested the actual expectation of ridership of those communities adjacent to the railway stations and identified incentives to increase ridership within them.

Sampling Strategy

We first identified the block groups, for which more than half of the block-group area fell within a 2-mile radius of the railway stations. The goal of the sampling method was to

obtain responses from those that live within 2 miles of the station, not a general representation of Michigan residence rider preference. Based on the identified block groups, Survey Sampling Inc. (http://www.surveysampling.com/) drew a random sample of people residing within those block groups. For each of the five cities, 400 samples were selected, except for Detroit, for which 600 samples were drawn.

The mail survey was conducted according to Dillman et al. (2009) from March 2010 through September 2010. The pre-notice letter was sent out on March 12th 2010, the questionnaire was sent out on March 19th 2010, the postcard was sent out on March 31st 2010, the replacement questionnaire was sent out on April 20th 2010. Despite Dillman's advice of using first class mail, we decided to send all mail through non-profit. This mailing method had the distinct advantage of not getting forwarded in case the residents had moved in the mean time – as only those households were targeted that lived within the 2 mile radius.

After MSU mail office reran the data sampled by Survey Sampling Inc. to avoid sending questionnaires to vacant households, 2050 questionnaires were sent out. Households within a 2-mile radius around railway stations were asked to fill out the survey while it should be completed by the adult (18 and over living in the household), who had the most recent birthday. Overall, the research team received 569 completed questionnaires, which correspond to a 27.8% response rate. The respondents by city can be seen in Table 3.

City Station	Percent of Respondents	Number of Respondents
Detroit	19%	109
Ann Arbor	31%	176
Dearborn	14%	81
Kalamazoo	18%	104
Battle Creek	18%	99
Total	100%	569

Table 3: Distribution of Respondents by City
Source: authors

Limitations of the Survey Design

On the question of which traveler incentive would cause the respondent to ride the train more, there was no alternative incentive box, forcing the respondent to choose between the options given. This could have prompted the respondent to choose to ride less frequently, based on an alternative incentive that was not listed.

The question about gas price increase within the traveler incentive questions was limited because of the desired focus of the question. We were unable to determine thresholds, or if there was a maximum or minimum dollar amount at which the respondent would ride or not ride the train. Attempting this was beyond the scope of our survey, by length and content. Projections could take place, but very limited, thus only direct conclusions were made.

Due to the opened ended answer key and highly skewed distributions of answers to how many times someone would ride due to a certain variable, only generalized statements could be made. It was not possible to quantify exactly how many more times per month a person would ride based on a certain variable.

Statistical Survey Analysis

The survey was evaluated using primarily descriptive statistics to analyze either a single question or the questions and their relations to one another. For all statistical analysis, the computer software program SPSS Statistics 17.0 was used. The tests included:

- Frequencies (a descriptive statistic)
- ANOVA (Analysis of Variance)
    - Independent Sample Mann-Whitney U test
    - Kruskal-Wallis 1-way ANOVA
    - T-test
- Pearson Chi Square Test

Frequencies

Frequencies use a common trend in the data to show majorities. By a frequency test, data responses were counted to determine the number of respondents who were in favor or not in favor of the response, or had a common response to the question. Valid percentages were used, meaning the results or percentages used reflected only those who answered the question. Percentage distributions were used as well, which shows the percentage of the totals that fall into certain categories. Frequencies and percentage distributions were used for the following, 1) to determine the amount of ridership that each respondent preferred, given each incentive, 2) the responses to current traveler preferences which could reveal potential for a mode shift of certain passengers, and 3) finally, to determine the impacts on, desires or expectations of development in the communities.

Travel Incentives

The problem statement is to discover what drives people to choose high speed rail. The goal was to measure the potential of people to ride the train more frequently. Questions within the survey focused on current and potential ridership in order to identify incentives for travelers to choose rail. The survey responses were coded according to Table 3.

Code	Theme of Question	Question Elements
Train_Work	Current Ridership	train ridership to work
Train_Job	Current Ridership	location of job to train stations
Train_Leisure	Current Ridership	train ridership for leisure
Train_Connect	Potential Ridership	increase in connections to other trains
InterBus_Connect	Potential Ridership	more connections to inter-city buses
IntraBus_Connect	Potential Ridership	more connections to intra-city buses
MoreCar_Parking	Potential Ridership	more car parking available
Safe_Car_park	Potential Ridership	safer vehicle parking available
Comfort	Potential Ridership	more comfortable, safe train stations
Gas$4	Potential Ridership	gas prices of $4 per gallon
Gas$5	Potential Ridership	gas prices of $5 per gallon
Gas$6	Potential Ridership	gas prices of $6 per gallon
Detroit_direct	Potential Ridership	direct link to Detroit airport
Chicago_direct	Potential Ridership	direct link to Chicago airport

Table 4: Traveler Incentives within Survey Questions

The answer choices to these questions include options of riding 1-2 times, 3-5 times, 6-10 times or more than 10 times per month, and finally “Doesn’t Matter”. Coding for these questions was simplified because many categories were given. The responses for “Doesn’t matter” to this question was coded as a 0 while all other responses were coded as 1. The question could then be analyzed as those who would change their behavior versus those who would not. The information lost was the magnitude of what individuals would change in order

to ride the train. However, the recoding provided valuable information that would otherwise be unable to distinguish.

Frequency, Reliability, Shortened Travel Time

From the existing literature the conclusion was on the basis of time and cost. Three factors affecting potential ridership occupy much of the debate about what will encourage ridership. The first is schedule reliability, which means there are more on-time arrivals. It is expected that more people are likely to take the train if they know exactly when the train they need to take is going to be there and they can be sure that it is not delayed. Second, does the system need more frequent trains? Do potential riders need more departures or arrivals of trains to commit to HSR? Third, does the new HSR shorten travel time? This is presumably the main purpose of high(er) speed rail (HSR) given the political debate on HSR advantages. Time is critical to potential riders (Martin, 2007). The study wanted to discover how respondents valued all three factors influencing ridership (reliability vs. frequency vs. shortened travel time), so the survey provided a ranking system for their responses. The question was how much do you value each of those three in comparison to the others. A separate question, generated percentages of how many people, of the total surveyed, would ride the train more given each incentive.

Cost

As seen in the literature review, cost is of equal or second to time in the importance of determining travel demand. Percentage distributions were made between an increase in ridership and gas prices to discover the amount of people that would ride more per month given an increase in gas prices. The following are the codes used for the questions,

- Gas$4
- Gas$5
- Gas$6

Other Incentives

The other question reported with frequencies was if the respondent would ride the train more given a certain incentive. Percentage distributions were reported per city. Accessibility was a common theme within the incentives to travel by rail, or use public transportation, thus frequencies were also used to report an increase in ridership and a connection to an airport. The related questions were coded as follows:

- Detroit_direct
- Chicago_direct

Travel Preferences

Another goal of the study is to discover the preferences of travelers in Michigan, in particular if high(er) speed rail (HSR) were available. How would HSR affect the attitude or preference toward the car? Reporting frequencies to the questions regarding the respondent's favorite mode of travel and primary mode of travel within the state of Michigan would display the current preference. The question becomes what would influence Michiganders to switch from car to rail travel, perhaps additional investment, better accessibility or connections?

Accessibility was a strong topic within the literature, as both an incentive and a preference for travel by rail. Proximity to the train station, expressed as a percentage distribution, was reported with the ridership preference questions, seen in Table 5, of the

respondent's current mode of travel to Chicago, their favorite mode of travel to Chicago, and lastly, their primary mode of travel within Michigan.

Code	Theme of Question	Question Elements
Chicago	Current Ridership	Mode of travel to Chicago
Favorite	Current Ridership	Favorite mode of travel
Primary	Current Ridership	Primary mode of travel
Primary_other	Current Ridership	Primary mode of travel
MDOT_Invest	Potential Ridership	MDOT Investment
ChicagoDetroit	Potential Ridership	Desire for HSR
CD_Option	Potential Ridership	Willingness to pay
CD_Times_you	Potential Ridership	Ridership on HSR
CD_Times_neighbor	Potential Ridership	Ridership on HSR

Table 5: Traveler Preferences within Survey Questions

Shifting Preferences to Rail

Connectivity to other public transportation services is another key factor in choosing to shift travel choice from the car to rail. Themes of connectivity, accessibility and preferences could be analyzed using the respondent's answers to how many times per month they would ride to Chicago, if the HSR were available. The question was also asked how many times the respondent believed their neighbor would ride. Coding for these questions was labeled CD_Times_you and CD_Times_neighbor, referring to Table 4. Preferences on the extent of HSR services were analyzed using the question whether respondents would ride more if there was a direct rail link to the Detroit Metropolitan airport and/or the Chicago's O'Hare International airport. As previously noted, the responses were reported using a percentage distribution for how many times the respondents would ride given the connection.

Within previous studies, communities prefer investment in modern technology (Kottenhoff, 1999), infrastructure and services that increase train speed (de Rus and Nombela, 2007). What investments should be made and where? Due to the desire of travelers for modern technology, the question whether respondents would prefer track improvements or rail stations was analyzed with a frequency test, and percentage distributions.

Demographics of Travel Preferences

How do the characteristics of the travelers affect their preferences, specifically who would take the train more, over the car? The respondent's desire for high speed rail and age was determined by a frequency test, specifically a percentage distribution.

Community Impacts

The communities along the Wolverine line could be expected to have been developing due to the benefits of the rail line already functioning in the corridor. However, the questions within the survey were structured around *high speed rail*. How do the communities plan to develop in the future, and what are the expectations? MDOT expects property values to rise substantially (MDOT, 2004). Other benefits could be accessibility between the metropolitan areas, a rise in employment opportunities, economic development and tourism. The respondents were asked to rate their expectations of impacts on their community based on the construction of the HSR line. The question responses were coded according to Table 6.

Code	Theme of Question	Question Elements
Tourists	Community Impacts	change in tourism
New_Businesses	Community Impacts	change in new businesses
Neighbors	Community Impacts	change in people living in neighborhood
Noise	Community Impacts	change in noise level
Grocery_Stores	Community Impacts	change in number of grocery stores
Shopping_Stores	Community Impacts	change in number of shopping stores
Restaurants	Community Impacts	change in number of restaurants
Traffic	Community Impacts	change in amount of traffic
Comm_Jobs	Community Impacts	change in access to jobs
Property_Values	Community Impacts	change in property values

Table 6: Community Impacts within Survey Questions

Frequency or percentage distributions were used to analyze the results of these questions and the majority or averages of the expected changes due to the introduction of HSR along the corridor**.** The percentage distributions were used to establish which community expected more change in a specific category.

Analysis of Variance (ANOVA)

This test is used to discover the differences per category in the responses to a common question. It is generalizing the t-test to more than two groups. The ANOVA takes two or three means and compares them, but used when 2 or more means are equal. After the coding of answer choices (in beginning of “Frequencies” of “Survey Analysis”) for questions on frequency, on-time arrival, and shortened travel time (incentives), an analysis of variance (ANOVA) was used to reveal the differences per city. The context of the city could determine responses to frequency, reliability and shortened travel time or change in behavior. The type of traveler was

expected to reveal different results as well, as compared to the three incentive variables. The respondent characteristics were age, gender, number of individuals and vehicles in the household and proximity to the train station. The categories of bus connections, more car parking, safer car parking, safer more comfortable stations, or incentives for travelers to ride the train more, were tested via ANOVA.

