Toledo-Detroit Ridership Feasibility & Cost Estimate Study

PREPARED FOR:

The City of Toledo and Toledo Metropolitan Area Council of Government

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FINAL REPORT

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Chapter 1

Project Overview

SUMMARY

Chapter 1 of this report sets out the background and purpose of the Toledo-Detroit Rail Study, including outlining the study's goal, the scope, and the methodologies used. In addition, a discussion of the Freight Railroad Principles impacting the project, particularly regarding the sharing of right-of-way with Passenger Rail, are included at the end of this chapter.

1.1 Introduction

This study will evaluate how passenger rail service between Toledo, Detroit and Ann Arbor will further enhance the economy of all three cities. It will strengthen the regional economy by providing better access to markets, jobs, and income, as well as to the social and leisure facilities of both the Michigan and Ohio regions. It should be noted that this includes not just the Detroit and Toledo regions, but also in the longer term the benefits of rail investment will expand as service is extended to reach Northern Michigan, Chicago and possibly Southern Ontario.

This study will provide a pre-feasibility level of understanding about the basics of operating a passenger rail service from Toledo to southeast Michigan including Detroit, Dearborn, Ann Arbor and Detroit Airport. Using basic operating assumptions about route and technology options this report outlines estimates for the travel market, capital and operating costs, potential financial and economic benefits of expanding passenger rail service along the corridor. It will provide guidance on whether or not there is a case to be made for developing the rail corridor connecting Toledo with both Detroit and Ann Arbor.

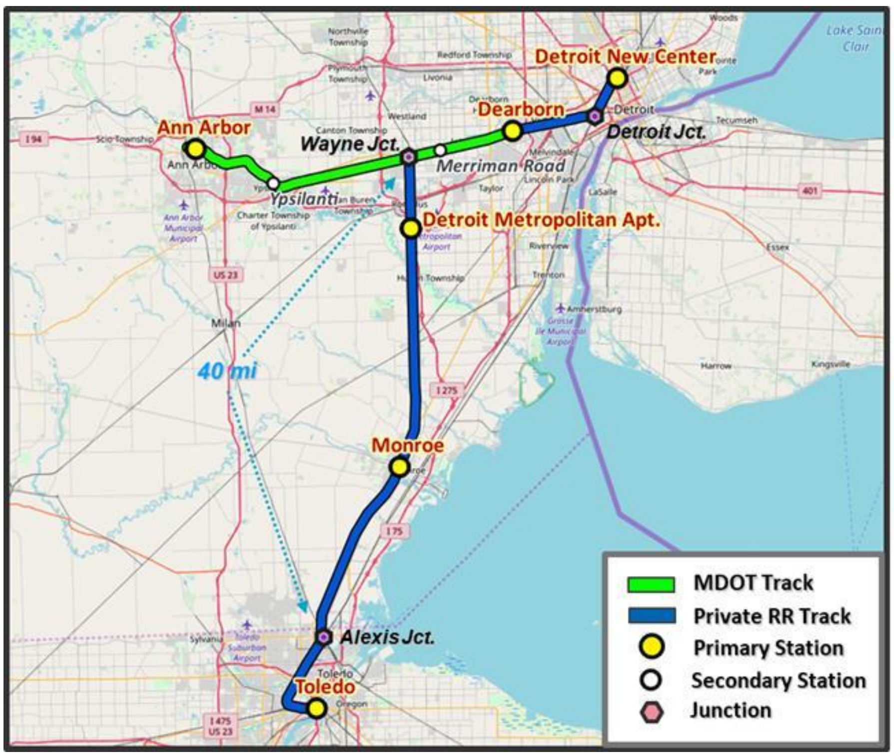
Since the early 1980's, there have been many changes in the travel environment including:

- The changing demographic and socioeconomic factors that have occurred in the intervening period reflecting greater mobility and a more widely distributed population.
- Changing travel conditions for auto use due to more congestion on the interstate highway system and higher energy (gas) prices that make auto travel more time consuming and expensive.
- Changes due to Air Deregulation that has significantly reduced the amount of air service for trips under 300 miles, and which has tended to concentrate more air travel at a few very large mega-hub airports. Fortunately for Detroit, the DTW airport has been one of these airports who have benefited from airline deregulation, becoming a major international gateway, requiring massive facility expansions and generating many airport-related jobs as a result.
- The development of more cost effective rail technology due to improved locomotive performance and efficiency, as well as the introduction of modern communication systems.

As a result of these changes, rail travel has become increasingly competitive, and for example Amtrak has seen a significant use in its ridership since the year 2000 across the Midwest with Chicago-Detroit ridership increasing by 57% between 2000 and 2011.

Exhibit 1-1 shows the proposed corridor that will be assessed by this study. It extends from Toledo to Southern Michigan, with connections to DTW Airport, Detroit, Dearborn and Ann Arbor. DTW Airport has become a very powerful trip attractor for both employment and air passenger trips, generating over 90,000 trips per day. In addition to commuting to Southeast Michigan and Detroit, this corridor would also connect to domestic and International air travel, as well as support recreational and leisure travel in southern Michigan. Once train service begins in the proposed Ann Arbor to Traverse City (A2TC) corridor, rail connectivity would extend all the way to the northern Michigan Peninsula, a favorite vacation destination for Toledo residents.

Exhibit 1-1: Proposed Toledo-Detroit-Ann Arbor Rail Corridor



The route shown in Exhibit 1-1 was recommended for this study because it is the only route that directly serves DTW airport. A single rail line could serve both Ann Arbor and Detroit, and the earlier Ohio Hub studies found that the CSX route via DTW Airport would be less expensive to develop and would generate higher ridership than would the CN Wyandotte route. The Wyandotte route is complex to develop because of numerous freight yards which are likely to increase the cost and reduce the effectiveness of that alternative for passenger service. However, the Wyandotte and Ann Arbor direct routes shown in Exhibit 1-2, may be more fully assessed in a future feasibility study or Tier I EIS.

Exhibit 1-2: Additional Toledo-Detroit-Ann Arbor Alternatives for a Future Assessment

1.2 Purpose and Objective

This study will provide the City of Toledo Ohio, Toledo Metropolitan Area Council of Governments (TMACOG), Michigan DOT, the Southeast Michigan Council of Governments (SEMCOG) and other project stakeholders with a basic understanding of:

- The background history supporting the development of the Toledo-Detroit-Ann Arbor Corridor.
- Potential route and technology options for the corridor.
- The market for intercity travel in the current travel environment.
- The capital and operating costs of train service.
- The financial and economic benefits that would be derived from implementing the system.

This study will assess the feasibility of developing the rail corridor with regard to: the need for passenger rail development in the corridor; capital costs; operation and maintenance costs; ridership and revenue; operating ratios and benefit-cost analysis; and the economic benefits to the community. It will ***not*** recommend a "preferred alternative" nor will it exclude any options from future consideration. The assessment assumes an approximate +/-30% level of accuracy, with equal probability of the actual cost moving up or down. Additional work will be needed to develop more precise estimates. This will be done if the project moves into the next stage of the planning process.

1.3 Project Scope

The study approach uses TEMS RightTrack™ Business Planning System to provide a fully documented analysis of the opportunity associated with the development of a Toledo-Detroit-Ann Arbor passenger rail corridor. The approach identifies the Business Case for developing the corridor in financial and economic terms, including an assessment of stakeholder and community benefits. Key deliverables include:

- A review of past passenger rail studies that are most relevant to the current proposed development of passenger rail in the corridor.
- A comprehensive intercity travel market analysis for the base and forecast years.
- An assessment of potential routes and stations based on existing and historic analysis of options.
- A review of potential train technology for 79 & 110-mph operations and its potential operating schedules and costs.
- Both a financial and economic analysis of potential options and their ability to meet United States Department of Transportation (USDOT) Federal Railroad Administration (FRA) funding requirements.
- As assessment of community benefits for providing input to stakeholder and community groups to identify the project pros and cons.
- Preparation of a conceptual level pre-feasibility report for use in assessing the project viability and its ability to achieve fundability.

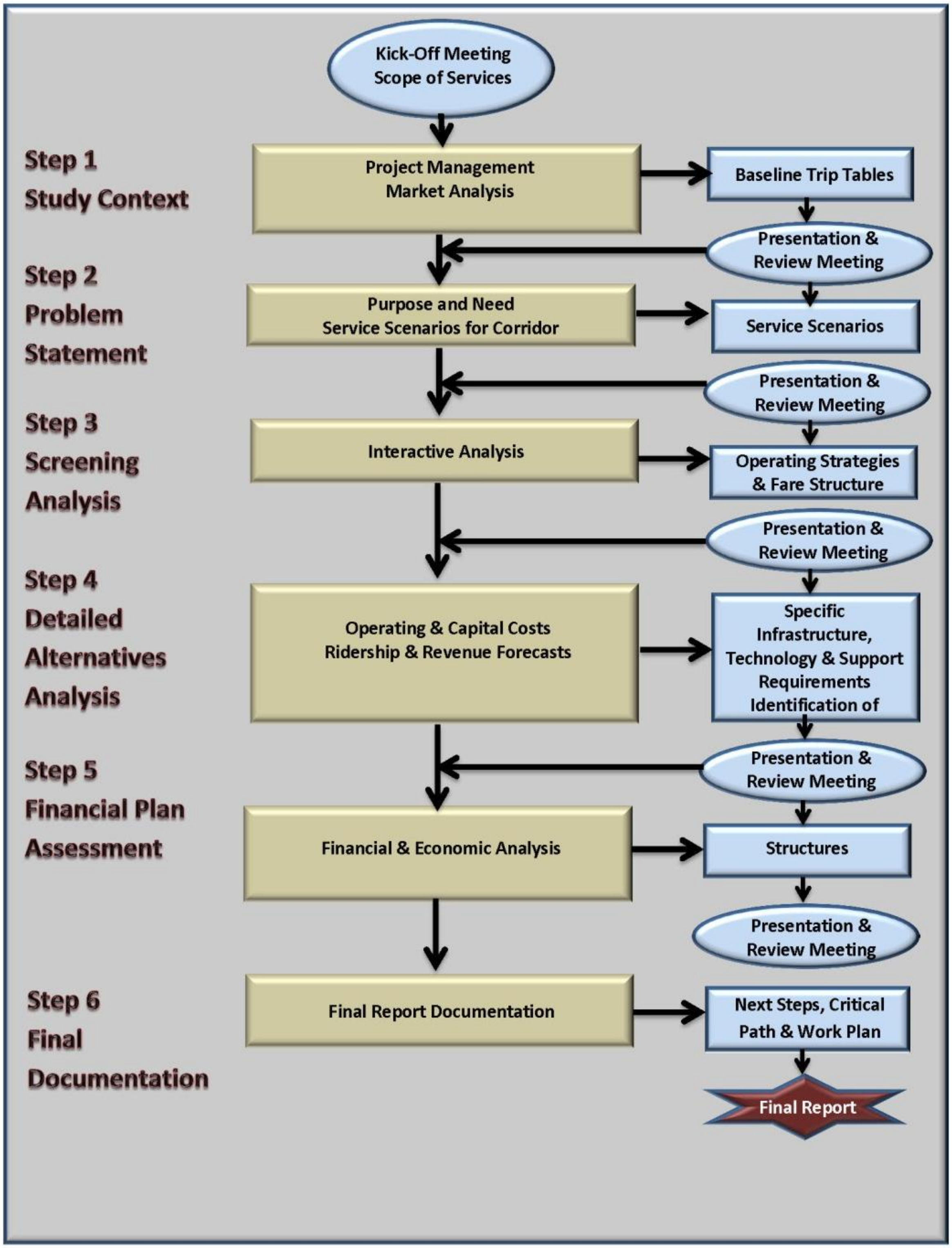
1.4 Project Methodology

To ensure that all of the USDOT FRA criteria and factors are fully evaluated, the study team has used a business planning approach. As specified by the USDOT FRA, the selection of an appropriate rail option is "market driven." The difference in the selection of one rail option over another is heavily dependent on the potential ridership and revenue. A reasonable alternative has been developed for evaluation based on its potential to improve market access, raise train speed, and reduce cost.

To ensure that market potential is properly measured, the TEMS Business Plan Approach carries out a very detailed and comprehensive market analysis. The output of this market analysis is then used to determine the right rail technology and engineering infrastructure for the corridors.

In developing the Business Case, the TEMS team used the TEMS RightTrack™ Business Planning Process that was explicitly designed for passenger rail planning and uses the six step Business Planning Process as shown in Exhibit 1-3. Key steps in the process are the definition of the proposed rail service in terms of its ability to serve the market; an interactive analysis to identify the best level of rail service to meet demand, and provide value for money in terms of infrastructure; ridership and revenue estimates for the specific rail service proposed; and the financial and economic assessment of each option.

Exhibit 1-3: RightTrack™ Six Step Business Planning Process



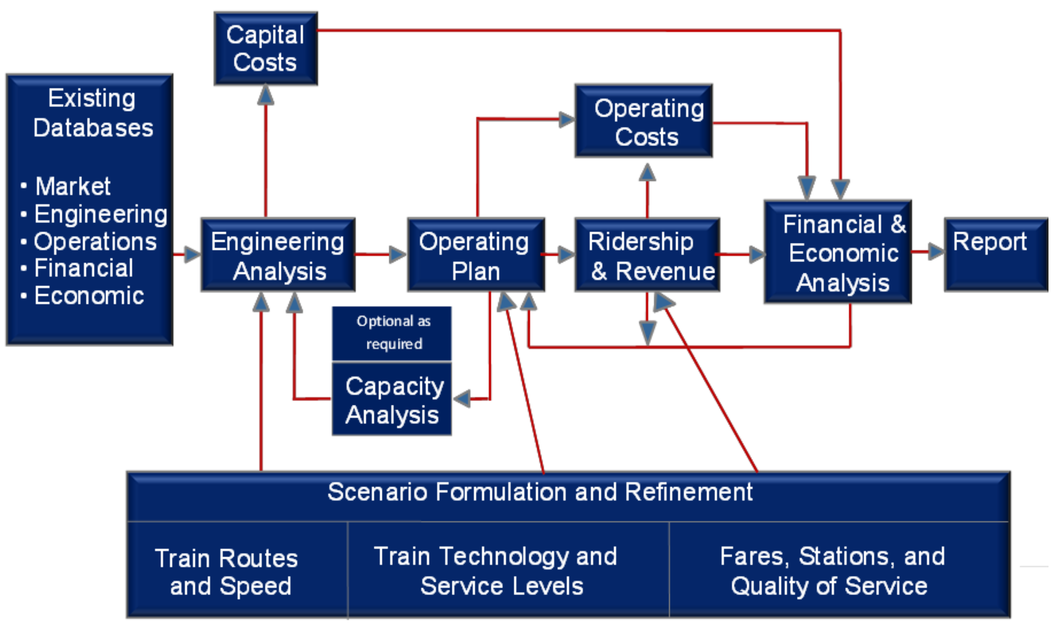
1.4.1 Study Process

The Business Planning Process is designed to provide a rapid evaluation of routes, technologies, infrastructure improvements, different operating patterns and plans to show what impact this will have on ridership and revenues, and financial and economic results.

The current study entailed an interactive and quantitative evaluation, with regular feedback and adjustments between track/technology assessments and operating plan/demand assessments. It culminated in a financial and economic assessment of alternatives. Exhibit 1-4 illustrates the process that led up to the financial and economic analysis.

The study investigated the interaction between alignments and technologies to identify optimum trade-offs between capital investments in track, signals, other infrastructure improvements, and operating speed. The engineering assessment included GOOGLE© map and/or ground inspections of significant portions of track and potential alignments, station evaluations, and identification of potential locations and required maintenance facility equipment for each option. TRACKMAN™ was used to catalog the base track infrastructure and improvements. LOCOMOTION™ was used to simulate various train technologies on the track at different levels of investment, using operating characteristics (train acceleration, curving and tilt capabilities, etc.) that were developed during the technology assessment. The study identified the infrastructure costs (on an itemized segment basis) necessary to achieve high levels of performance for the train technology options evaluated.

Exhibit 1-4: Interactive Analysis Process



A comprehensive travel demand model was developed using the latest socioeconomic data, traffic volumes (air, bus, auto, and rail) and updated network data (e.g., gas prices) to test likely ridership response to service improvements over time. The ridership and revenue demand estimates, developed using the COMPASS™ demand modeling system, are sensitive to trip purpose, service frequencies, travel times, fares, fuel prices, congestion and other trip attributes.

A detailed operating plan was developed and refined, applying train technologies and infrastructure improvements to evaluate travel times at different levels of infrastructure investment. Train frequencies were tested and refined to support and complement the ridership demand forecasts, match supply and demand, and to estimate operating costs.

Financial and economic results were analyzed for each option using the RENTS™ financial and economic analysis system. The analysis considers cash flows over a 30-year horizon using criteria recommended by USDOT FRA Cost Benefit guidelines, and the U.S. Office of Management and Budget (OMB) Social Discount Rates. The analysis provided a summary of capital costs, revenues, and operating costs for the life of the project, and developed the operating ratio and cost benefit ratio for each option.

1.5 Freight Railroad Principles

It is in the interest of passenger rail feasibility that any shared use of freight rail corridors or tracks along the Toledo to Detroit rail corridor respect the need for continued safe and economical rail freight operations. At a minimum, it is intended that the freight railroads need to be able to operate their trains as effectively as they could if passenger service did not exist. Beyond this, it is desirable to actually create benefits for freight rail service if possible while developing the infrastructure needed to support passenger services. Freight railroads must retain their ability not only to handle current traffic, but also to expand their own franchises for future traffic growth.

As such, both CSX and Norfolk Southern (like the other Class 1 railroads) have established "Letters of Principle" to provide guidance to passenger rail planners[1]. The purpose of the principles is to protect the safety of railroad employees and communities, service to freight customers, and the right-of-way and land needed to fulfill the railroads' freight transportation mission.

With regard to High-Speed Rail (HSR) service and corridors, Norfolk Southern's principles point out that the following special considerations are necessary:

- Norfolk Southern acknowledges that each passenger proposal is unique, so Norfolk Southern's application of the principles to particular proposals will often be unique as well.
- Norfolk Southern will work with planners to insulate higher-speed rail corridors from interference with and from NS freight corridors.
- On Norfolk Southern, passenger trains operating in excess of 79-mph require their own dedicated tracks. On Norfolk Southern, trains operating in excess of 90-mph require their own private right-of-way.
- Where higher-speed trains share tracks with conventional freight trains, those high-speed trains will not be able to exceed 79-mph. Where shared track is concerned higher speed trains must meet the same safety standards as conventional freight trains.

[1] CSX Principles, email from Marco Turra, CSX to Elizabeth Treutel, Michigan Environmental Council, dated June 4, 2015; NS Principles, https://wideni77.files.wordpress.com/2013/09/norfolk-southern-proposed-passenger-projects-061413.pdf, retrieved on 08/06/15

CSX's principles require that:

- Access to host railroad track and property must be negotiated between the parties on a voluntary basis.

- Designing for safety is paramount and separate tracks will be needed to segregate freight and conventional passenger rail from higher-speed rail at sustained speeds in excess of 90-mph.

- Service to rail freight customers must be reliable and protected and cannot be compromised; adequate capacity must be maintained and, in some cases, built to address future freight growth.

- New infrastructure design must fully protect the host railroad's ability to serve its existing customers, both passenger and freight, and locate future new freight customers on its lines. Host railroads must be adequately compensated, especially in regard to the significantly higher maintenance cost associated with enhanced track infrastructure that will be required for high-speed rail.

- Host freight railroads need to be fully protected against any and all liability that would not have resulted but for the added presence of high-speed passenger rail service.

At present the passenger proposals laid out here are still un-negotiated, un-funded and at a pre-feasibility level. This report makes certain assumptions regarding the need for capacity enhancements along rail lines that would be utilized for providing passenger service. The proposal is to separate freight from passenger trains as much as possible on separate tracks, and if possible on separate rights of way. Future engineering and operations studies will address the details of integrating the proposed passenger operations with freight operations, and will be subject to close negotiations with the railroads. In future detailed studies, capacity work will be performed if and as required, within the framework of an overarching strategy to provide dedicated infrastructure for supporting the capacity needs of passenger service.

1.6 Organization of the Report

1. **Chapter 1 – Project Overview:** Chapter 1 lays out the overall approach for implementing the proposed Toledo-Detroit Rail Line (including service to Ann Arbor.) Chapter 1 outlines the goal for the project, the project scope, and the methodologies used. In addition, a discussion of the Freight Principles impacting the project, particularly regarding the sharing of track with Passenger Rail, are included at the end of this chapter.

2. **Chapter 2 – Approach to Corridor Development:** This section provides background on the history and previous studies that have helped focus the current analysis and that have led to identification of potential route and technology options that should be considered for this Study. As in the case of the Midwest Regional Rail Initiative (MWRRI) and Ohio Hub studies, the aim is to evaluate an affordable set of options that can provide good service at a reasonable price.

3. **Chapter 3 – Service and Operating Plan:** This chapter discusses the development of the Service and Operating Plan and includes a discussion of the track infrastructure and train technology options. This chapter also describes the operating plan, station stopping patterns, frequencies, train times and schedules for each route and technology option. Operating costs were also calculated for each year the system is planned to be operational using operating cost drivers such as passenger volumes, train miles, and operating hours.

4. **Chapter 4 – Capital Plan:** This chapter discusses the development of the Capital Plan and includes a discussion of the capital cost methodology and a likely range of capital costs for developing the proposed Toledo to Detroit rail line.

5. **Chapter 5 – Socioeconomic, Demographic Transportation Databases:** This chapter is divided into subsections of introduction of the chapter, zone system, socioeconomic data, transportation network data, origin-destination data, stated preference survey process, results and analysis. This chapter describes the steps of developing the market data which includes developing a zone system, socioeconomic database of the study area, how the transportation networks were developed, how the origin and destination databases were obtained and validated, and on value of time that were derived from previous stated preference surveys.

6. **Chapter 6 – Travel Demand Forecast:** This chapter also presents the analysis of the Total Travel Demand for passenger rail, including ridership and revenue results. The ridership and revenue forecasts for this study were developed using the COMPASS™ Travel Demand Model. The COMPASS™ Multimodal Demand Forecasting Model is a flexible demand forecasting tool used to compare and evaluate alternative passenger rail network and service scenarios. It is particularly useful for assessing the introduction or expansion of public transportation modes such as passenger rail, air, or new bus service into markets.

7. **Chapter 7 – Operating Costs:** This chapter discusses the development of the Operating Costs and includes a discussion of the operating cost methodology.

8. **Chapter 8 – Financial and Economic Analysis:** This chapter presents a detailed financial analysis for the Toledo-Detroit rail service, including key financial measures such as Operating Surplus and Operating Ratio. A detailed Economic Analysis was also carried out using criteria set out by the 1997 FRA Commercial Feasibility Study[2] which includes key economic measures such as NPV Surplus and Benefit/Cost Ratio. All of these are provided in this chapter.

9. **Chapter 9 – Conclusions and Next Steps:** This chapter outlines the key findings of the study, and the next steps that should be taken to move forward the development of passenger rail service in the Detroit-Toledo-Ann Arbor rail corridor.

[2] High-Speed Ground Transportation for America: Commercial Feasibility Study Report To Congress: https://www.fra.dot.gov/eLib/details/L02519

Chapter 2

Approach to Corridor Development

SUMMARY

The purpose of this chapter is to provide a review of the background history and issues that have helped to focus the current analysis and that have led to the identification of the options that should be considered for the current study. As in the case of the Midwest Regional Rail Initiative (MWRRI) and Ohio Hub studies, the aim is to evaluate an affordable set of options that would provide good service at a reasonable cost.