Non-parametric Independent Group Tests

Due to highly skewed distributions on a number of remaining questions within traveler preference, in Table 3, with continuous outcomes regarding respondents' intentions,

- CD_Option (how much would you pay for the option of HSR)
- CD_Times_you (how much more would you ride HSR)
- CD_Times_neighbor (how much more would your neighbor ride HSR)

non-parametric independent group tests were used. These are extensions of ANOVA tests. These tests included the Independent Sample Mann-Whitney U test, which is used in situations with only 2 groups, and the Independent Sample Kruskal-Wallis 1-way ANOVA, an extension of the Mann-Whitney test, which is used only for situations with greater than 2 groups. For the question if people would pay for the option of HSR, a Kruskal-Wallis 1-way ANOVA and a Mann-Whitney test were used to reveal differences on the proximity to the train station. For the next two questions of how much more would the respondent and their neighbor ride per month if the HSR option were available, the answer space was open-ended. As a result, categorizing the data involves needing to round fractions, either to 1 or 0, or round up if the answer ended in

0.5. Also, the time frame of the question was one month, and therefore an upper limit of 30 trips was assumed reasonable, for both questions.

T-test

The t-test, or a one way ANOVA test, is for data that is not normally distributed. It is used to determine if the difference in the means, or averages, of two groups, in an independent two sample t-test is statistically different. In this specific t-test, the sample sizes must be equal, and the distributions assumed to have the same variance.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_{X_1 X_2} \cdot \sqrt{\frac{2}{n}}}$$

The top of the ratio is the difference between the means or group 1 and group 2. The bottom is the measure of variability. The denominator of *t* is the standard error of the difference between the two means. $S_{X_1 X_2}$ is the pooled standard deviation, and *n* is the number of responses in each group. The *t* value, given the degrees of freedom, is tested per a theoretical value to evaluate whether it was a chance finding. If the null hypothesis is to be rejected, the significance is 0.05 or less. Finding the samples having 5% or less chance of being drawn from the same population, the relationship can be deemed significant, or the means between the groups are statistically different. Within the traveler's preference section, a separation was made between if people would pay anything for the option of HSR and whether they would pay anything above 0. With the new coding, a *t*-test was performed between if the respondent wanted HSR and how much the respondent would be willing to pay for HSR.

Pearson Chi Square Test

These tests are used to determine significance between different questions or variables, or if they are related. It does not tell details of the relationship. It involves a cross tabulation of two variables and determines if the correlation is due to chance. The greater the distance the observed relationship is from the null hypothesis, the greater the confidence of the relationship.

$$X^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

The Chi Square equation is seen above, where *O* is the observed frequency and *E* is the expected frequency, and *n* is the degrees of freedom. The result is compared with a table of theoretical values, using the Chi Square value and degrees of freedom. The likelihood that the null hypothesis is correct had an assumed threshold of 5%, or a p value of 0.05. The relationship was determined significance if the Chi Square test revealed a p value of 0.05 or less.

Travel Incentives

Overall, all travel incentives, as seen in Table 3, and changes in behavior were tested for significance via a Pearson Chi Square test with city station. Again, all of these statistical analysis were completed using the coding which differentiated between whether a respondent would change their behavior (changed to a 1) or not (changed to a 0). Also, group statistics was used to find the mean of the responders that lived in proximity to the train station and responded to each incentive question. Looking at individuals based on whether or not they live within one

mile of a train station, or increased accessibility, reveals insight on the likelihood of individuals changing their behavior. Thus, the rider's proximity to the train station, and questions dealing with travel incentives were tested for significance with a Pearson Chi Square. Respondent characteristics, such as age and gender were tested via the Pearson Chi Square against the travel incentives. A final Pearson Chi Square test was performed within the travel incentive questions, based on if the responder used the train for work or for leisure within the last year.

Traveler Preferences

Survey questions pertaining to discovering traveler preferences, as seen in Table 3, were analyzed to discover significant relationships. From the literature review, demographics could be seen as playing a role in traveler preferences. The significance of demographic factors of the respondents was considered when analyzing all ridership preference questions.

Community Impacts

Analyzing if any of the demographics factors had an effect on the expected impacts on the community, Pearson Chi Square tests were conducted on all the factors that could change, as seen Table 5, with HSR being introduced to the community. Frequencies, in percentages, were used to show the majority of the responder's opinions. All values used the valid percent.

Results

The findings below paralleled those found in the literature review, on aspects of traveler incentives, travel preferences and community impacts. It was determined that the largest incentive was a connection to airports. The second most important factor, an expected factor, is cost, also seen in the price of gasoline. As seen in 2009, gas prices caused a large increase in public transportation ridership (Yanmaz and Ozbay, 2010). The third largest incentive was a decrease in travel time. Frequency was a fourth incentive, closely followed by on-time arrivals. A further incentive for increased ridership was better station comfort and safety. Finally, respondents believed that accessibility was important, such as connections to other buses and trains or distance to the train station. Another factor that made high speed rail more attractive was transit oriented development (TOD). This concept is expanded upon by community interviews with transportation planners. Traveler preferences for travel on the high speed rail are dependent on travel decisions, specifically Michigan traveler decisions, with a significant relationship to age, primary mode of travel and favorite mode of travel. Shifting those preferences to rail, specifically if high speed rail were implemented, involve Michiganders willingness to pay for high speed rail, ridership and demographics. Lastly, community impacts varied per city but Detroit expected the most amount of change to occur due to high speed rail.

Transportation Planner Interviews

The only issue, the five city planners disagreed on, was the pattern of development high speed rail would stimulate. The planners for Ann Arbor and Dearborn believed that transit oriented development (TOD) would be stimulated around their stations, which would be a

perfect opportunity to create density and reduce the need for, and space devoted to cars. They also assumed that if the railway stations and the surrounding communities were developed through mixed land uses, this would improve ridership on the high speed rail. In comparison, the transportation planners for Detroit, Kalamazoo and Battle Creek said that development near the train stations is primarily dependent on other local rail and other connecting transportation modes over shorter distances. They predicted that high speed rail will promote bedroom communities near the stations, primarily serving Chicago. People in Kalamazoo and Battle Creek would have an hour and a half travel time into Chicago, and given the time zone difference of an hour, transportation planners argued that then people living in Kalamazoo and Battle Creek would live locally but work in Chicago. The Aerotopolis initiative connecting Detroit Metro airport and Willow Run airport was mentioned. Advertisements and word of mouth campaigns, to increase the success of HSR, were identified. A further concern of the HSR viability concept that was mentioned multiple times is that people need to change their mindset around the concept of public transportation. The transportation planners argued that we need to switch the transportation ideology (i.e. people's perception of public transportation). This is supported by the results that the respondents do not currently ride the train frequently. Within the past year, 9% rode the train for work purposes and 23% rode it for leisure. The response rate for this question was higher than the majority of questions, at 548 out of 569 respondents (96%).

Travelers Incentive

The goal of research question one is determining the local incentives for increasing the ridership and sustaining its growth in the long-run. All incentives reported significance with the Pearson Chi Square tests, as seen in Table 7. The incentives are ordered in level of importance, based on the number of respondents that would increase their ridership to at least 1 to 2 times more per month.

	How much more would you ride the train if the following incentive were provided?	**City Station**
1	Detroit Airport Connection	$(27.057)^1$
2	Gas $6 per gallon	$(11.755)^1$
3	Chicago Airport Connection	$(13.29)^1$
4	Shortened travel time	$(13.515)^1$
5	Gas $5 per gallon	$(15.502)^1$
6	More Frequent service	$(20.239)^1$
7	More Comfortable Stations	$(25.283)^1$
8	Gas $4 per gallon	$(19.481)^1$
9	More on-time arrivals	$(30.533)^1$
10	Train Connections	$(20.495)^1$
11	Safer Car Parking	$(23.677)^1$
12	More Car Parking	$(14.679)^1$
13	More Intrabus Connections	$(32.526)^1$
14	More Interbus Connections	$(53.793)^1$

Note: χ^2 values are in parenthesizes; ^{1} significant result.

Table 7: Pearson Chi Square Tests

Which incentive is the most powerful in Michigan, having the car as the godfather economy? Of 569 respondents, 26.2% reported that no type of HSR incentive (shorter travel time, more frequent train service, more on-time arrivals, better bus and rail connectivity at interchanges, convenience at stations and in the train, gas prices or airport connections) would make them change their current travel behavior.

Cost

Cost is one of the largest factors in determining who would ride the train. Within our survey, cost was second only to time. Gas prices were one of the most important incentives found within the survey. If gas prices increased, from their current price of at least $3 per gallon, riders have more incentive to ride the train, as the cost of driving a car increased. 52.7% of riders would ride the train at least one or more times more per month if gas prices increased to $6 a gallon, as seen in Figure 3.

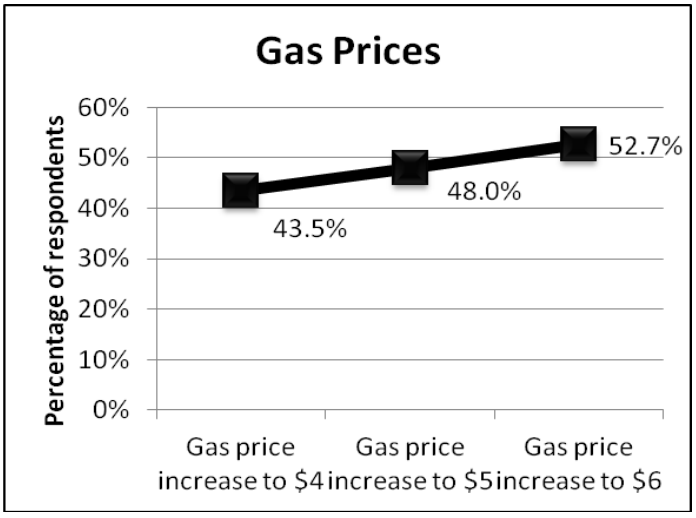

Figure 3: Gas Price Increase

Shortened Travel Time, Frequency, Reliability

Overall, the respondent characteristics and a change in their behavior based on frequency, reliability and shortened travel time was determined by a Pearson Chi Square test. Significance was found within the responses to proximity of the train station and all three factors. Significance was found with age and shortened travel time. The final comparison in

which significance was found with these three factors was for the question of if the respondent took the train for work or leisure in the last year, or they did not.

To the question of ranking the importance of shorter travel time, more frequent trains and more on time arrivals, the most important indicator of the three for increasing ridership on the Wolverine line was shorter travel time (train speed). The second factor to increase ridership is service (frequency of trains) and the last reliability (on-time performance). All communities within the five cities individually ranked shorter travel time, thereafter frequency of trains and finally on-time arrival as their preferences when it comes to improving train services on the Wolverine line. Shorter travel time overall is ranked by all cities as the primary motivator, combined the frequency of trains is most important for Ann Arbor than any other of the five case-study cities.

As for increasing ridership, the results showed a low response rate and uneven distribution in each category. Within in the survey, for the option of "Doesn't Matter" the responses were high. Those who would change their behavior, riding the train at least 1 time more a month, if the train experienced an improvement of either more on-time arrivals, more frequent service or a shorter travel time was significant. If there were more on-time arrivals, 57.4% responded it didn't matter and they would not ride more, but 42.6% of the riders would change their behavior. For more frequent service, 52.0% would not ride more, but at least 48.0% would ride at least 1 time more a month. If there was shortened travel time, 49.2% would change. Per city, the results are seen in Figure 4. Detroit was the city that was most likely to change its behavior for any improvement factor.

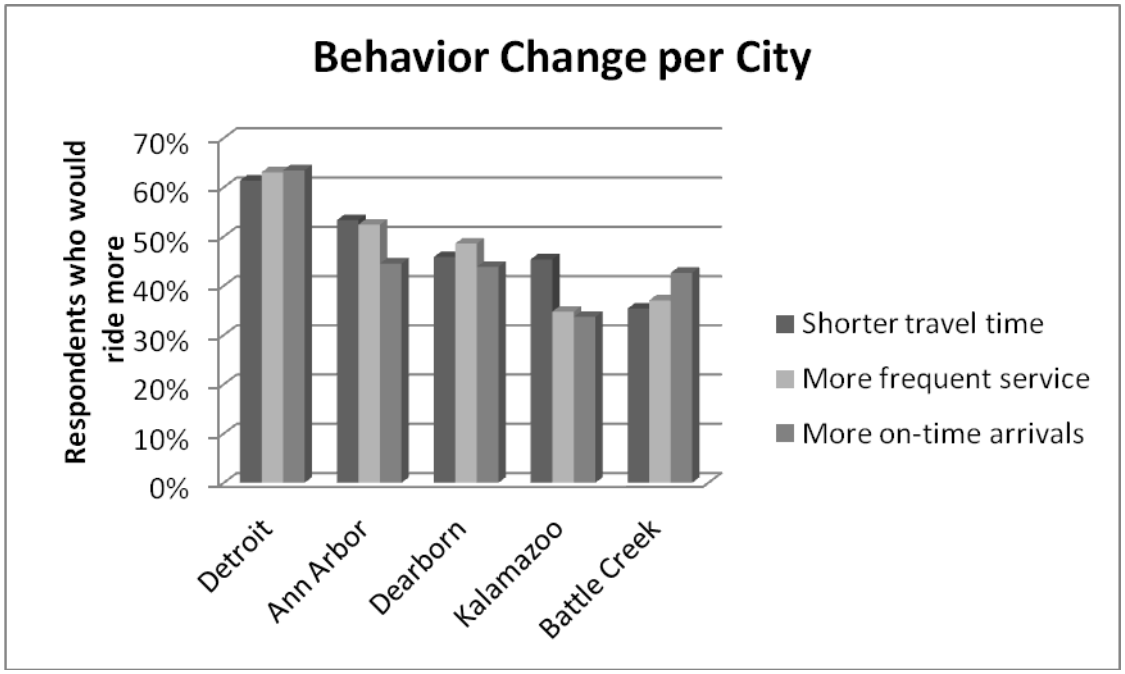

Figure 4: Travel Incentives per city

The other significant relationship found with a Pearson Chi Square test with these three variables was to age. The younger the respondent, the more likely they were to ride the train, at least 1-2 times more per month if it had a shortened travel time, as seen in Figure 5.

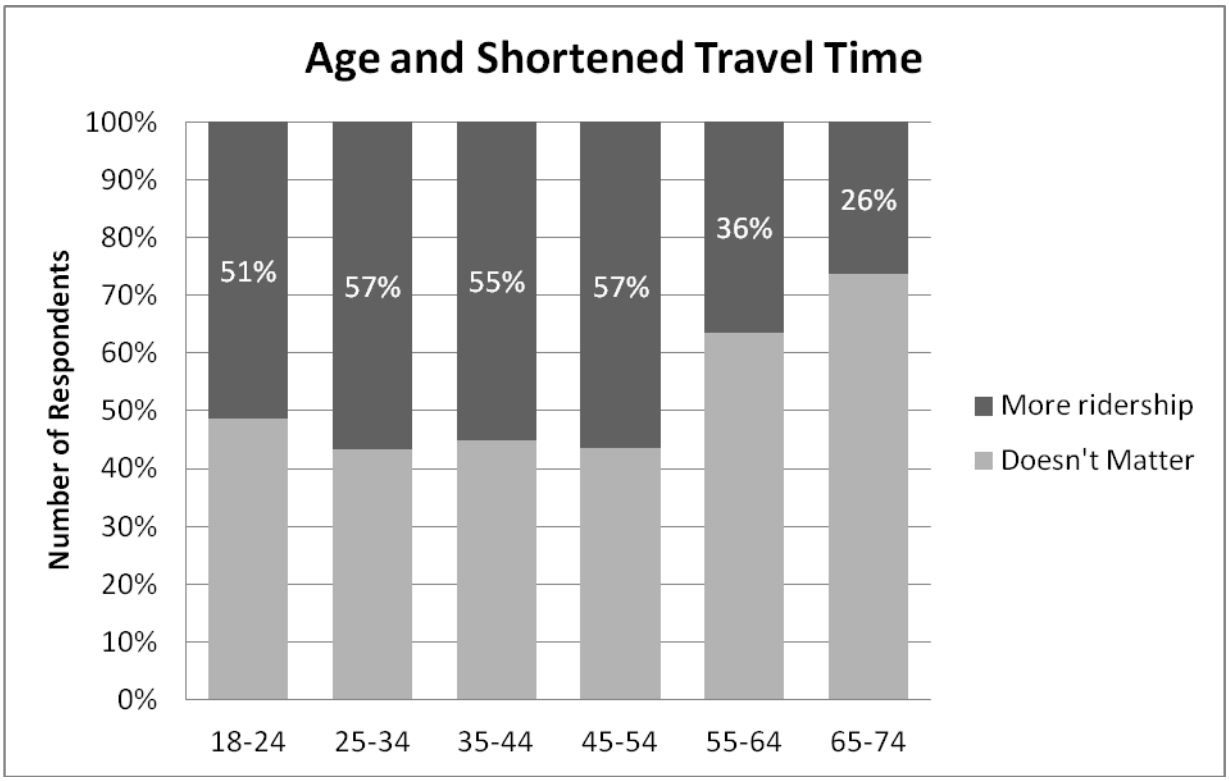

Figure 5: Travel Incentive and Age

Convenience

Convenience was an important factor within the literature for encouraging passengers to ride the train more. The distance to train station was significant. The majority of respondents, out of 537 that answered, 58% responded yes to living within a mile of the train station. Significant relationships were found with Pearson Chi Square tests, between this question and incentives questions involving frequency, reliability, and shortened travel time. Riders were willing to change their behavior if they lived within a mile of the train station and any of these improvements were made. If there were more on-time arrivals, 48.1% would change their behavior, for a change in more frequent trains, 52.5%, and for shortened travel time, 56.6%.

Based on current ridership questions, there was a significant relationship between cities and if the respondent's job was located with accessibility to the Amtrak train there. For the

majority of responses, the station was not conveniently located near employment. However, Ann Arbor had the highest response rate of yes, at 23 out of 163 (14%).

The largest incentive for respondents was a link to the Detroit airport, for all cities. 59% of respondents answered they would ride the train at least 1-2 times per month if there was a direct link to the Detroit airport, and 49% if there was a direct link to the Chicago airport.

All Other Incentives

All other travel incentives received favorable responses in that at least a quarter of the respondents would change their travel behavior, ride at least one time more a month, given any of the incentives, as seen in Figure 6.

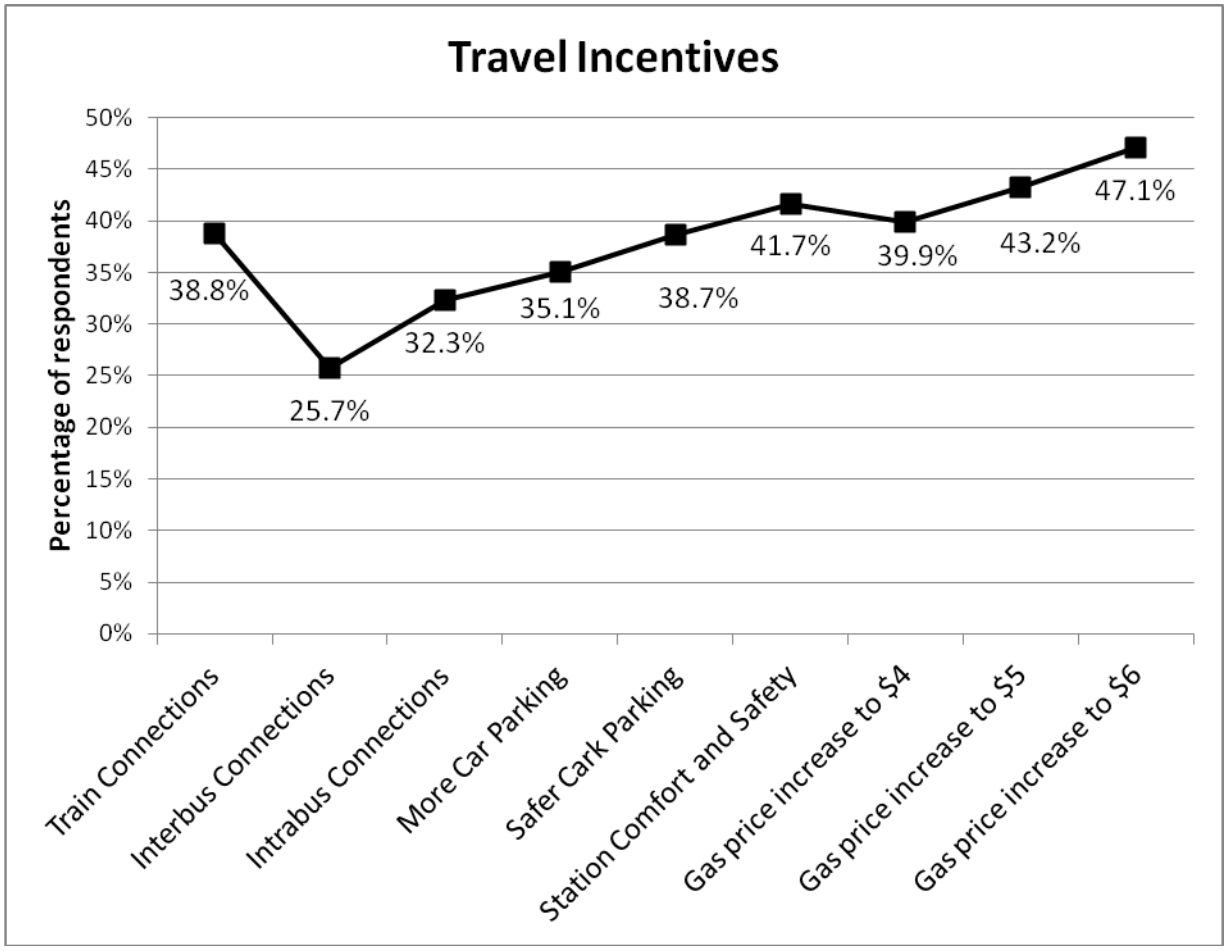

Figure 6: Travel Incentives

Based on the results of the following ANOVA tests, all factors that could potentially increase ridership show a significant difference in between groups. The results from the ANOVA test are shown in Table 8.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Train_Connect	Between Groups	47.398	4	11.85	11.118	0
	Within Groups	558.5	524	1.066		
	Total	605.898	528			
InterBus_Connect	Between Groups	74.221	4	18.555	20.413	0
	Within Groups	472.682	520	0.909		
	Total	546.903	524			
IntraBus_Connect	Between Groups	53.211	4	13.303	11.954	0
	Within Groups	575.333	517	1.113		
	Total	628.544	521			
MoreCar_Parking	Between Groups	42.609	4	10.652	9.229	0
	Within Groups	596.734	517	1.154		
	Total	639.343	521			
Safe_car_park	Between Groups	57.794	4	14.448	13.087	0
	Within Groups	577.386	523	1.104		
	Total	635.18	527			
Comfort	Between Groups	82.465	4	20.616	17.31	0
	Within Groups	625.287	525	1.191		
	Total	707.753	529			

Table 8: ANOVA test for Incentives

The main difference is caused by the responses from the Detroit metropolitan area, as they are significantly different in their preferences. Detroit residents would ride the train significantly more, if further connection (no matter which transport mode) would be provided. As depicted in the Mean-Plot Diagram below, Figure 7, investments targeting Detroit would experience a higher response in ridership than in any other of the four Michigan cities analyzed.