2.1 History of Passenger Services and Studies

Connecting Toledo and Detroit are three mainline railroads: the former New York Central (NYC) via Wyandotte (now NS/ConRail); the former Pere Marquette (PM) via Wayne and Plymouth (now CSX); and the former D&TSL Grand Trunk (now CN) which closely parallels the NS/ConRail line for most of its length. The CN line has never hosted passenger trains. B&O's passenger trains entered Toledo on the branch line from Deshler using trackage rights over NYC's line from Toledo to Detroit. PRR used PM's line to Carleton where it re-entered its own track. (This line is now ConRail's Lincoln Secondary. CSX uses it as a short cut for double-stack trains to Livernois intermodal terminal in Detroit.) After C&O acquired PM in 1947, it integrated its own passenger services with those of the PM. After C&O acquired control of B&O in 1962, B&O's trains also shifted onto the PM route.

Passenger services on both the C&O (former PM) and NYC routes lasted until 1971 when Amtrak took over intercity passenger services from the freight railroads. At that time, all passenger trains between Toledo and Detroit were discontinued. However, from 1980 until 1995, Amtrak reinstated a single daily round trip, the Lake Cities, which operated over the NYC (ConRail) line via Wyandotte. The service was slow; requiring nearly two hours for just 57 miles. However, the connection to Toledo gave Michigan travelers an outlet to eastbound trains such as the Lake Shore Limited without having to backtrack all the way to Chicago. Since the Lake Cities service ended in 1995[3], there has been no passenger rail service between Detroit and Toledo, only an Amtrak Thruway Bus continues to make this connection.

In 2004, the Ohio Hub passenger rail study assessed both historic passenger routes: NS Wyandotte and CSX via Detroit Airport for upgrading to 110-mph standards for passenger service, as shown in Exhibit 2-1.

[3] *Michigan Services*, retrieved from http://www.wikiwand.com/en/Michigan_Services on April 11, 2019.

Exhibit 2-1: Detroit-Toledo Passenger Options from 2004 Ohio Hub Study

NS via Wyandotte: 60.5 miles

CSX via Detroit Airport: 68.1 miles

The Ohio Hub study recognized the need to provide dedicated tracks for passenger trains, since most Ohio rail mainlines have been very busy, and the capacity needed for reliable 110-mph passenger service simply could not be obtained without separating freight from passenger operations.

The Midwest Regional Rail System (MWRRS) plan included a capacity analysis for each corridor radiating out of Chicago, but since the Ohio Hub plan was based on dedicated tracks, it was not considered necessary at the time to perform a shared-use capacity analysis. However, a capacity analysis should be undertaken after discussions start with the freight railroads, once the operational and infrastructure requirements for the service have been better defined and detailed by working with the railroads.

The Ohio Hub study found that the CSX route via Detroit Airport would cost less and would generate greater ridership than would the NS Wyandotte option. The CSX route serves very strong intermediate stations both at the Airport and Dearborn. These comparisons are summarized in Exhibit 2-2 below.

Exhibit 2-2: NS Wyandotte vs CSX Airport Route, 2004 Ohio Hub Comparison

Route	Miles	110-mph Time (HH:MM)	Capital Cost in 2002 Dollars	2025 Revenue in 2002 Dollars
NS Wyandotte	60	0:55 Express/ 1:06 Local	$312.5 mill	$16.8 mill
CSX Airport	68	0:57 Express/ 1:08 Local	$194.8 mill	$17.8 mill

The CSX Airport route shares 20 miles of track (across the top of the "T") with the Detroit-Chicago line, whereas NS Wyandotte only shares 5 miles, so the CSX option actually needs to upgrade fewer track miles in spite of its greater overall length. The Wyandotte line crosses over more bridges and through more freight yards than does the inland CSX route. The intensity of freight operations along the Wyandotte line is very high, making this route more attractive as a freight corridor while raising barriers to introduction of intercity passenger service. For all these reasons the 2004 Ohio Hub study favored development of the CSX route past DTW airport in favor of the Wyandotte line.

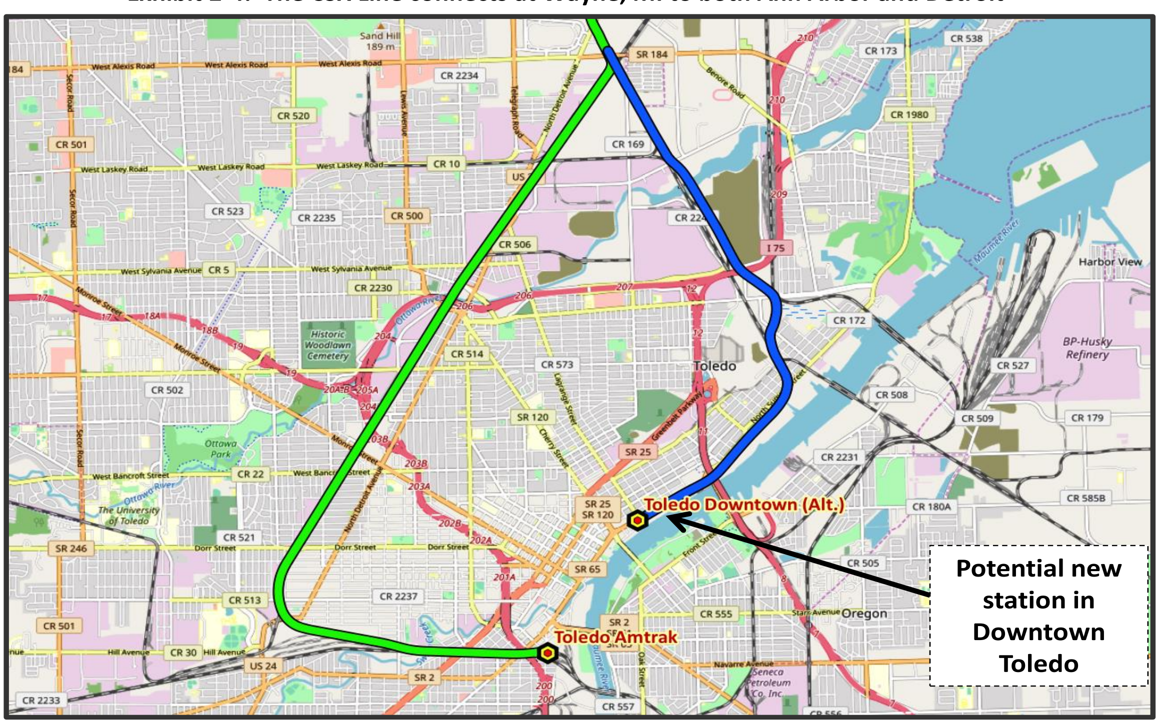
As well, developing a rail connection to Ann Arbor is an important objective of this study. Adding this requirement amplifies the benefit of choosing the CSX line since at Wayne Junction, trains could turn either right or left to go either to Detroit or Ann Arbor respectively, as shown in Exhibit 2-3. Otherwise, ***two separate rail corridors*** would be needed to reach each city, since both legs of the "V" in Exhibit 1-2 would have to be developed. This would more than double the rail mileage (and associated cost) that has to be upgraded for providing an effective solution for both cities.

Using the CSX line, a single rail route can connect Toledo with both Detroit and Ann Arbor, as well as with DTW Airport. The NS Wyandotte line misses DTW airport and cannot serve Ann Arbor. For these reasons, this study has focused on the CSX Airport Route. The NS Wyandotte line will be proposed for expanded use as a freight diversion line rather than as a route for passenger service.

Exhibit 2-3: The CSX Line connects at Wayne, MI to both Ann Arbor and Detroit

Exhibit 2-4 shows two different Toledo station options which have been identified as possible southern termini for the route. One possibility would be to run from Alexis Junction (on the north side of Toledo) following the Norfolk Southern line into the Amtrak station. This option is the one that was assumed by the Ohio Hub. However, for reaching an alternative site that is closer to downtown Toledo, another option may be to continue following the CSX line farther south to a branch line and turn south alongside the Maumee River. This will be further discussed in Chapter 3.

Exhibit 2-4: The CSX Line connects at Wayne, MI to both Ann Arbor and Detroit



2.2 Michigan Rail Freight Trends

The plan for introducing passenger service on the CSX line past DTW airport has to alleviate potential conflicts between passenger and CSX freight trains. The Ohio Hub plan did this by adding a dedicated track to the corridor the entire way from Toledo to Wayne Junction. By adding its own track, the passenger service would have minimal impact on existing rail freight operations. This is the most conservative costing approach, since it provides a separate track for passenger operations.

However, since the Ohio Hub study was completed in 2004, there have been major changes in the industrial economy of Michigan. Many automobile plants closed as a result of the Great Recession of 2008. The auto plants that remain tend to rely on truck transportation more than they formerly did. An even more recent trend is the replacement of coal power plants by natural gas and renewable energy sources, resulting in a sharp decline in railroad coal traffic. Additional closures are planned over the next four years, while all of Michigan's coal power plants are scheduled to be fully replaced by 2040[4]:

> *Consumers Energy has said it plans to retire its five remaining coal-fired plants from 2021 to 2040 and replace them with renewable energy, primarily wind and solar, along with supercharged programs to improve efficiency, demand response, advanced energy saving technology and regional market purchases. Other utilities around the country are taking similar tacks to replace fossil fuels with renewable energy.*
>
> *DTE Energy has announced plans to retire three coal plants — River Rouge, St. Clair and Trenton — which will all be closed between 2020 and 2023. Two other plants in Belle River and Monroe will close in 2030 and 2040, respectively.*
>
> *Interim plans call for DTE replacing much of the generation by building at least one and possibly two natural gas-fired plants, quadrupling renewable energy generation, increasing electricity efficiency programs and by using other technology to boost clean power.*

Exhibit 2-5 and 2-6 shows the rail freight tonnage trend in southeastern Michigan over the past 30 years.

As shown in Exhibits 2-5 and 2-6, total originated and terminated rail traffic in southeastern Michigan was running in the 40-million ton range through the 1990's, except for the recession of the early 1990's which bottomed out in 1992. This is clearly evident on the chart.

The early 2000's were peak years when Michigan rail freight was running in the annual 45-million ton range, but in 2008 the Great Recession decimated the U.S. auto industry with a severe impact on southeastern Michigan. Following the 2008 recession, Michigan freight rail traffic stabilized in the approximate 30-million ton range or two-thirds of its earlier level.

[4] *Race is on by Michigan utilities to end coal use,* Crain's Detroit Business, January 20, 2019. Retrieved from https://www.crainsdetroit.com/energy/race-michigan-utilities-end-coal-use on April 11, 2019.