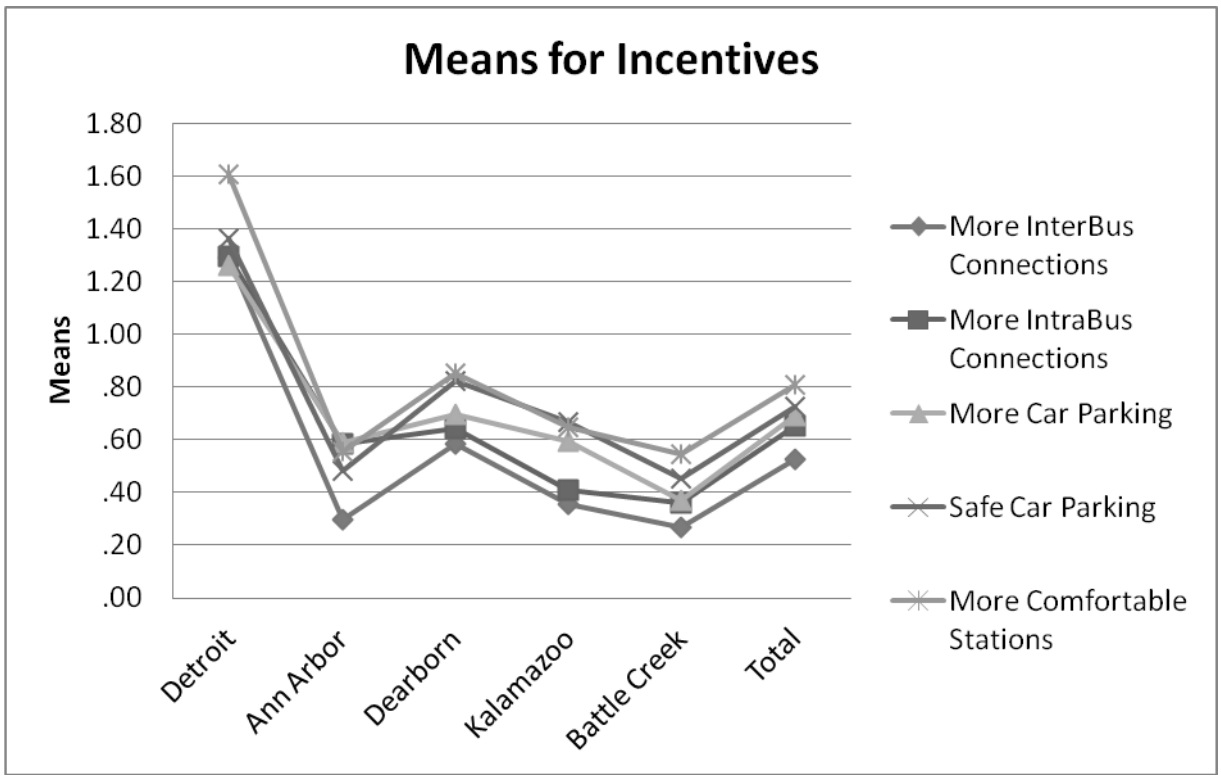

Figure 7: Per City Incentives

Significance was found by a Pearson Chi square test between incentives to ride the train and if respondents took the train for leisure or for work. Different effects were found when looking at those who have taken the train for work in the last year and those who have taken the train for leisure in the last year versus those who have not. In both cases, people who have used the train for work or leisure in the last year were more likely to change their behavior if there was shortened travel time, more frequent service and more on-time arrivals. At least 66% of those who rode the train for work or leisure within the year would ride more given any of the three primary incentives. Shortened travel time gained the largest percentage of riders. For other incentives, more train connections and cleaner and safer stations were among the largest incentives for those who had previously taken the train for work or leisure. The most outstanding result for all incentives was between those that would ride more if they had not

ridden the train, and those that would ride more if they did ride at least once a month for work or leisure. If people had not used the train at least one time or more per month for work or leisure, they were less likely to ride the train. For those who currently rode the train for work or leisure, they would ride the train more given any incentive.

Travel Preferences

The following results of respondents' traveler preferences parallel the literature review format of 1) making travel decisions 2) shifting these preferences to rail and then 3) shifting these preferences to high speed rail. In the current literature, it was determined that travel demand decisions were based on a multitude of factors including cost and time. Results on how much respondents were willing to pay for high speed rail is found within the travel preference questions. Other factors stated in the literature, such as personal resources (money;, access to a car, bus, or commuter rail system; needs, demands, desires of one's family; demand for the goods that travel can access and the price of gasoline, bus fares, etc were considered within the survey questions. Based on household size, number of vehicles owned, and the demographics of the household, the survey reports on how and what travel decisions are made by Michigan residents. The decision to shift their travel preferences to rail was analyzed based on current mode of travel, the favorite mode of travel to Chicago and also the respondents' primary mode of travel within Michigan. Finally, the questions were asked if the high speed rail was implemented, how many more times per month would the respondent ride, and how much they expect their neighbor to ride.

Making Travel Decisions

Travel decisions were found to correspond with answers on current mode of travel, desire for high(er) speed rail (HSR) and age, primary mode of travel within Michigan, and favorite mode of travel to Chicago. Each was found to have significance, as seen in Table 2.

Current mode of travel

The current mode of travel to Chicago had a significant relationship per a Pearson Chi Square test (Table 9) with the size of the household, number of household vehicles and age. The most significant response was that if the household did not own a car, they did not travel to Chicago. The more cars the individual owned, the less likely it was that they would ride the train at least 1 or more times a month. The respondent's primary mode of travel to Chicago is currently the car, however as seen in Figure 8, the train captures 20.9% of the travel to Chicago. The primary mode of travel for trips within Michigan is the car, for 92% of the respondents.

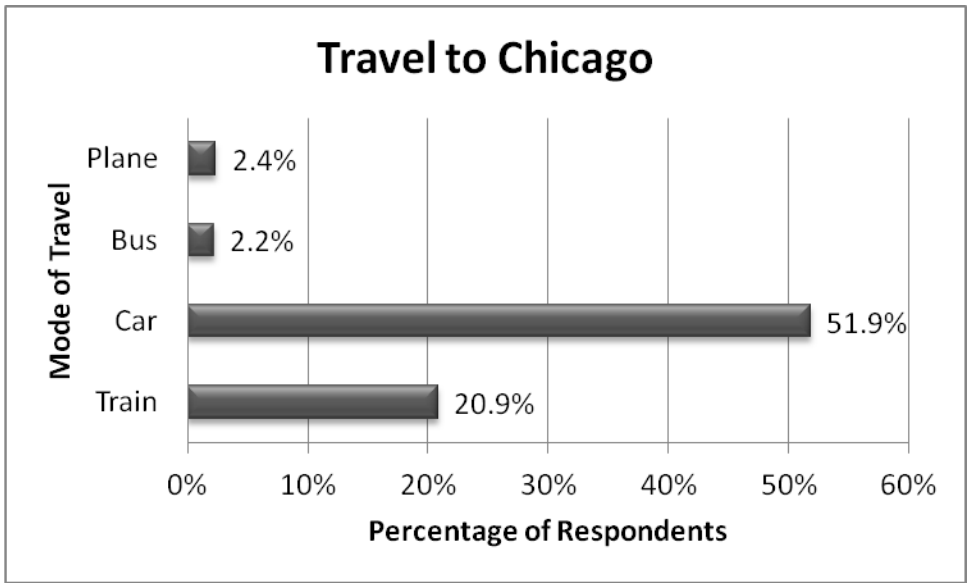

Figure 8: Current Mode of Travel to Chicago

Desire for HSR and Age

The older age group, between the ages of 55 and 64, were more likely to use a car as their current mode of travel. The younger the responder, the more they would ride the train.

Primary mode of travel within Michigan

The primary mode of travel to Chicago had a significant relationship, per a Pearson Chi Square test (Table 9), with the number of vehicles owned per households. If they owned a car, they were far more likely to use the car than any other mode. Even for those who did not own a vehicle, 60% of them still used a car as their primary mode of travel.

Favorite mode of travel to Chicago

There was also a significant relationship, per a Pearson Chi Square test (Table 9), with the respondent's favorite mode of travel to Chicago and age, size of household and gender. For those between the ages of 18-34 their favorite mode of travel was by train, as seen in Figure 9.

Those between the ages of 35 and 54 their preference between car and train was split in half. The older the responder, the more they preferred their car.

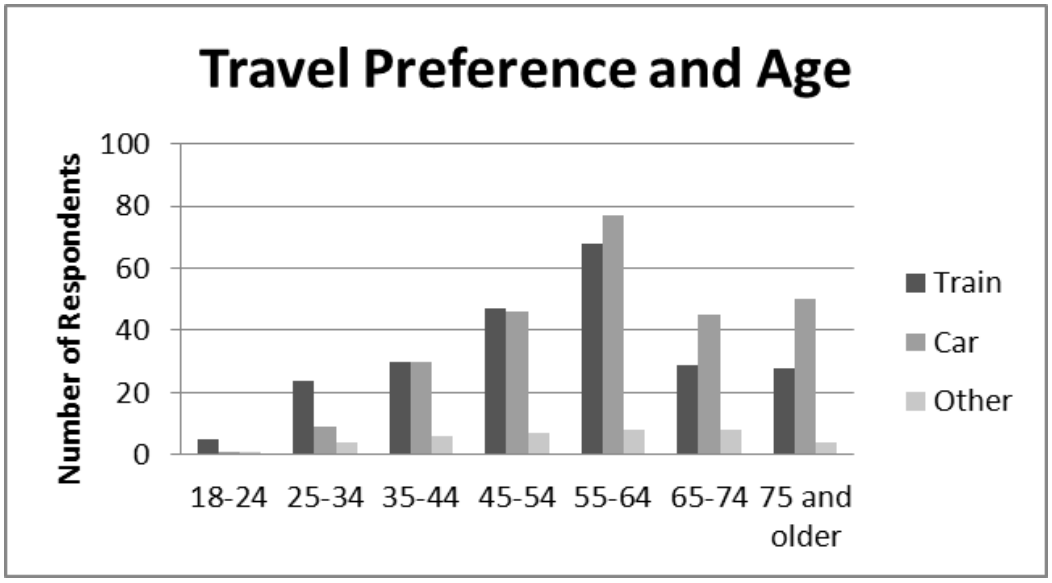

Figure 9: Favorite Mode of Travel to Chicago and Age

Both Detroit and Ann Arbor prefer other modes of transportation to Chicago over the car. Of the total respondents from Ann Arbor, the majority or 54% prefer the train over any other option. The car is the dominant preference for the other three cities. For the relationship between the size of the household and the respondents favorite mode of travel, the greater the amount of people in the household, the more they would prefer to travel by train. For those with 5 or more people in the household, 54% chose the train as their favorite mode of travel to Chicago.

Number	Survey Question	Age	Size of Household	Number of Vehicles	Gender	Whether respondents lived within a mile of a train station
1	When you travel to Chicago, how do you usually travel?	(48.261)[1]	(92.480)[1]	(49.050)[1]	(7.894)	(7.77)
2	What would be your *favorite* mode of travel for a trip of two hours of travel time within Michigan if you had any transport option available to you?	(65.790)[1]	(238.871)[1]	(31.365)	(22.418)[1]	(9.517)
3	What is your *primary* mode of travel for trips within Michigan?	(41.000)	(59.355)	(105.722)[1]	(4.680)	(19.040)[1]
4	Do you want high speed rail service between Chicago and Detroit for your community?	(32.740)[1]	(23.002)	(3.321)	(2.763)	(2.802)
5	Do you think MDOT should rather invest in a) Your railway station to make it more accessible, comfortable, and safe OR b) Track improvements for higher train speeds, OR c) Neither.	(18.449)	(15.527)	(15.527)[1]	(20.884)[1]	(408.000)

Note: χ^2 values are in parenthesizes; [1] significant results.

Table 9: Pearson Chi Square Tests for Traveler Preference Questions

Shifting Preferences to Rail

The goal of the research was to identify the passenger travel preferences within the top five cities in Michigan if high-speed rail service was implemented. The high majority of respondents, 79%, wanted HSR. Of the respondents, 16% chose the option that they did not care whether HSR was implemented or not, and the final 4% responded specifically that they did not want HSR between Detroit and Chicago. The results prove respondents want the infrastructure, but what is their willingness to pay for it?

Willingness to Pay

A non-parametric independent group tests was used for the first question regarding how much respondents would be willing to pay for HSR. A Kruskal-Wallis 1-way ANOVA found differences on age (a *p* value, or significance, of less than 0.001) and a Mann-Whitney test (a *p* value, or significance, of less than 0.05) revealed differences on the proximity to the train station. A *t* test was performed between, if the respondent wanted HSR and how much the respondent would be willing to pay for HSR, and significance was found. The independent samples test revealed a significance of 0.005, if equal variances were assumed. The majority responded they want the service for their communities, although they do not want to pay much for it. However, 27.4% of survey respondents did not answer the question. 31% of the non-responders were women versus 18% were men. Due to the highly skewed data received for the question of how much would you be willing to pay for the *option* of HSR service (between Chicago and Detroit) coming to your community, the data was categorized, as seen in Table 10.

Of the 413 respondents, 59% of respondents were willing to pay at least something for the option of HSR.

Pay per Month	Respondents	Percentage
$0	168	41.0%
$0.01-$5.00	78	18.8%
$5.01-$10.00	60	14.5%
$10.01-$20.00	27	6.5%
$20.01 +	80	19.2%
Total	413	100.0%

Table 10: Willingness to Pay per Month for HSR

41% of the respondents would not pay anything for the option of HSR. However, of the people (59%) who would pay something, or 245 people, 138 (56%) of them would pay $10 or less. The median response was $10, and the mean $33. 107 respondents of the 245 people (44%) would pay more than $10 per month. Within the data, there was a large discrepancy between the highest and lowest values. There were 24 people who said they would pay $2 or less, and 18 people who said they would pay $100 or more.

Michigan Department of Transportation (MDOT) Investment

If the respondents are not willing to pay for the HSR, how should the state's money be invested? The question was asked what the respondents wanted MDOT to invest in more, either track improvements for increased trail speed, or more accessible, safer and comfortable railway stations. People were more interested in network improvements than work on specific stations, with over half, or 62%, reporting that they wanted funds to go into track improvements to increase speed. In comparison, less than 25% of the communities approve of investments in rail stations. The remainder, 14%, wanted to invest in neither. Though both

genders preferred track improvements for shortened travel time, females were more likely to prefer investments in stations that were more accessible, safer and comfortable, as seen in Figure 10.

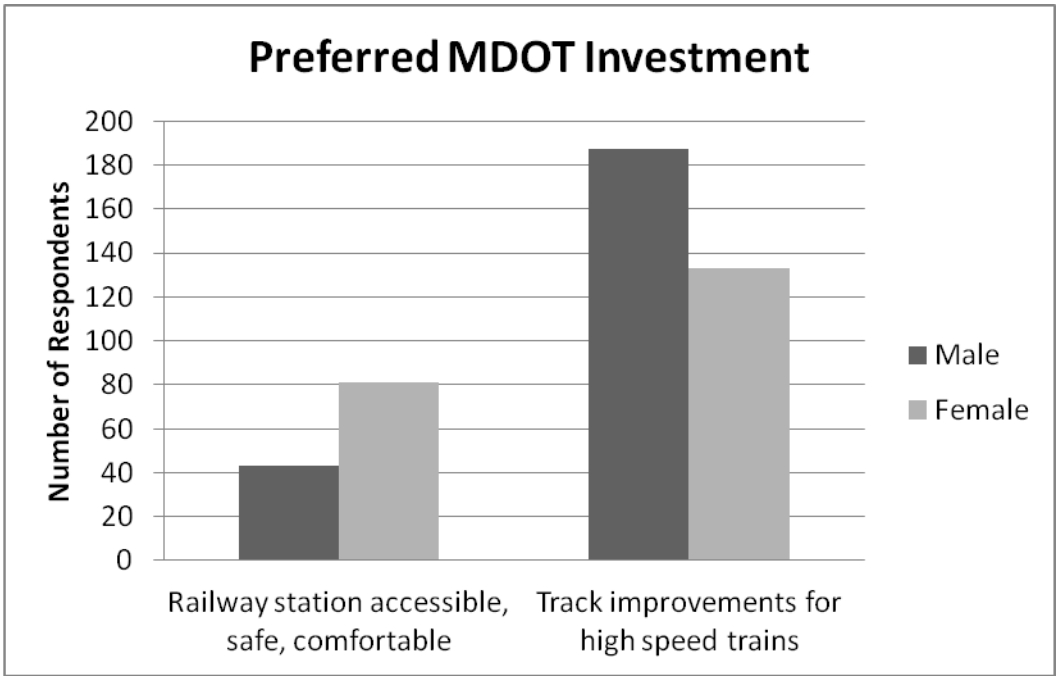

Figure 10: MDOT Investments and Gender

Of females, 52% wanted track improvements and 32% wanted station improvements. Of males, 71% wanted track improvements, and 16% wanted station improvements. Though all cities preferred track improvements, Ann Arbor wanted track improvements the most.

Shifting Travel Preference to HSR

Due to highly skewed distributions on ridership within traveler preference questions (i.e. how much more would you ride HSR, and how much more would your neighbor ride HSR), non-parametric independent group tests were used. For the two questions of how much more would the respondent and how much more would their neighbor ride the train per month if the

HSR option were available, significance was found. For the first question, a Kruskal-Wallis 1-way ANOVA found differences on age (a *p* value, or significance, of less than 0.001), and the number of people in the household (a *p* value, or significance, of less than 0.05). A Mann-Whitney test revealed differences on whether respondents lived within a mile of a train station (a *p* value, or significance, of less than 0.05). For the second question, of how many times the respondent's neighbor would ride the train, a Kruskal-Wallis 1-way ANOVA revealed differences on age of the respondent (a *p* value, or significance, of less than 0.01) and a Mann-Whitney test revealed differences on whether the respondent lived within a mile of a train station (a *p* value, or significance, of less than 0.05).

Ridership by Age

To the question of how much would you or your neighbor ride a month and age, the respondents answered similarly for each question. The answers were highly distributed in terms of number of riders per month. However, the responses generally followed the pattern that the 75 and older group would ride the train less. Figure 11 illustrates the relationship of age to frequency of ridership, at least 1 time or more a month.

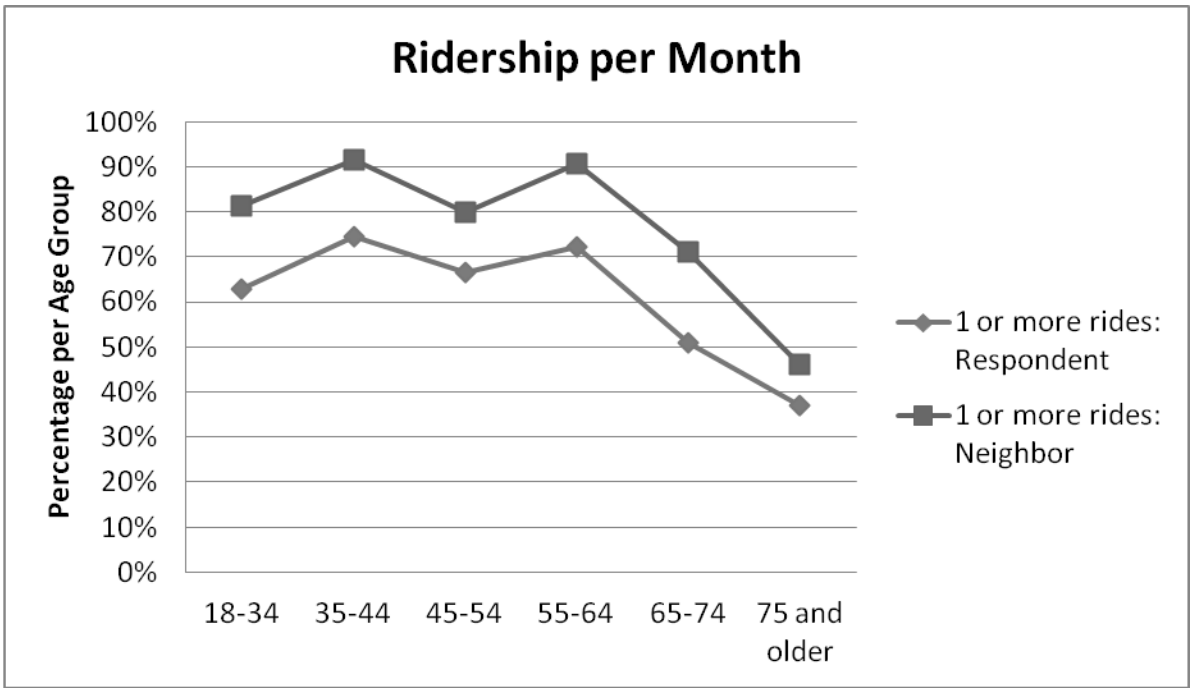

Figure 11: Ridership by Age

Ridership by Persons in Household

If HSR were implemented for any community on the Wolverine line, 67% of respondents would ride the train at least once a month or more, as seen in Table 11. The most ridership, at least 1 or more ride per month, can be gained from 2 person households.