Exhibit 2-5: Southeastern Michigan Rail Freight Tonnage[5]

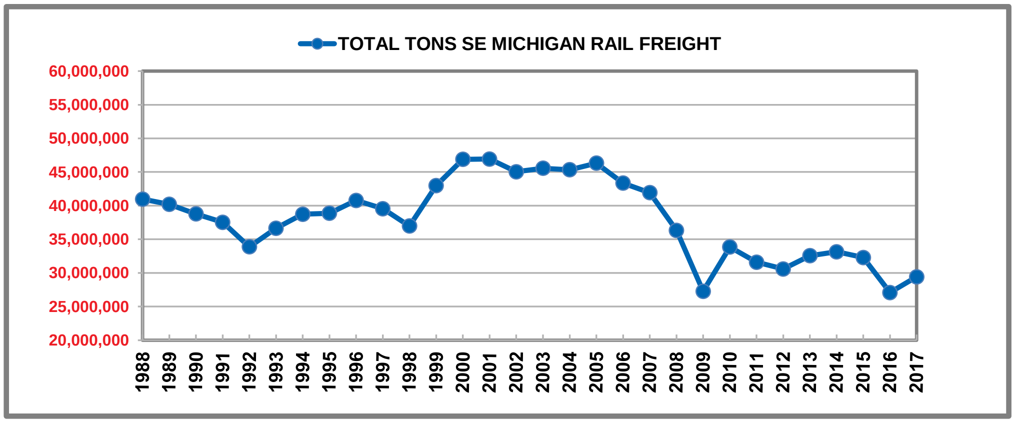
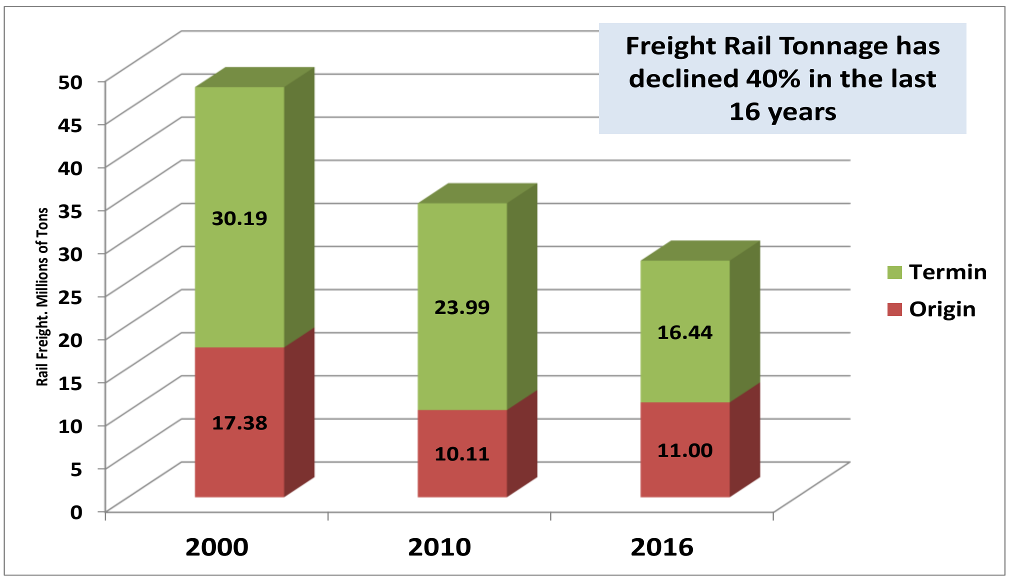


Exhibit 2-6: Southeastern Michigan Rail Tonnage Summary



A further traffic drop in 2016 was caused by an aggressive move by Michigan utilities to start converting power plants away from coal to natural gas. Coal recovered slightly in 2017, but this is likely only a temporary reprieve given historically low natural gas prices, and the plans that have been announced by all the major Michigan utilities.

Coal in Michigan is still a significant share of overall rail traffic. Of 29 million tons in 2017, 11 million tons (more than one-third of all remaining tonnage) is still comprised of coal. If this traffic were to disappear as expected within the next 10-20 years, freight rail tonnage in southeast Michigan will fall under 20 million tons, and Michigan's railroads will have lost more than half of their freight compared to what they were handling in the early 2000's. The expanding short line industry hustles every available carload, but given the restructuring of the southeastern Michigan industrial base along with the collapse of coal, it is going to be very difficult for railroads to recover their freight volumes anywhere close to historic levels.

In this environment the most likely response of the railroads (absent any form of governmental intervention) will be to rationalize their networks to match capacity with demand. For example, after the 2008 market collapse due to the Great Recession, Norfolk Southern shifted most freight away from the

[5] Source: U.S. Surface Transportation Board, Public Waybill Sample, for BEA Zone 57 (1995 zone system, still in use by STB)

Detroit-Kalamazoo line to focus volume on other routes. Had the State of Michigan not intervened by purchasing the line in 2012, Norfolk Southern would have downgraded the route to a 25-mph branch-line.

Similarly, CSX has already shifted traffic away from its former Detroit to Grand Rapids mainline and has tried to remove the signals. In February 2019, CSX leased 53 miles of track from Mount Morris through Flint to Plymouth MI to Lake State Railway[6]. It is clear that both CSX and Norfolk Southern have been in contraction mode for at least the past decade, and this trend is still continuing.

In this environment, it may be imprudent to propose major rail capacity expansion in the face of such declines in freight traffic volume. Rather, it may be more beneficial from both a public and railroad perspective, to seriously consider whether some of the existing rail capacity ought to be repurposed to passenger use (as the Detroit-Kalamazoo line already has been) while the tracks and capacity needed to support passenger operations still remain in place. This would provide the ability to start passenger services quickly while helping railroads "right size" their freight networks to adjust to their new realities.

2.3 Freight Integration Opportunities

Exhibit 2-7 shows four possible freight train routes from Toledo to Detroit:

- **Route 1** is the historic Pere Marquette mainline via Plymouth, MI. Most of CSX's manifest freight trains to Rougemere Yard in Detroit run this way, even though the route is 20 miles longer than any of the other more direct alternatives.
- **Route 2** is a possible shorter route for CSX to get to Rougemere Yard. It would use ConRail's Lincoln Subdivision to Penford Junction, then follow the CN rail line around the west side of Ford's River Rouge complex to enter the north end of Rougemere Yard.
- **Route 3** is the current CSX route for double stack trains. From Carleton trains follow ConRail's Lincoln Subdivision past NS Oakwood Yard. Trains would enter CSX's Rougemere Yard from the south. CSX uses this route for intermodal trains heading to Livernois yard, but manifest freight uses Route 1 to get to Rougemere.
- **Route 4** is Norfolk Southern's Wyandotte main line from Toledo. ConRail controls this line north of Gibraltar; south of Gilbralar to Toledo, the route is Norfolk Southern property. CN's shore line closely parallels this corridor for most of the way.

As shown in Exhibit 2-7, any of the direct alternatives 2, 3 or 4 would save CSX about 20 miles as compared to the current circuitous routing via Plymouth. In addition, a reroute would practically eliminate highway traffic congestion and grade crossing blockages that are now occurring in the Plymouth area. At the time of the ConRail (CR) split in 1999, documents filed with the Surface Transportation Board indicated CSX's intent to use ConRail's Lincoln Secondary at Carleton (Route #3) as a shortcut for all of its Detroit-bound freight. Although CSX does run its double-stack trains into Detroit this way, this never happened for manifest freight because single track on the Lincoln Secondary does not have enough capacity to handle all the trains.

[6] *Lake State Railway to lease 53 miles of CSX track in Michigan*, Trains Magazine, February 26, 2019. Retrieved from http://trn.trains.com/news/news-wire/2019/02/26-lake-state-railway-to-lease-53-miles-of-csx-track-in-michigan on April 11, 2019.

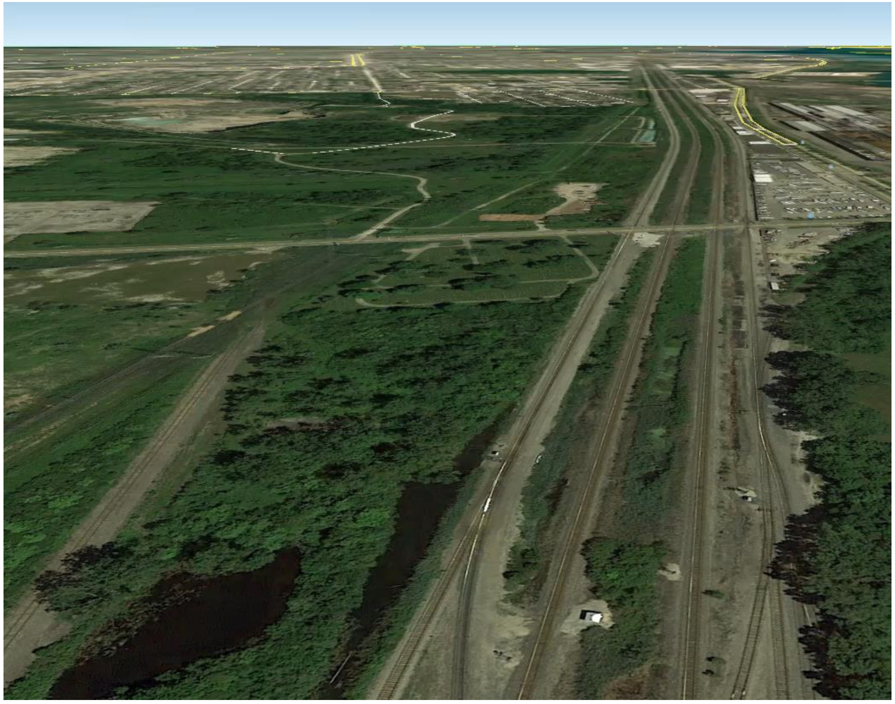
Exhibit 2-7: Freight Routes from Toledo to Detroit

However, for development of passenger service, reroute options #2 or #3 are not ideal since they are only ***partial reroute*** options – that is to say, conflicts between freight and passenger trains south of Carleton would still remain. The best solution for passenger trains would be a ***complete reroute of Detroit freight trains*** starting at Alexis, on the north side of Toledo, via Gibraltar (using route #4) directly to Detroit. Route 4 provides direct and relatively conflict free access from the south into any of the three main downtown Detroit yards: NS Oakwood, CSX Rougemere or CR Livernois yard.

- This is optimal for freight because the CR/NS rail line has two or more tracks offering plenty of capacity for CSX's trains, and the route is much more direct than CSX's existing route.
- This is also optimal for passenger since it provides a dedicated passenger corridor all the way from Alexis to Wayne Junction; passenger trains would have not only a dedicated track but also a separate right of way; and only local freight would need to be accommodated along the corridor, not the heavy through freight heading into the downtown Detroit rail yards.

As shown in Exhibit 2-8, there is already plenty of existing track capacity along the Wyandotte corridor to accommodate the CSX trains. The NS line is fully double tracked and immediately adjacent are an additional two CN tracks, so there are a total of four existing tracks in the corridor. It is hard to imagine that a capacity analysis would show the need for adding any more than this. Especially given the recent trend of declining rail freight traffic in Michigan, the existing four tracks should provide plenty of capacity for CSX's freight trains without any significant investment in new infrastructure.

Exhibit 2-8: NS Wyandotte Rail Corridor with Four Existing Freight Tracks



Adding capacity to an existing rail corridor and maintaining ***shared use*** is always the easiest to do from an institutional perspective; while it is always more complicated to develop a ***dedicated*** passenger corridor, because of the need for rerouting freight trains. It is always simpler to only have to deal with a single railroad than having to deal with multiple entities, so this is why many state DOTs favor shared use, not because sharing the infrastructure with freight trains is better, but only because it is easier to negotiate.

In this case however, there is a great opportunity to simplify the institutional arrangement by expanding the existing "Conrail Shared Assets" subsidiary who are already jointly owned 50/50 by Norfolk Southern and CSX. ConRail serves as a neutral switching railroad for both carriers. It collects and distributes railcars for both railroads, and also maintains and dispatches the tracks within its terminal zone. Trains of either CSX or NS can operate over ConRail tracks and enjoy unbiased dispatching over the tracks of this neutral terminal railroad. However, in 1999 south of Gibraltar, NS was assigned exclusive ownership and operation of the Wyandotte corridor by mutual agreement with CSX:

- If the Wyandotte line were transferred back into ConRail's control from Gibraltar to Alexis Junction, then CSX could directly access the south end of the corridor at Alexis and use the Wyandotte route as its mainline to Detroit.
- CSX could sell its own track from Alexis up to Plymouth, MI to Ohio and Michigan DOT's on terms similar to the Kalamazoo-Dearborn transaction. CSX would be paid a fair price for the value of the land, rail line and improvements and could still retain exclusive rights to continue using the line for freight on a "pay as you go" basis.
- In turn, CSX could use part of the cash proceeds to compensate NS for its interest in the Alexis to Gibraltar segment.

If a financial transaction could be structured along these lines, both NS and CSX would end up with cash in their pockets, and both railroads would have a more efficient freight route structure than they had beforehand. ConRail would also expand its operations to the doorstep of Toledo. Michigan and Ohio DOT would gain a dedicated passenger rail corridor on a separated right of way, which is the best outcome possible for starting a new passenger service. Only local freight operations along the line would continue after the transaction.