Rides per Month	Ridership	Percent
0	167	33.4%
1	138	27.6%
2	97	19.4%
3	28	5.6%
4	13	2.6%
5	18	3.6%
6	8	1.6%
7	1	0.2%
8	1	0.2%
10	14	2.8%
12	2	0.4%
14	1	0.2%
15	1	0.2%
18	1	0.2%
20 +	10	2.0%

Ridership	Percent
0 rides per month	33.4%
1 + rides per month	66.6%

Table 11: Rides per Month on High Speed Rail for all cities

Ridership by City

Per city, Ann Arbor respondents would be the most likely take the high speed train at least 1 time a month. Detroit and Kalamazoo were the next most likely. Ann Arbor was also the most willing to pay. Ann Arbor has the highest potential train ridership to Chicago, as seen in Table 12. It has the current lead of ridership for the year by a substantial amount, even in the month with the lowest ridership. Ann Arbor would also be willing to pay the most for the service, 60% of respondents paying $5.00 or more.

Rides per Month	Detroit	Ann Arbor	Dearborn	Kalamazoo	Battle Creek
1	27	53	17	29	12
2	16	28	13	15	17
3	11	12	0	5	8
4	3	3	1	4	2
5	4	6	4	2	2
6	3	3	1	1	0
7	0	1	0	0	0
8	0	0	0	0	1
10	4	7	2	0	1
12	1	1	0	0	0
14	0	1	0	0	0
15	1	0	0	0	0
18	0	0	0	1	0
20 +	1	5	1	3	0
Totals	**71**	**120**	**39**	**60**	**43**

Table 12: Potential Train Ridership per City

Demographics of Travel Preferences

The majority of respondents to the survey were in the 55 and older category, if given the option of HSR. The split between male and female respondents was relatively even on the preferred mode of travel to Chicago, although males slightly preferred car travel more than women. The majority, or 72%, of respondents live in either a 1 or 2 person households. Also, 58% of the respondents lived within a mile of the train station. All but 8% owned at least one vehicle in their household. From the interviews from the five city transportation planners, they claimed it was the attitude toward taking public transportation that influenced train ridership the greatest within Michigan.

Community Impacts

Research question three asks what are the community impacts in the top five cities in Michigan which are expected to draw the most passenger numbers for high-speed rail service. Based on the survey results, all community impacts were significant, per a Pearson chi square test, as seen in Table 13.

Community Impact	City Station
Tourists	(23.418) [1]
New Businesses	(23.944) [1]
Neighbors	(57.461) [1]
Noise	(32.548) [1]
Grocery Stores	(50.562) [1]
Shopping Stores	(34.730) [1]
Restaurants	(16.295) [1]
Community Jobs	(22.431) [1]
Property Values	(27.222) [1]

Note: χ^2 values are in parenthesizes; [1] significant result.

Table 13: Pearson Chi Square Tests for Community Impacts

People expect that as a result of the implementation of HSR, their communities will see:

- More tourism (74%).
- Better access to job opportunities (76%).
- More business development at both the areas around their stations and the destinations (63%).
- A change in property values.
- More restaurants, although 47% said there would be no change.
- A change in traffic, either more or less.
- No change in the amount of neighbors or noise.

- No change in the number of grocery stores and shopping stores, although respondents thought the change in shopping stores would be substantially more than in grocery stores.

Community impacts were seen on a per city basis, but most especially Detroit. Detroit always expected the most amount of change as compared to other cities, except for in the noise category. The greatest impacts expected because of HSR were for a change in tourists and new businesses, as seen in Detroit in Figure 12.

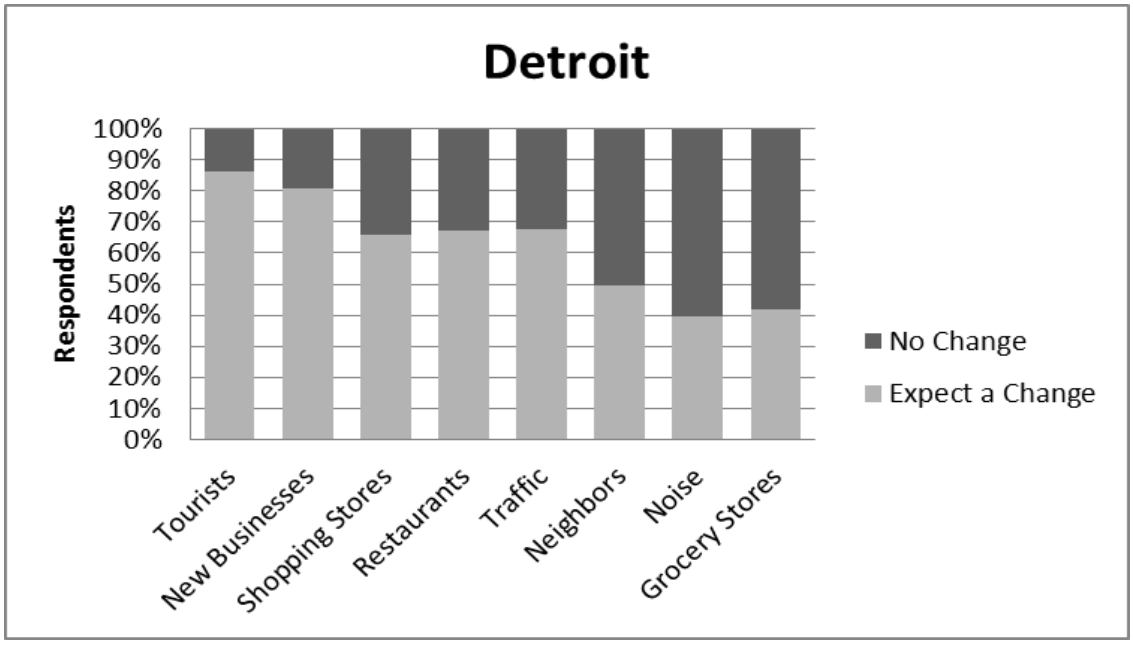

Figure 12: Community Impacts

Most cities expected no change in property values, however just over half of the respondents from Detroit, Ann Arbor, Dearborn expected better property values after the HSR implementation. Jobs were the overwhelmingly most expected change within a community. Detroit, with 92% of respondents, expected better availability of jobs within their community, as seen in Figure 13.

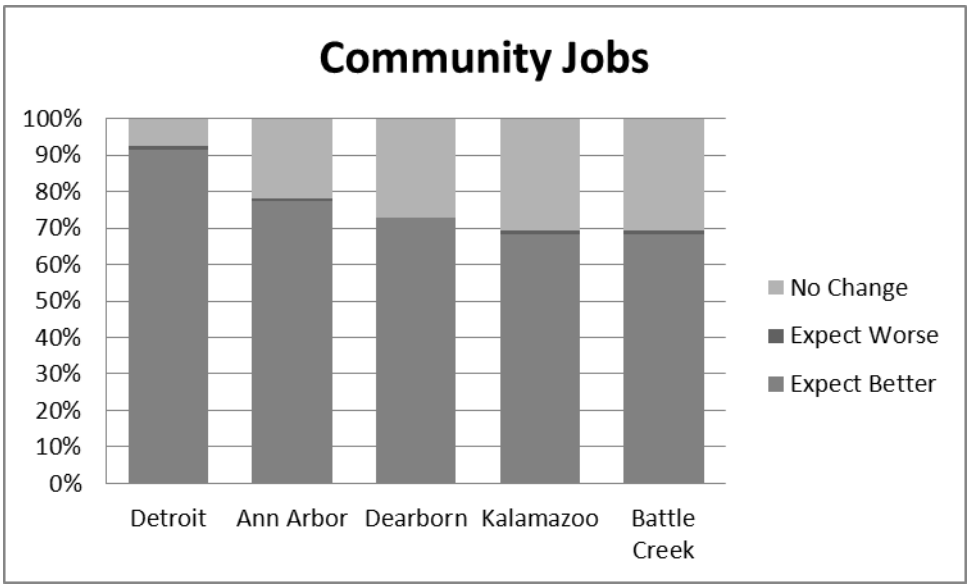

Figure 13: Change in Jobs per City

Political Decision Maker Interviews

The questions to the political decision makers are framed within their definition of the objectives, purpose and role they saw the HSR playing within Michigan and therefore local rail riders. They were asked to compare all decisions made to significant results including: MDOT investments in track improvements and track upgrades, connections to major airports and comments on any outstanding incentives or suggestions on methods for increasing ridership. The majority of interviewees saw the original purpose of the HSR line being to increase train speed, and therefore to shorten travel time. At the same time, they responded that giving a viable transportation option was critical, therefore having an alternative that competes with car and air travel. All subsequent decisions made within the process to upgrade the Wolverine line, under the MWRRI's planning framework, were based on this purpose to compete with car and air travel and giving a viable transportation option.

The question, of what role HSR plays within the transportation options of local Michigan riders, did not reveal a distinct consensus. Roles mentioned included drawing people and business from Chicago, serving airports, tourism, providing realistic alternatives for the car, economical travel, delivering better energy efficiency than buses or airplanes, and increasing connectivity.

The HSR service was designed to serve everyone. The most common cited demographic for the HSR to appeal to or attract, however, was specifically the student and business person. The desire to market to the business traveler was implied, and traditional incentives, specifically frequency and reliability, were mentioned as necessary and the ideal method of capturing this market demographic.

Objectives

A question asked about ordering objectives of HSR revealed that the most important objectives, according to those interviewed, for implementing HSR followed traditional rail incentives of shortening travel times, increasing frequency and providing reliability. These objectives would then fulfill subsequent objectives of competing with air and car travel, relieving airport and highway congestion, improving the environment (as rail uses less energy), and economic development, and accommodating a higher percentage of the market share. All interviewees agreed the traditional rail objectives and travel incentives were defined before the project's inception, but continued to evolve based on developments within the project, relationships with the railroad companies and regulations, east coast HSR initiatives, funding levels, and the sequence of funding. Design factors that were heavily influenced by this lack of

funding, or by the sequence of funding were the purchase of track, completion of grade separations, and station work.

MDOT Investments

Within the survey results was a desire for MDOT investment to be targeted towards track improvements to increase train speeds, rather than in station improvements and making them more comfortable and safe. Sequencing of the funding made available was the cause of the latter being completed first. The stations, when the funding was awarded, were described as overcapacity, out of date or many years past their lifespan, in a bad state of functionality. Although it was reiterated that the intended goal was not to invest in stations first, the station upgrades were highly desired by all those interviewed. Reasons cited included stations being a gateway to the community, granting a sense of pride to the community and better service and amenities, assisting a tourist destination, positively affecting public perception, increasing ridership, and finally, mentioned by the majority of interviewees, providing intermodal connectivity. Station improvements were seen as highly complementary to the HSR line, and the station stops and laying groundwork were integral parts of the HSR project.

Airport Connections

The strongest result of the incentives was providing a connection to the Detroit airport, increasing ridership at least 1 to 2 times more a month. However, as described by the interviewees, track alignment and rerouting was infeasible, infrastructure costs were too high, and acquiring property included the need to demolish private homes. Logistics and operations were too complicated and obtaining an increased number of frequencies of trains to properly

serve the airport was currently unattainable. All challenges were exacerbated by competition from private transportation entities currently within the airport opposing the connection and lack of collaboration between political leadership. Finally, and most importantly, interviewees reported other modes were more feasible and better served the airport. A commuter rail line and bus connections (as used in other states) were mentioned as the most likely and probable. Both projects are currently in discussions within MDOT and city government, although no implementation date has been set.

Recommendations

Collaboration, and the need for its continuation within the HSR project, resounded throughout the interviews. All interviewees were involved in the Midwest Regional Rail Initiative (MWRRI) study in some manner. The MWRRI study, its continued relevance and valuable guidance, was cited many times. Conclusions or economic justifications of the study were referenced, including increased economic development, jobs, tourism, ridership, and connectivity as well as better attraction of industry, thru-way bus connections, and access to Detroit. Other challenges encountered within the HSR project as a whole included: 1) lack of State Transportation Commission's support in early years, 2) not always getting to make decisions based on ridership, 3) economic results not being an independent activity, 4) treating inherent uncertainty in forecasts accordingly, 5) needing to help the freight railroads as well as passenger rail, 6) branding efforts like the Acela train in the northeast corridor, and 7) attracting business travelers. All challenges affect ridership and revenues. Suggestions for increasing ridership included a change in type of rail car, giving Amtrak more press or media attention, spreading awareness and marketing, and continuing Amtrak's trend of being a better

service agency. However, in the end, at least two interviewees agreed and all implied that good service, or reliable, frequent and timely service would sell itself. The decision makers responsible for upgrading the Wolverine line listed the following as some of the greatest positive while working on the HSR project: capitalizing on the money spent at the federal level, the cooperation and coordination within the MWRRI and the nine state coalition and the support from the corridor and the communities along it.

Analysis and Discussion

The following is a critical analysis of findings of traveler incentives and preferences of Michigan travelers choosing high speed rail (HSR) as related to the existing literature. Second points are repercussions and recommendations of each outstanding finding within the results. Lastly, the outstanding challenges of implementing HSR in the United States, and themes not addressed within this study which need further research are discussed.

Critical Analysis

The study corresponds to existing literature, supporting and solidifying the importance of certain incentives. The Wolverine rail line is in direct competition with air travel, as stated by Park and Ha (2006), with the length of the HSR under the 311 mile threshold. In their study, the Korean HSR promoted the reduction of air travel by approximately 85% after it was fully operational, reliable, and fares were at their lowest (Park and Ha 2006). Public transportation increases with gas prices. Within the survey, an increase to $6 per gallon of gas, 53% of people would ride the train at least 1 to 2 times more a month. Historically, higher gas prices have sparked a rise in public transportation and transit ridership (Yanmaz and Ozbay, 2010).

While Michiganders valued reliability as an incentive, compared to reductions in travel time and frequency of train services, the reliability incentive was comparatively weak. This finding is aligned with Batley et al. (2011) who concluded that lateness and reliability have little effect on rail demand at the market level.

A considerable finding within the study found over a quarter of respondents, despite any travel incentives, would not change their current travel behavior. Speculation, given the quarter of respondents that would not ride the train more given any incentive, is possible in order to provide insight on what is needed to increase ridership. An increase in gas prices was the second highest incentive for Michiganders. Extrapolating the data on gas prices using a trend line, gas price increases would correlate to an increase in ridership. With an increase of gas prices to $7, $8 and $9 per gallon, ridership would increase to 57%, 62% and 66% respectively. Adding the total ridership per month if gas prices were to rise to $9 per gallon, and using an exponential trend line, ridership would reach at least 2,400 riders per month. Given the unlikely occurrence of gas prices surpassing $6 per gallon, given the political controversy, this incentive should be combined with additional incentives.

Assuming the impossibilities of gas price rise, and a direct rail connection to the airport (due to the debilitating infrastructure costs of implementation), the most realistic speculation is with gas prices increasing to $6 per gallon, and shortening travel time (the 2nd top incentive, and 4th, respectively). Shortening travel time to 3 hours and 46 minutes corresponded to a change in behavior of at least 248 people, or an increase of between 248 and 496 train trips to Chicago (1 to 2 times more trips per month). Current ticket prices from Detroit to Chicago are generally between $24 and $78 with an extra fee of $23 for business class seats (Amtrak.com). Assuming one quarter of these seats are business travelers, the highest amount that could be earned per year by Amtrak through ticket sales on the Wolverine line alone is $1 million and the

lowest would be $180k (given 496 extra riders or 248, respectively).[2] Operating costs are recorded and publicly available by Amtrak for the state as a whole, and correspond to approximately $20k per mile (Cody, 2013). Extrapolating this per mile figure for the 245 miles of Amtrak Wolverine line in Michigan, gives a yearly operating cost of $5.1 million (Cody, 2013). To break even with solely ticket sales as revenue, and gas prices and shortened travel times as incentives, Amtrak would have to increase ridership to at least 5 times per month.

Another method of speculation is combining the increased ridership of the top three traditional traveler incentives, of shortened travel time, frequency and reliability. These incentives fall 4th, 6th and 9th on this study's list of potential traveler incentives. Increasing ridership by frequency or reliability would increase the ridership to a maximum of 434 or 484, trips, respectively. Assuming again, that one quarter of these seats are business travelers, the highest amount that could be earned per year by Amtrak is $1.4 million and the lowest would be $400k, under the current pricing scheme of ticket sales (Amtrak.com, 2013). To break even with solely ticket sales as revenue, Amtrak would have to increase ridership to at least 3.6 times per month.

This speculation does not include another Michigan rail line, the Blue Water. The Blue Water rail line links Port Huron, Michigan to Battle Creek, and then shares the Wolverine corridor to Chicago. The potential and expected increase in ridership was not included in the speculation for potential revenue. The data collected via this study was specifically for those that live within a 2 mile radius of the stations; therefore the increased ridership does not apply

[2] This corresponds approximately with per station ticket revenue divided by ridership, as reported by Amtrak per station (Amtrak 2013).

to the Blue Water line. Ridership could increase on this line alone, but would also increase the operating costs per mile.

This study does not provide a threshold, or a formula for the increase in ridership due to each incentive. Recorded is the number of people that would ride more per month, given the occurrence of each incentive. Given general calculations, ridership would have to increase at least 3.6 times, to break even, if a combination of traditional travel incentives were implemented.

The finding suggests continued challenges for the success of rail within Michigan, and therefore car-oriented societies. Given great investments in rail as of late, this finding suggests the need for further study to direct the efforts of upgrading rail, and how to encourage its development.

Repercussions and Recommendations

Travel incentives are a priority for the Wolverine line, to maximize the investments being made to meet projected ridership numbers. Though continuing to obtain shortened travel time is critical, other incentives could be equally important to car-oriented societies, if not more.

Non-Traditional Incentives

Time is the third most powerful incentive for riding the train, especially a reduction in trip-time from Detroit to Chicago. Almost half of the respondents (49%) would ride more. Frequency and reliability were closely related as well, with 48% of respondents indicating they would ride the train at least one or more times per month, and 43% for on-time arrivals.

Though the responses were high, the percentages did not represent a majority; therefore the need exists to rethink traditional approaches to travel incentives within Michigan or car-oriented societies.

The transportation planners that were interviewed identified four non-traditional incentives, specifically for the Michigan corridor. The first was encouraging bedroom communities, including Battle Creek and Kalamazoo, as the HSR would put them within a one hour distance to Chicago, and give further advantage of a one hour time zone difference. Secondly, increase the attractiveness of destination for leisure travelers. This could involve relocating stations to be within walking distance of downtown and college campuses. Thirdly, use a word of mouth campaign to advertise the benefits of traveling by rail. The final suggestion was to continue the Aerotropolis Wayne County Initiative, creating an airport city between the Detroit Metro Airport and Willow Run Airport. An outstanding challenge presented by the transportation planners was changing public perception around public transportation. Amtrak ridership increases depending on its occupancy in peoples' thoughts and trip planning.

The interviews from the political decision makers revealed insight about non-traditional incentives as well. Mentioned within the interviews of political decision makers as well, in that rail is not usually considered by Michiganders when planning an average trip. A couple examples are that Amtrak service increases when it is in the news (Kazmerski 2012) and Amtrak service experiences a sharp decline when the service is disrupted by construction, and a lasting decline even after construction has been completed (Savoy 2012). Non-traditional incentives also could include marketing to university students (Savoy 2012) or for large events (Kazemerski 2012). A unique opportunity is presented in this case study, with HSR connecting the 3rd largest

city in the county with Detroit, an investment ready city (due to its recent and dramatic economic downturn). The HSR connection of business investments could be an incentive for people to ride HSR. Pulling traffic from Chicago would spur investment in Detroit (Savoy 2012). A resounding strategy suggested by those interviewed was attracting business travelers to ride HSR, although the business market will be harder to capture, because it is directly tied to frequency reliability and shortened travel time. Methods could be portraying the train as higher class (Cody 2012) and providing amenities as such. Also, branding the train like the Acela in the Northeast corridor (Savoy 2012) as well as achieving the ideal number of train frequencies (Franke 2012).

Connections to Airports

A direct connection to the Detroit Metro airport or Chicago's O'Hare airport provided increased ridership, or a change in travel behavior. Although providing a direct connection to the Detroit airport was the most important travel incentive overall, perhaps a direct rail link to the Chicago airport was less favorable as there is more access by other modes of transportation, by commuter rail or the Metra. Currently, there is limited connection to the Detroit airport by public transportation. Costs of parking at the airport and lack of other modes of transportation to the airport could have fueled the significant desire for a rail connection at the Detroit airport.

The HSR line did not connect directly to the Detroit airport with, the primary explanations being infrastructure costs and feasibility of different modes being a higher priority. The majority of interviewees acknowledged that the connection was of great importance, highly desirable and were aware of efforts to facilitate the connection via alternative modes of

bus or commuter rail. According to this study, investment in Detroit would capture the most amount of ridership of any of the five cities. The number of frequencies of trains was highlighted as a priority (Kuehne 2012, Savoy 2012) in order to serve the airport and capture the greatest market. Collaboration with all parties including airport personnel and public transit agencies serving the airport (Cody 2012), and those planning future station locations (Savoy 2012) was emphasized by the interviewees. Using collaboration and political strategy could increase the likelihood of the success of an airport connection and investment in Detroit as a whole and subsequently, increased ridership.

Cost

Cost is the second the largest factor in determining who would ride the train more frequently. Specifically, if gas prices increased dramatically the majority of the respondents would change their travel behavior. Gas prices are the most direct form of driver disincentive. As seen by the Haire (2010) study, the largest rise in public transportation due to gas prices was in the demand for commuter transportation by rail (Haire, 2010). Within the survey, Michigan travelers were found to be very sensitive to changes in price of competitive modes. Interviewees suggested that the most important objective was the competition between modes. Mentioned frequently by those interviewed, was business travelers and capturing this demographic. Focusing marketing on the potential increase in gas prices or their volatility could be rewarding for the HSR market and the desired business travelers, especially in Michigan.