Of course, this type of a deal is as of yet un-negotiated and un-funded. Norfolk Southern, CSX or ConRail are by no means committed to any sort of transaction along these lines. At this early level of study however, the approach is suggested as a conceptual way to proceed. For the right price a transaction along these lines may be able to offer significant benefits to all parties. If this were possible, it is likely that very little new infrastructure, aside from the needed connection tracks, grade crossing and signal system improvements would need to be made. Some existing rail assets would be repurposed to a higher and more effective use while the freight infrastructure would be right sized to match demand. If this approach proves to be feasible, it could enable a new passenger service to get started years sooner than would otherwise be possible if there were a need for the extensive environmental clearance and construction of major new infrastructure.

Chapter 3

Service and Operating Plan

SUMMARY

This chapter discusses the development of the Service and Operating Plan including identifying the technology options that should be considered for the Toledo-Detroit-Ann Arbor corridor. This chapter also describes the station stopping patterns, frequencies and train times for each technology option.

3.1 Introduction

The Toledo-Detroit-Ann Arbor Corridor, shown in Exhibit 3-1, will either start at the Toledo Amtrak station or at an alternative downtown station site, as shown in Exhibit 3-2 below. Segments of the corridor are operated by CSX, NS and CN:

- If the route starts at the Amtrak station it will follow Norfolk Southern (NS) north to Alexis Junction on the north side of Toledo. If instead the route were to start at the alternative site as shown in Exhibits 2-4 and 3-2, it would follow an Ann Arbor branch line and a short section of CN north to Manhattan Blvd, where it would enter the CSX line. Use of CSX is necessary because the Ann Arbor line passes directly through the middle of two freight yards which serve the Chrysler Plant and a GM Auto Ramp. Using CSX to bypass Hallett Tower and these two freight yards would impose some speed restrictions associated with the curves and making track connections between different lines.
- From Alexis Junction to Wayne Junction, the route follows CSX through Monroe and past DTW airport. At Wayne Junction, connections to the MDOT Chicago-Detroit line would be built in both the southeast and southwest quadrants.
- From Wayne Junction west to Ann Arbor, and east to Dearborn, the route would share the MDOT-owned track with both Norfolk Southern freights and Amtrak's Chicago-Pontiac passenger trains. This segment of line may also include two new commuter stations at Ypsilanti and Merriman Road.
- From Dearborn to Detroit Junction, the route follows Conrail trackage past Livernois yard. At Detroit Junction the route turns north on CN rails to New Center. Trains could continue beyond New Center all the way to Pontiac, sharing the CN tracks with Amtrak's Chicago-Pontiac trains.

Exhibit 3-1: Proposed Toledo to Detroit/Ann Arbor Corridor

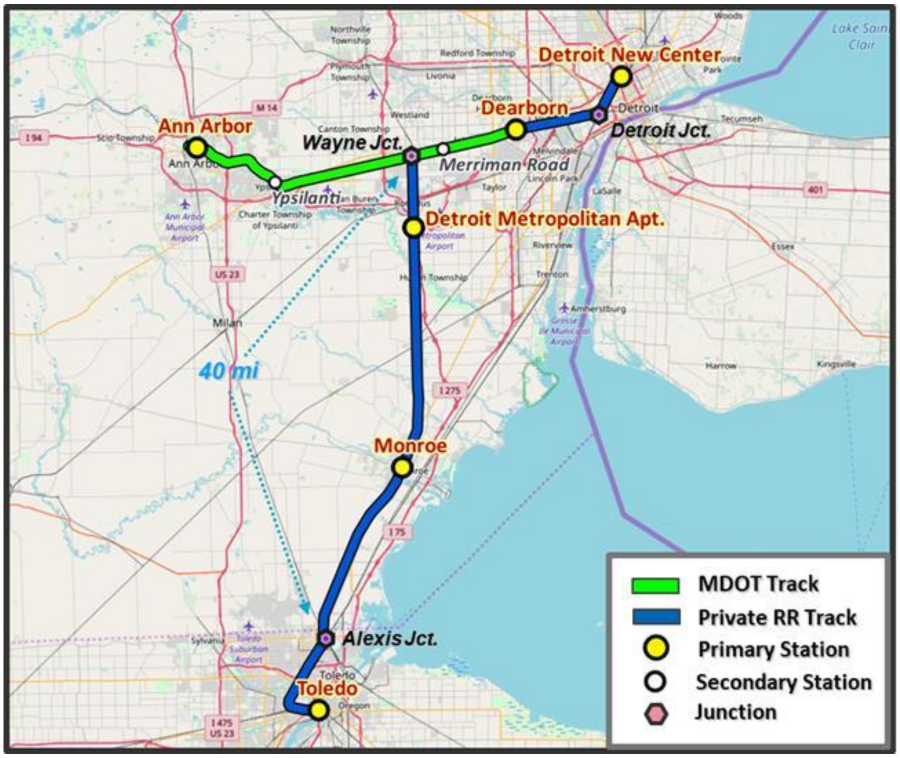
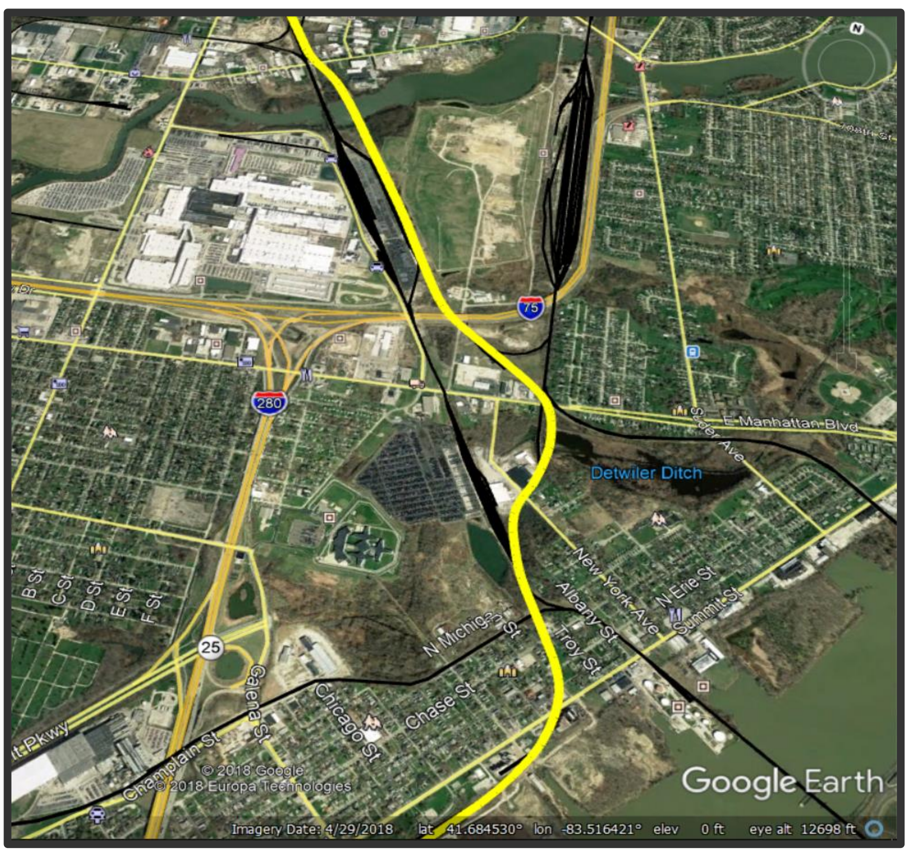


Exhibit 3-2: Route following CSX to Alternative Toledo Downtown Station Site



The service would stop in the following locations:

- In Toledo there are two possible station sites. Although the distance from the Amtrak station to Alexis is greater, trains could run faster since the NS track is straight. But because of curves and other speed restrictions along the route to the alternative station site, the travel times from either potential station up to Alexis would be very similar.
- Detroit, Dearborn and Ann Arbor stations would serve the large population and employment centers of southern Michigan.
- A station at Monroe would allow residents of this southern Michigan community as well as those of the northern Toledo suburbs to access the rail system.
- A Detroit Airport station may in the future develop into a hub for a southeastern Michigan rail system that reaches out in all directions to connect to many potential destinations.
- If commuter rail stations at Merriman Road and Ypsilanti are developed as proposed by Michigan DOT, the proposed Toledo-Detroit-Ann Arbor train service could also serve those stations.

3.2 Train Technology Options

The Technology Database includes 79-to-90 mph conventional passenger trains as those currently operated by Amtrak on most Midwestern corridors; and 110-mph trains with high-speed diesel[7] engines (such as the Siemens Charger) along with tilting railcars, as were assumed by the earlier Midwest Regional Rail System (MWRRS) and Ohio Hub studies. The operating analysis will assess both kinds of diesel trains for potential use in the Toledo-Detroit-Ann Arbor corridor.

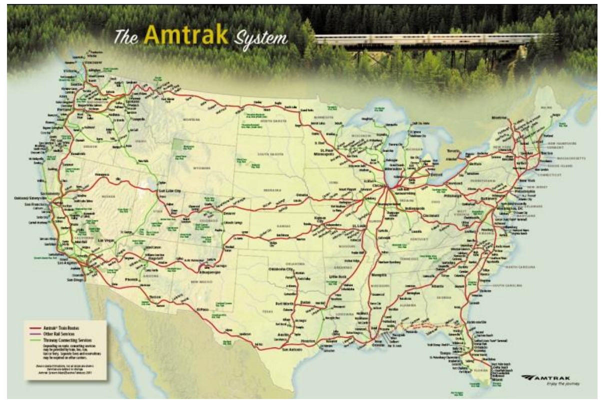
Conventional Rail – 79-to-90 mph: Conventional trains, as shown in Exhibit 3-3, typically operate at up to 79-mph on existing freight tracks using diesel locomotives that are geared for passenger service. Such locomotives also typically can provide "hotel" electric power to the passenger coaches they are hauling, so no supplemental electric generators are needed on board the coach cars. Some trains are delivered in a high-capacity bi-level configuration as shown. 79-mph represents the highest speed at which trains can legally operate in the United States without having a supplementary cab signaling system on board the locomotive. With cab signals, passenger trains can operate at 90-mph+. The key characteristics of these trains are that they:

- Are designed for economical operation at conventional speeds
- Are non-tilting for simplified maintenance

Conventional trains are used by both Amtrak and commuter rail systems in many corridors across the country. For this analysis, conventional trains with one locomotive will be assumed for the 79-mph option. 79-mph speeds are compatible with the capabilities of the I-ETMS Positive Train Control (PTC) system that is already installed on the Toledo-Detroit-Ann Arbor tracks. However, the high center of gravity of Amtrak's P-42 (and other locomotive types which are similarly based on a modified freight design) or use of bi-level equipment will limit the safe speed around curves.

[7] The term High-speed diesel, as used in this context does not refer to the speed of the train; rather, it refers to the revolutions per minute (RPM) at which the diesel engine is designed to operate. High speed diesel engines are lighter and produce more power than the heavy, lower RPM marine diesel engines that are typically used for rail freight applications.

Exhibit 3-3: Conventional Rail – Representative 79-90 mph Trains



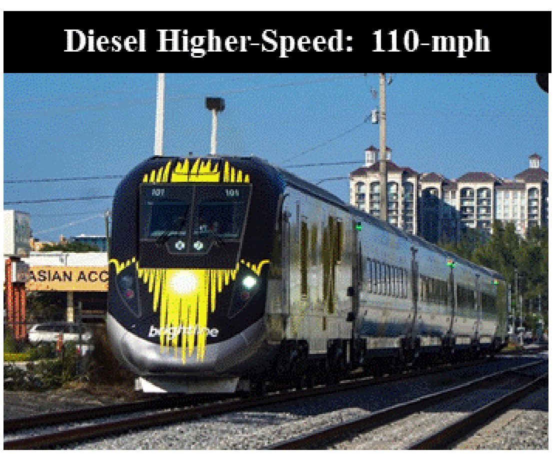
Accelerated Rail – 110-mph: A 110-mph service can be incrementally developed from an existing conventional rail system by improving track conditions, installing a "Vital" Positive Train Control system that is certified for 110-mph speeds, and by improving grade crossing protection. However, it is also important to deploy trainsets that can take full advantage of the improved infrastructure capabilities. This can provide a very low-cost option as compared to the development of new rail or highway rights of way.

The superior acceleration and braking capability of high-speed diesel trains such as the Siemens Charger shown in Exhibit 3-4, along with tilt and a low center of gravity built into the cars can allow trains to go around curves faster. This has proven to be very effective for improving service on existing track, often enabling a 20-30 percent reduction in running times. Higher speed trains:

- Are designed for operation at or above 110-mph on existing rail lines.
- Can be diesel or electric powered.
- Are usually tilting unless the track is very straight.

Although the Siemens Charger is powerful enough so single-unit 110-mph operation may be possible, two locomotives were originally proposed for the MWRRS. The Brightline service uses them in pairs, with one locomotive on each end of the train.

Exhibit 3-4: Accelerated Rail Shared Use (Diesel) – Representative Trains and Planned Corridor Service



3.2.1 Rolling Stock and Operational Assumptions

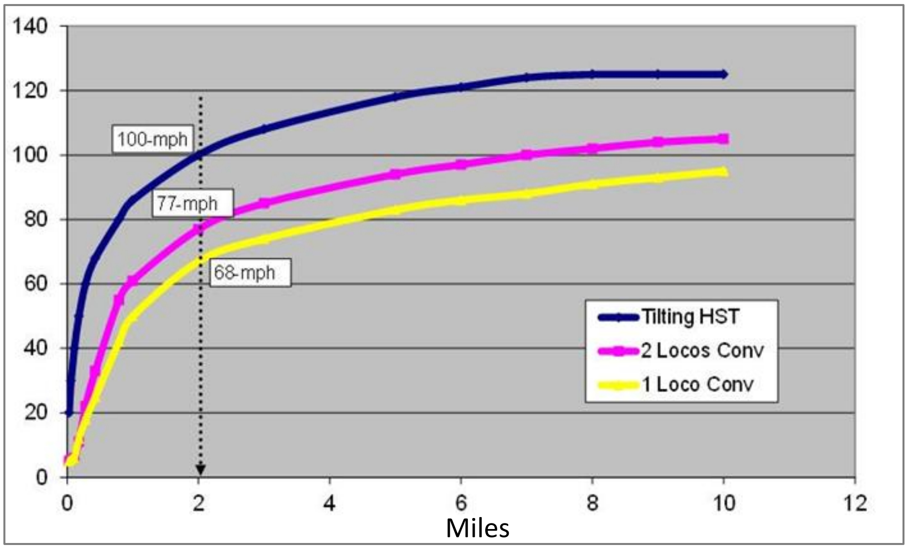
Consistent with the assumptions customarily made in feasibility-level planning and Tier I EIS studies, the following general assumptions are proposed regarding operating requirements for rolling stock for the Toledo-Detroit-Ann Arbor rail corridor for all train technology options are as follows:

- Trains will be reversible for easy push-pull operations (able to operate in either direction without turning the equipment at the terminal stations);
- Trains will be accessible from low-level station platforms for passenger access and egress, which is required to ensure compatibility with freight operations;
- Trains will have expandable capacity for seasonal fluctuations and will allow for coupling two or more trains together to double or triple capacity as required;
- Train configuration will include galley space, accommodating roll-on/roll-off cart service for on-board food service. Optionally or alternatively, the trains may include a bistro area where food service can be provided during the entire trip;
- On-board space is required for stowage of small, but significant, quantities of mail and express packages, and also to provide for an optional checked baggage service for pre-arranged tour groups;
- Each end of the train will be equipped with a standard North American coupler that will allow for easy recovery of a disabled train by conventional locomotives;
- Trains will not require mid-route servicing, with the exception of food top-off. Refueling, potable water top-off, interior cleaning, required train inspections and other requirements will be conducted at night, at the layover facilities located at or near the terminal stations. Trains would be stored overnight on the station tracks, or they would be moved to a separate train layover facility. Ideally, overnight layover facilities should be located close to the passenger stations and in the outbound direction so a train can continue, without reversing direction, after its final station stop; and
- Trains must meet all applicable regulatory requirements including:
    - FRA safety requirements for crash-worthiness,
    - Requirements for accessibility for disabled persons,
    - Material standards for rail components for high-speed operations, and
    - Environmental regulations for waste disposal and power unit emissions.

3.2.2 Train Technology Operating Characteristics

Typical performance curves for representative trains are shown in Exhibit 3-5. The curves reflect the acceleration capabilities of both rail technologies that are included in this study. With conventional diesel power, one locomotive on a 300-seat train will accelerate according to the yellow “1 Loco” curve; a second locomotive will improve acceleration slightly as shown by the magenta “2 Loco” curve. This improvement is most noticeable at high speeds, since a single P-42 locomotive (if it is also providing hotel power to the train) has hardly enough power to reach 100-mph; two locomotives are needed to achieve 110-mph. This is the reason why the Chicago to Detroit Wolverine trains was using two P-42 locomotives before the Charger locomotives were introduced.

Exhibit 3-5: Comparative Train Acceleration Curves



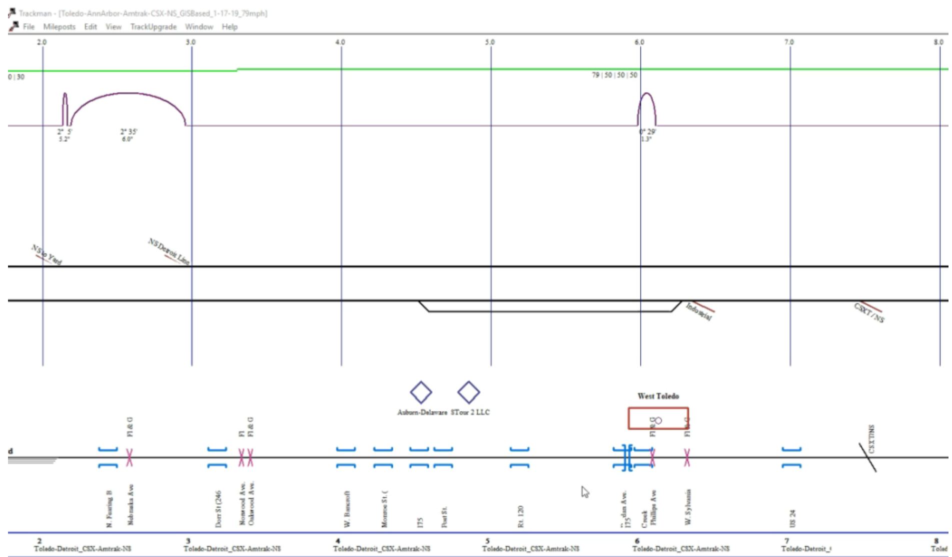
As shown in Exhibit 3-5, purpose-built Diesel Trains, such as a single level train pulled by a Siemens Sprinter, can offer considerably improved performance over conventional diesel trains that are based on freight-derived designs. High-speed diesel trains have enough power to reach 125-mph to 135-mph, and they can accelerate to 110-mph much faster than a conventional diesel train could. In fact, up to about 80-mph the acceleration capability of a high-speed diesel is very similar to that of an electric locomotive. This explains why the Maryland Commuter (MARC) service recently ordered Siemens Charger diesel locomotives to power its trains on the Northeast Corridor[8], which have until now been powered by electric locomotives.

Based on the acceleration curves shown in Exhibit 3-5, train timetables can be developed based on simulated train running times and can be used to calculate rolling stock requirements. Train frequencies and the required train seating capacity are then determined via an interactive process using the demand forecast COMPASS™ Model.

[8] *MARC replacing electric locomotive fleet with high-speed diesels*, August 12, 2015, see: https://www.railwayage.com/passenger/commuterregional/marc-replacing-electric-locomotive-fleet-with-high-speed-diesels/

Exhibit 3-6 shows how TEMS' TRACKMAN™ software has been used to electronically catalog the track infrastructure and proposed improvements, thus providing a detailed track database. The TRACKMAN™ database captures relevant data on the locations of all stations, grades, curves, speed limits, highway grade crossings, overhead and under grade bridges, side tracks and rail spurs. Based on this detailed infrastructure database, a full range of technology and train service options can be assessed.

Exhibit 3-6: Base Track Infrastructure for the Toledo Area as Shown in TRACKMAN™



LOCOMOTION™ results are slightly faster than actual times, since they are based on optimized performance of trains under ideal conditions. If dedicated tracks and/or exclusive right of way are used exclusively, then a 5 percent slack time allowance added to the train running time is appropriate. Shared use situations assume that passenger trains will have dispatching priority over freight, but practical schedules still need to allow 10-15 percent slack depending on the density of freight traffic and the complexity of the route.

3.3 Train Timetable Development

Based on the available infrastructure and technology options, operating plans can be developed for the full range of alternatives. TEMS uses an Interactive Analysis (Exhibit 1-4) that estimates train times for each route and technology, then develops train schedules and operating plans that include train stopping patterns, slack time for freight train interaction and can assess train loads between each station. Based on the train loads it has been projected that the market could support 10-12 train frequencies on each of the three legs of the system.

The LOCOMOTION™ program reflects different operating characteristics (acceleration, curving and tilt capabilities, etc.) associated with the different types of train technologies as they interact with the rail infrastructure. In the speed profiles, the red line shows the speed limit, and the black line shows the simulated speed actually obtained by the train at that point. The following subsections give the results of the LOCOMOTION™ analysis for each speed option and from Toledo to both Detroit and Ann Arbor. Consistent with Norfolk Southern's passenger principles, speeds have been limited to 79-mph on the short stretch of NS trackage from Alexis to the Toledo Amtrak station.

3.3.1 Toledo to Detroit New Center

Exhibit 3-7 shows the speed profile for 79-mph Toledo to Detroit service; whereas Exhibit 3-8 shows the same territory using Siemens Charger locomotives with tilting railcars and a top speed of 110-mph.