Station Improvements versus Track Upgrades

Stations were developed before track upgrades as the Federal Railroad Administration (FRA) assigned federal funding of funds specifically for this purpose and did not approve the application for funding of track improvements to Michigan concurrently. The funding needs for the purposes of track improvements was complicated by track procurement, construction scheduling, planning as well as operations and logistics.

A railway station is the gateway to a community, therefore the state decided to forward the funds and responsibility for upgrading stations and ownership to the communities, in order to create an amenity tailored to the needs and desires of specific communities. As such, the importance of the question of investments to rail stations versus track improvements is removed from the responsibility of the Department of Transportation. However, the significance is relevant, as investments in track improvement over stations was highly desired, by those living closest to the station. A proven business model solely focused on connectivity and not stations investments is the widely successful bus company Megabus, expanding its services in the US yearly (Megabus.com). While completely eliminating stations is not plausible for the HSR line nor suggested, the increase in ridership, with a transportation service that has eliminated stations, corresponds with the results of this study.

The political decision makers were aware of a shift of preference in younger generations, especially to public transportation, with marketing to students being mentioned within the interviews. The desire for connectivity to big cities, especially among younger people, is exemplified by Megabus' success as well.

Challenges for Future Research

This study included surveying only those Michigan residents living within two miles of the rail stations, as an assumption was made that they had the greatest accessibility to the HSR train. With the vast majority of Michiganders' preference toward driving cars and the increased availability of parking at HSR stations, the relevancy of the two mile distance is called into question. Within car-oriented societies in the United States, especially Michigan, accessibility to rail might not be defined solely by proximity. The political decision makers defined ridership in terms of the awareness of rail, and with its increase, more ridership. The level of awareness of resident's and their living distance to rail stations could be called into question for a significant population of Michigan residents. Within the survey questions, there was no indication for the respondents to know they lived within at least two miles of the HSR station. Additional research would be to understand the awareness of Michigan residents of rail or HSR and their accessibility or distance to stations.

Within the recommendation of focusing on gas prices, or driver disincentives, caution is naturally advised. Michigan's economy is driven by the car and driver disincentives would be widely unpopular. Encouraging train travel by this incentive could be considered unwise. However, changing political and public perception surrounding the importance of rail widely impacts ridership and could be considered critically important.

Not addressed within this study is an in-depth view of regular ridership behavior in car oriented societies. Instead a different question needs to be posed: What motivation supersedes traditional HSR incentives in car-oriented societies? The answer is not obvious and requires an

in-depth view into car-oriented societies and their regular ridership behavior. While this study was not intended to identify such incentives, it provides some helpful guidance for future work.

Though speculation is given, challenges exist for comparing increased ridership with recouping or breaking even with the operating costs. First, it is unknown, via this study, if a threshold exists for each incentive. For example, how many more on-time arrivals would be required for ridership to increase enough to be profitable for the entire corridor? Also, the implementation of a certain incentive does not relate directly to an increase in operating expenses or an increase in revenue due to increased ridership. For example, increasing train speeds, or shortening travel times, can increase infrastructure costs by an exponential factor. Grade crossings would be the largest and most inhibiting cost challenge for the HSR line in Michigan to increase speeds past 110 miles per hour (due to federal regulations) or shortening travel time further than the current goal of 3:46 minutes (Hoeffner 2012). Specific thresholds for how much ridership can increase for each incentive is not determined within this study.

Conclusion

Incentives provided in the existing literature such as shortened travel time, reliability and frequency are important; however, seem to be less important to rail riders in Michigan. Reliability was a relatively weak incentive, compared to the other incentives. Connection to airports is one of the strongest incentives for Michigan high(er) speed rail (HSR) riders. However, a direct rail connection to the Detroit airport is cost prohibitive. The respondents are particularly sensitive to changes in gas prices, naturally changing their driving behavior and would increase their ridership on the HSR. However, gas prices are politically contentious, as well as driver disincentives being publicly unpopular. An objective of high speed rail is to compete directly with alternative modes, thus creative solutions must be sought to discourage use of the car, perhaps through a marketing campaign for Amtrak, road tolls or gas taxes. Overcoming the airport connection challenge, greater collaboration and feasible transportation alternatives such as commuter rail and buses, should be pursued. Overall, over a quarter of the respondents did not believe any incentive would make them ride the HSR more. The top two incentives for ridership, including an increase in gas prices and direct airport connections are infeasible for Michigan. This suggests a need to rethink traditional incentives, as this study can only speculate on the required incentive(s) for Michiganders to choose to ride rail. Employing non-traditional incentives is recommended. These include, leveraging the opportunity of becoming Chicago's bedroom communities, word-of-mouth campaigns, making destinations more attractive, and fostering the Aerotropolis project. Finally, targeting incentives to capture

specific demographics, such as business travelers or younger generations of university students could expand the ridership base.

APPENDIX

Current Ridership

The following group of questions will ask you about your current use of Amtrak train service and your current travel behavior.

1. How many times have you taken the Amtrak train for work (incl. college) within the past year (March 2009 - February 2010)?

☐ Please enter either the number of trips or (0) if you did not take the train.

1b. Is your job located so you could take the Amtrak train to get there?

☐ Yes ☐ No ☐ Do not currently have a job (retired, etc.)

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2. How many times have you taken the train for leisure (every trip except work-related trips) within the past year (March 2009 - February 2010)?

☐ Please enter either the number of trips or (0) if you did not take the train.

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3. When you travel to Chicago, how do you usually travel? **Please check only one**.

☐ Train ☐ Car ☐ Bus

☐ Don't travel to Chicago ☐ Other: _____

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4. What would be your *favorite* mode of travel for a trip of two hours of travel time within Michigan if you had any transport option available to you? **Please check only one**.

☐ Car ☐ Bus ☐ Train ☐ Plane

☐ Motorcycle ☐ Walk ☐ Bike Other:_____

5. What is your *primary* mode of travel for trips within Michigan? **Please check only one**.

☐ Car ☐ Bus ☐ Train ☐ Plane

☐ Motorcycle ☐ Walk ☐ Bike Other:_____

Potential Ridership

The following group of questions will ask you about your likely change in travel behavior if Amtrak was to upgrade its services along the *Wolverine* Line (connecting the cities of Pontiac, Troy, Birmingham, Royal Oak, Detroit, Dearborn, Ann Arbor, Jackson, Battle Creek, Kalamazoo, Niles, Michigan City, Chicago).

6. How many more times per ***month*** would you ride the train on the *Wolverine* Line if the following changes to the current train service were to be implemented? **Please check only one box for each service feature.**

	More than 10 times per month	6-10 times per month	3-5 times per month	1-2 times per month	**Doesn't Matter**
more on-time arrivals	○	○	○	○	○
more	○	○	○	○	○

frequent train service					
shorter travel time	○	○	○	○	○

7a. Please choose which of the following two options is more important to you (when opting to take a train vs. other travel options for your journey)

☐ on–time arrivals ☐ frequency of train service

7b. Please choose which of the following two options is more important to you (when opting to take a train vs. other travel options for your journey)

☐ frequency of train service ☐ shorter travel time

7c. Please choose which of the following two options is more important to you (when opting to take a train vs. other travel options for your journey)

☐ shorter travel time ☐ on-time arrivals

8. How many more times per *month* would you ride the train on the *Wolverine* Line if the following changes to the current train service were to be implemented? **Please check only one box for each service feature.**

	More than 10	6-10 times	3-5 times	1-2 times per	**Doesn't**

	times per month	per month	per month	month	**Matter**
more connections to other trains	○	○	○	○	○
more connections to INTER-city buses (Greyhound)	○	○	○	○	○
more connections to INTRA-city buses (local transit)	○	○	○	○	○
more car parking available at train stations	○	○	○	○	○
safer vehicle	○	○	○	○	○

parking available at train stations					
more comfortable, safe train stations	○	○	○	○	○

---

9. How many more times per *month* would you ride the train on the *Wolverine* Line if the following gas-price scenarios or system expansions would occur? **Please check only one box for each service feature.**

	More than 10 times per month	6-10 times per month	3-5 times per month	1-2 times per month	**Doesn't Matter**
gas price of $4 per gallon	○	○	○	○	○
gas price of $5 per gallon	○	○	○	○	○
gas price of $6 per gallon	○	○	○	○	○

direct rail link to Detroit airport	○	○	○	○	○
direct rail link to Chicago airport	○	○	○	○	○

Community Impacts

The following group of questions will ask you about the impact you expect within your community if Amtrak was to start running the high speed rail service between Detroit and Chicago (reaching max. speeds of 110 mph).

10. Once the high-speed rail is operational, which impacts do you expect your community to experience? **Please check only one box for each impact.**

	I expect more	I expect no change	I expect less
Tourists	☐	☐	☐
New Businesses	☐	☐	☐
People living in my neighborhood	☐	☐	☐
Noise	☐	☐	☐
Grocery stores	☐	☐	☐
Shopping stores	☐	☐	☐
Restaurants	☐	☐	☐
Traffic	☐	☐	☐

Other:

---

11. Once the high-speed rail is operational, which impacts do you expect your community to experience? **Please check only one box for each impact.**

	I expect better	No Change	I expect worse
Access to Job opportunities	☐	☐	☐
Property values	☐	☐	☐

Other:

12. What are the two most important benefits you would wish for your community to gain through the high-speed rail?

Impact #1

Impact #2

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13. Do you think MDOT should **RATHER** invest in (**please check only one box**):

☐ **Your** railway station to make it more accessible, comfortable, and safe

☐ Track improvements for higher train speeds

☐ Neither

---

14. Do you want high speed rail service between Chicago and Detroit for your community?

☐ Yes ☐ No ☐ Do not care

---

15. How much would you pay per month to have the *option* of high speed rail service (between Chicago and Detroit) coming to your community?

Please enter the $ amount per month. ☐

---

16. How many times per month would you take the high speed rail from your community to any rail station on the Wolverine Line (between Chicago and Detroit)?

    Please enter the number of times per month. ☐

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17. How many times per month do you think your neighbor would take the high speed rail from your community to any rail station on the Wolverine Line (between Chicago and Detroit)?

Please enter the number of times per month. ☐

<u>Respondent Characteristics</u>

Your answers to the following questions will help MSU and MDOT determine general characteristics for those living around stations along the Wolverine Line. These data can then be applied to the larger population of those communities along the corridor. This information is completely anonymous and confidential.

18. What is your age?

☐ 18-24 years ☐ 25-34 years ☐ 35-44 years ☐ 45-54 years

☐ 55-64 years ☐ 65-74 years ☐ 75 years and over

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19. What is your gender? ☐ Female ☐ Male

20. How many persons including yourself live in your household?

Please enter the number of people. ☐

21. How many personal vehicles (cars, vans or pick-up trucks) do those in your household own or lease and use regularly? College students please answer for your place of residence while attending school.

☐ None ☐ One ☐ Two ☐ Three or more

22. Do you live within one mile of a train station?

☐ Yes ☐ No

Thanks again for completing this survey!

If you have any additional thoughts about any of the above topics or the survey itself, please share them here.

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