Exhibit 3-7: Toledo to Detroit New Center at 79-mph in 1:12:11

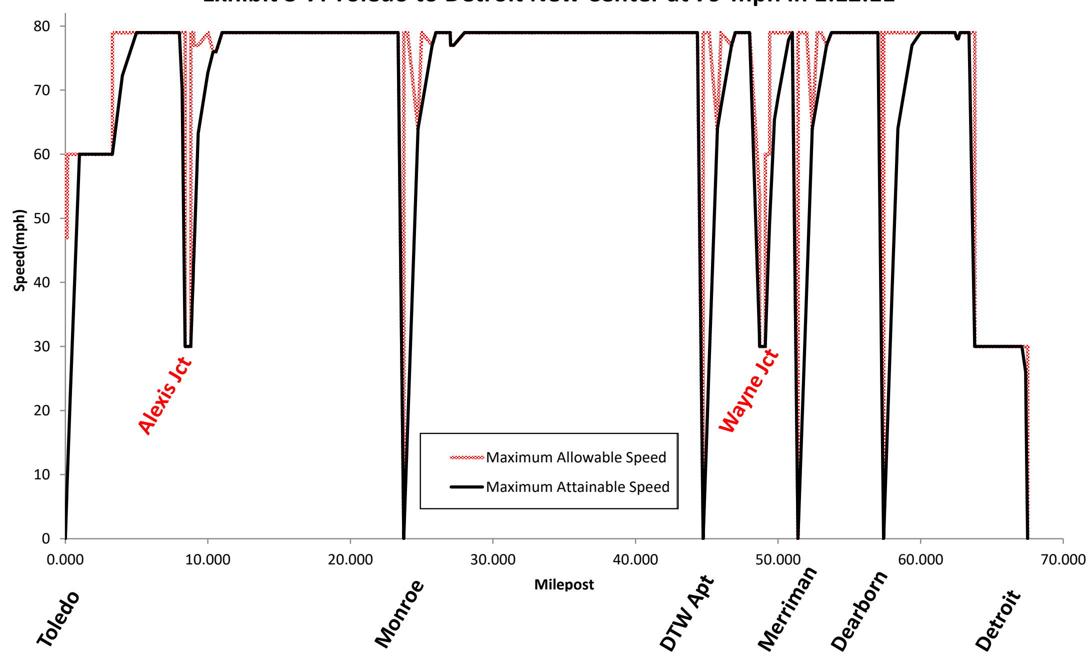
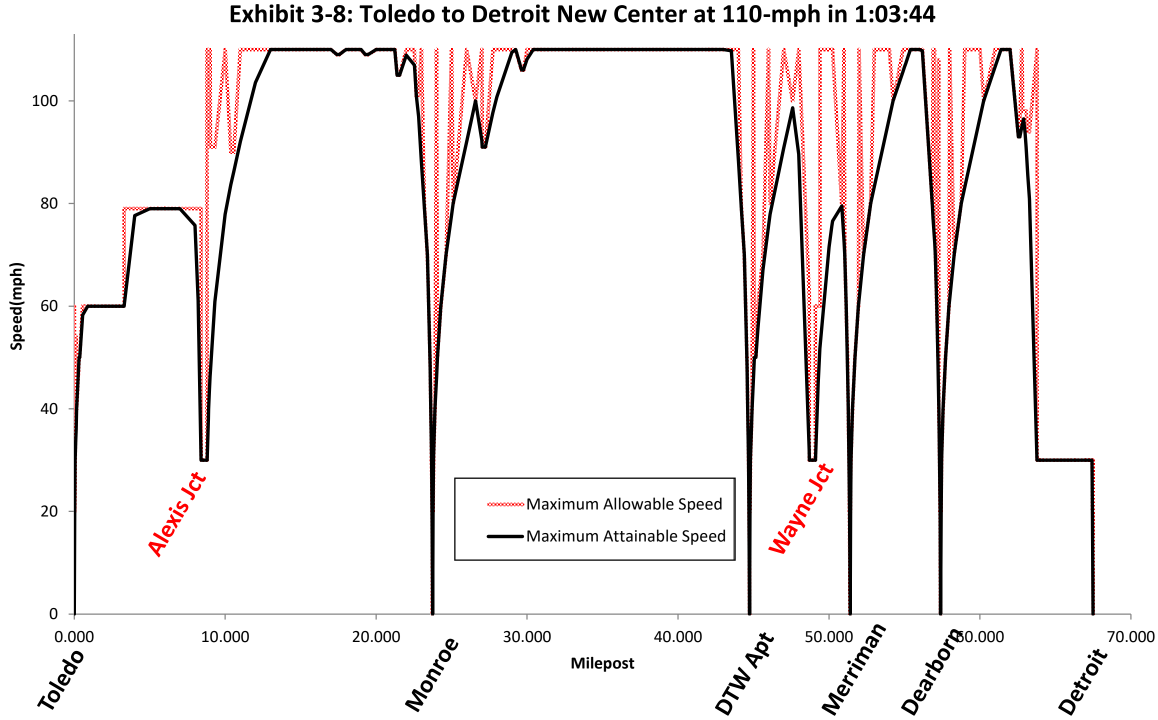


Exhibit 3-8: Toledo to Detroit New Center at 110-mph in 1:03:44



3.3.2 Toledo to Ann Arbor

Exhibit 3-9 shows the speed profile for 79-mph Toledo to Ann Arbor service; whereas Exhibit 3-10 shows the same territory using Siemens Charger locomotives with tilting railcars and a top speed of 110-mph.

Exhibit 3-9: Toledo to Ann Arbor at 79-mph in 1:08:07

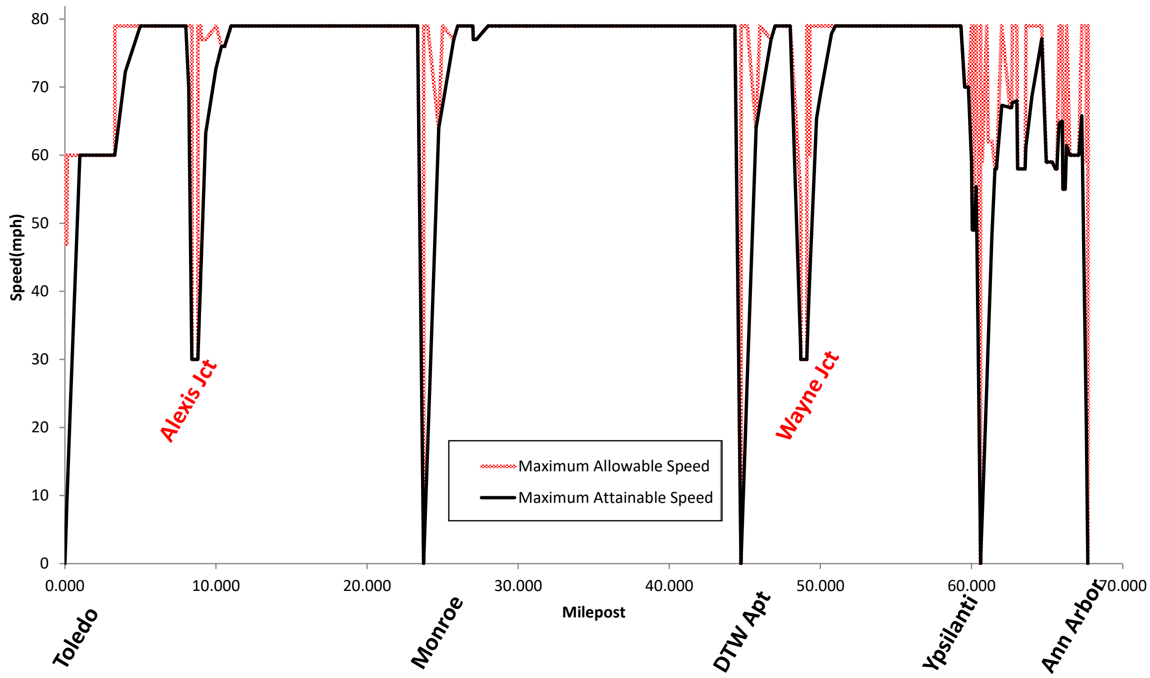
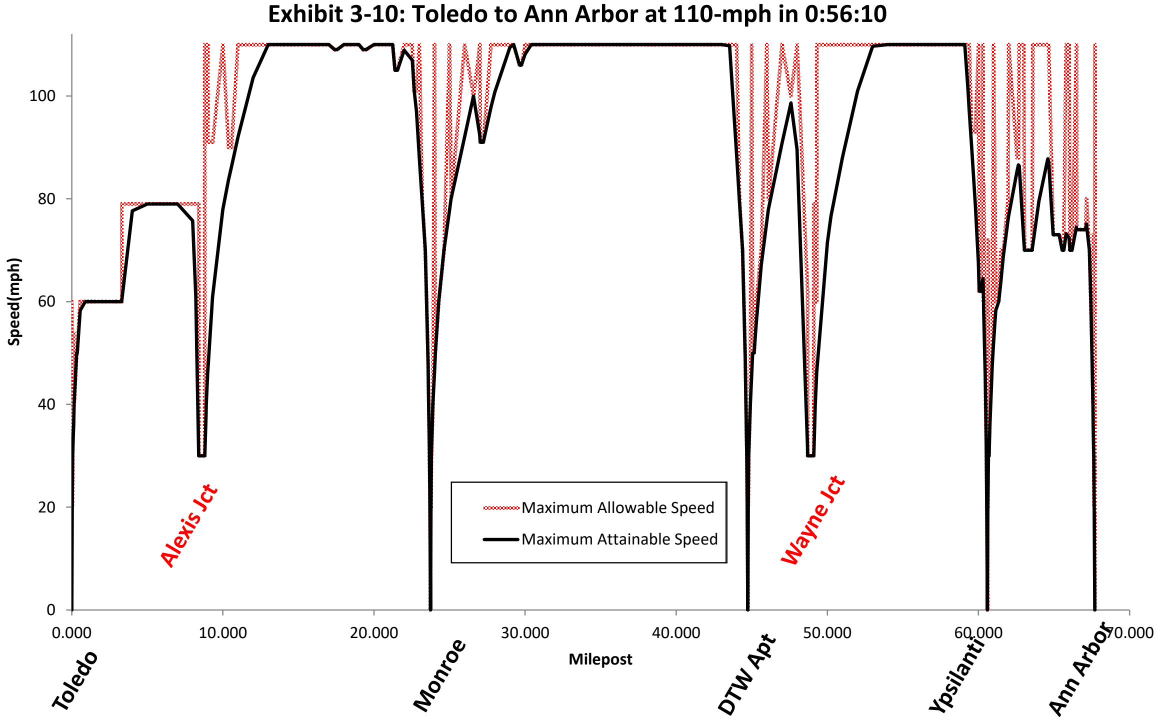


Exhibit 3-10: Toledo to Ann Arbor at 110-mph in 0:56:10



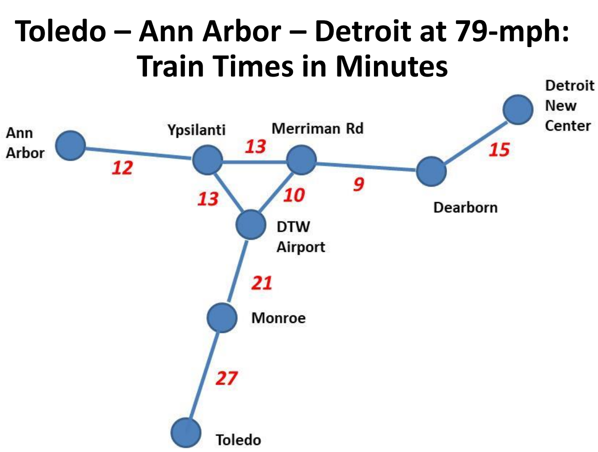
3.4 Running Times Summary

Running times have been developed for each pair of stations along the line. The times in Exhibit 3-11 were based not only on Locomotion runs but were have been benchmarked for consistency with published Amtrak schedules and previous studies.

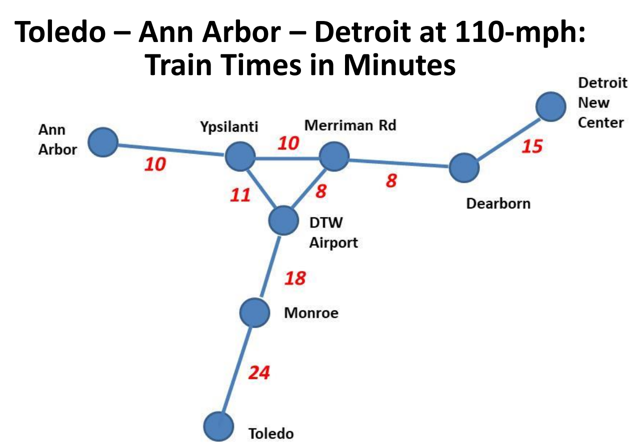
- Toledo to Detroit train times are consistent with the 2004 Ohio Hub schedules, the validity of which was accepted at that time by ORDC and the freight railroads.
- As well, the times are also consistent with current Amtrak schedules; Amtrak's Wolverine today needs 18 minutes to go from Detroit to Dearborn then another 30 minutes to get to Ann Arbor, for a total of 48 minutes. By comparison, our 79-mph option allows 12+13+9+15=49 minutes, but this includes the potential for added station stops at Ypsilanti and Merriman Road. Thus it can be seen that the proposed 79-mph schedules assume some slight improvement over the current operations, but stay close enough to current schedules that may be considered achievable.

The resulting schedules to Detroit at both 79-mph and 110-mph incorporate 14% slack time relative to LOCOMOTION™ times, which suggest that this benchmarking process results in a very conservative assessment. According to MapQuest, the driving time from Toledo to Detroit is one hour via I-75; from Toledo to Ann Arbor it is also about one hour via US-23. To match driving times, train schedules particularly to Detroit should be further tightened. This can be done by adding Detroit express trains into the 110-mph schedules, and by improving speeds and reducing excess slack for getting across the ConRail Shared Assets and CN trackage east of Dearborn. The potential for tightening the passenger train schedule and reducing running times needs to be further discussed with the freight railroads, and will be re-evaluated in the next phase of work.

Exhibit 3-11: Train Times from Toledo to Detroit and Ann Arbor



Service	Mins	% Slack vs TPC
TOL-DET	82	14%
TOL-AA	73	7%



Service	Mins	% Slack vs TPC
TOL-DET	73	14%
TOL-AA	63	12%

Chapter 4

Capital Plan

SUMMARY

This chapter develops preliminary Capital Costs for the 79-mph and 110-mph options by updating the earlier Ohio Hub estimates. This develops a cost for adding a passenger dedicated track to the existing rail line as the basis for establishing an initial starting point for negotiations with the freight railroads. Actual costs will depend on the outcome of the negotiations and may end up lower or higher. These costs are consistent with the train speeds and running times that were used as the input to the evaluation process.

4.1 Introduction

Three daily Amtrak round trips are already running across the top of the "T" from Ann Arbor to Detroit, so this track is already rated for passenger train speeds. However to make the proposed service more auto-competitive, further improvements to rail lines east of Dearborn and the introduction of express service to Detroit should be considered in future studies.

The most obvious investment need on the MDOT-owned segment is to restore double track west of Ypsilanti to Ann Arbor. This would ensure that the infrastructure has enough capacity to handle the proposed increased level of passenger train service to Ann Arbor. The cost of this double tracking is included in the capital cost estimate. Other needs can be further considered in the future, but it should be noted that the costs and benefits of any such improvements would be shared with the existing Chicago-Detroit-Pontiac Amtrak service.

Development of the CSX rail corridor south of Wayne Junction to Toledo will be more costly since passenger trains have not operated there since 1971. Passenger trains have not operated on the NS from Alexis Junction to Toledo Amtrak station since the Lake Cities ended in 1995. Although these freight tracks are signalled and are already equipped with the I-ETMS Positive Train Control (PTC) system, the lines are currently rated only for 45-50 mph freight speeds. This is not satisfactory for passenger service, so the rail corridor is going to need some significant upgrades to raise the speed. At a minimum:

- **For 79-mph passenger service**, the corridor needs development of stations; connection tracks at junctions between the lines; some work may be necessary to improve tracks to FRA Class IV standard, and the signal systems and grade crossing flashers and gates will have to be enhanced for permitting higher passenger train speeds.
- **For 110-mph passenger service**, a dedicated track would be added to the CSX line, and the current I-ETMS PTC system would be upgraded by adding a vital ITCS overlay.

4.2 Cost Estimating Approach

In terms of freight alternatives shown in Exhibit 2-7, it is not yet known how the railroads will respond to the suggestion that other alternatives (2, 3 or 4) could be more effective than CSX's current circuitous route #1 via Plymouth. Most certainly, CSX ***does*** use route #3 (Conrail's Lincoln Secondary) for intermodal trains, but this route does not have enough capacity to handle ***all*** of CSX's trains.

- In any event, option #3 offers only a partial solution, since it would not resolve the problem of capacity conflicts on CSX's line south of Carleton to Alexis.
- By comparison, Option #4 by rerouting CSX's Detroit freight the Gibraltar line, would fully resolve the freight capacity conflicts on CSX north of Alexis all the way to Wayne Junction.

Not only this, but Option #4 appears to be the most ***cost effective*** alternative as well, since the existing Gibraltar route appears to have enough capacity to accommodate more trains. However, even under the proposed reroute alternative, some CSX freight would still remain on the Plymouth line including:

- Local traffic to the New Boston auto ramp
- Local traffic to the Wayne, MI Ford plant and
- Trains heading farther north towards Saginaw and Grand Rapids via Plymouth, and which do not need to go to Detroit.

As a result, several freight trains per day would still operate along the CSX track, just as Norfolk Southern still operates freight over the MDOT-owned line from Dearborn to Kalamazoo. However, this is a manageable level of interaction between freight and passenger trains which can be accommodated on the existing infrastructure without major conflicts.

However, for the purpose of estimating costs for this study, a traditional costing approach based on adding infrastructure to the CSX rail corridor will be used to develop a benchmark cost estimate. This cost does not depend on CSX's willingness to change its operations or require a capacity analysis, since the engineering costs would be sufficient to add a dedicated track to the corridor all the way from Toledo to Wayne Junction. As a result, the costing approach will be to simply update the earlier 2004 Ohio Hub cost estimates. This was done by applying an inflation adjustment to estimate current costs.

4.2.1 Adjusting the Ohio Hub Costs

Exhibit 4-1 shows the original Ohio Hub costs for 79-mph and 110-mph which were in 2002 dollars.

- **Segment #1:** cost is for adding a third track on both the 79-mph and 110-mph options
- **Segment #2:** for 79-mph the Ohio Hub proposed only to upgrade the tracks and signal system, but for 110-mph it developed a cost for adding a third track to the corridor.
- **Segment #3:** Wayne Junction to Ann Arbor costs were part of the Midwest Regional Rail system but not part of Ohio Hub, so this segment is not included in Exhibit 4-1.
- **Segment #4:** Ohio Hub included some costs for projects that by now been completed but the cost estimate has been retained and adjusted as a placeholder for additional needs. This Ohio Hub cost also included a $6.536 million cost for a train layover facility at New Center which if brought to current dollars would be $9.18 million.

Exhibit 4-1: Original Ohio Hub Costs by Segment, in millions of 2002 Dollars

Segment	79-mph	110-mph
1-Toledo to Alexis	$30.2	$30.12
2-Alexis to Wayne Jct.	$68.2	$121.5
4-Wayne Jct. to Detroit	$43.2	$43.2

The Ohio Hub costs were adjusted by adding $20 million as the cost for an equipment maintenance base (in 2002 dollars) to segment #2. After this, costs were adjusted for inflation from 2002 to 2019 by applying a 1.4051 multiplier. The resulting costs in current dollars are as shown in Exhibit 4-2.

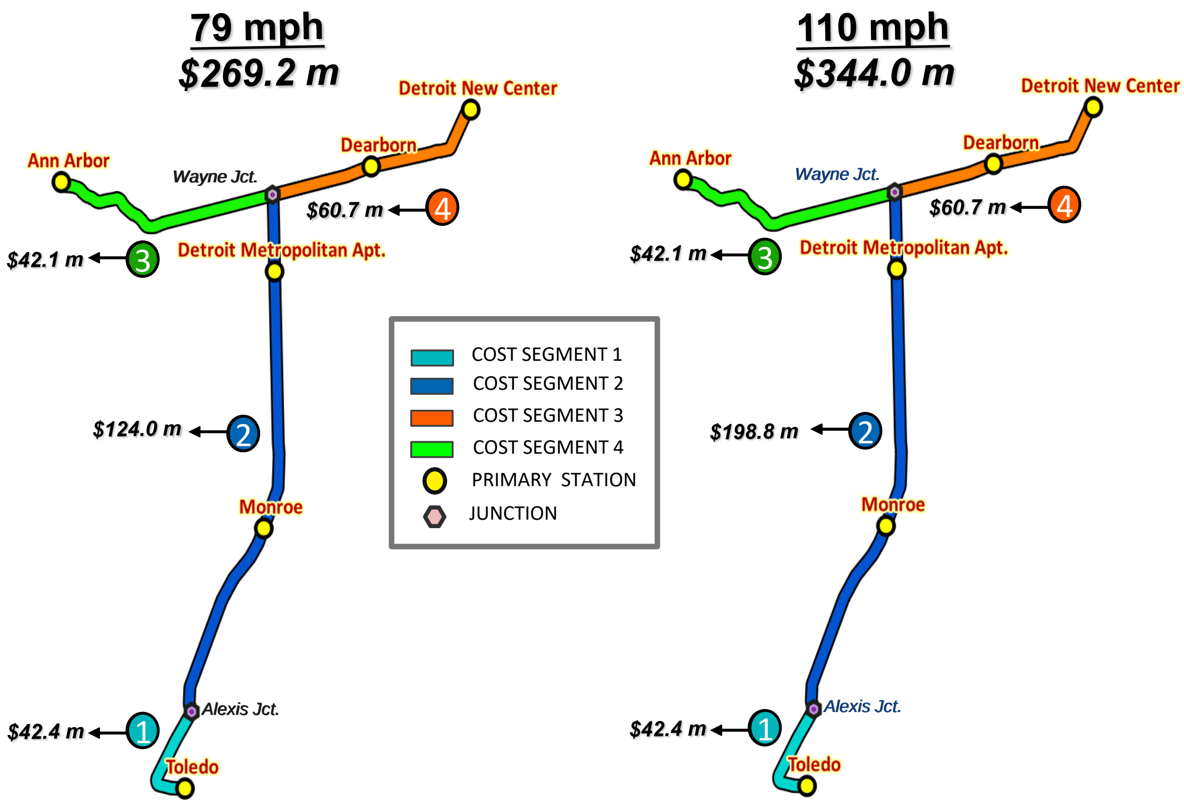
Exhibit 4-2: Adjusted Ohio Hub Costs by Segment, in millions of 2019 Dollars

Segment	79-mph	110-mph
1-Toledo to Alexis	$42.4	$42.4
2-Alexis to Wayne Jct.	$124.0	$198.8
4-Wayne Jct. to Detroit	$60.7	$60.7

The Segment 3 cost was sourced from the recent Ann Arbor to Traverse City rail study which had estimated a cost for restoring double track from Ypsilanti to Ann Arbor as $30.2 million in 2013. Applying an inflation factor of 1.09 brings this to $32.9 million in current dollars. A train layover facility costing the same as the one in Detroit ($9.2 million) was added, bringing the cost for segment #3- Wayne Jct to Ann Arbor up to $42.1 million.

These updated Ohio Hub infrastructure costs are summarized in Exhibit 4-3 and result in infrastructure costs in the $270-340 million range. Since many of the segment costs are similar if not identical, this shows that it may not cost much more to go directly to a 110-mph upgrade than to 79-mph, since much of the improvement work would be the same.

Exhibit 4-3: Infrastructure Cost Summary, in 2019 Dollars



4.2.2 Notes on Ohio Hub Costs

The Ohio Hub 110-mph costs for Alexis to Wayne Junction included adding a third track to the corridor at a cost of $1.492 million per mile (in 2002 dollars) which brought to current dollars would be $2.1 million per mile, or $84.9 million overall. By comparison, when Michigan DOT purchased 135 miles of NS track from Kalamazoo to Dearborn in 2011, it paid $140 million or $1.04 million/mile.[9] Since the CSX line is mostly double track and is in better shape, it is probably worth more than the NS line was.

The question is whether CSX would be better off selling the line and pocketing the cash while retaining an exclusive freight easement, as NS did --or would CSX be better off by spending the money to actually add a third track to the rail line, as Ohio Hub proposed to do?

Much of the remaining Ohio Hub cost for Alexis to Wayne Junction consisted of costs for signals, positive train control and grade crossing improvements. However, since the time of the Ohio Hub report, newer and better ways have been developed for addressing these issues. Since CSX has already installed Positive Train Control (I-ETMS) along this corridor, only adjustments to the signalling and PTC would be needed: not whole new systems, since the foundation for what will be needed to support passenger service is already in place.

[9] *Details emerging on MDOT purchase of train track from Kalamazoo to Dearborn*, October 11, 2011, https://www.mlive.com/news/2011/10/details_emerging_on_mdot_purch.html

For example, Ohio Hub costs for Alexis to Wayne Junction grade crossings included new gate systems and crossing surfaces for 58 crossings, at a 2002 cost of $220 thousand each. In current dollars this would be a cost of $309 thousand per crossing. However since many of existing crossings already have active protection, the need is only to install advance activation for constant warning time to allow higher approaching train speeds. The same ITCS solution that has already been installed on the MDOT Chicago-Detroit line could be used. ITCS radio-based advance crossing activation can be added for only $25,000 per crossing, which is much less expensive and offers better functionality than the traditional track-circuit based approach for providing constant warning time.

Similarly, for speeds up to 79-mph, the I-ETMS PTC system would suffice. For 110-mph speeds an overlay version of ITCS can be installed that would utilize the existing I-ETMS WIUs and radio network for communicating with the trains. Both ITCS and I-ETMS would be active on the same line and the two PTC systems could share much of the same wayside communications and signalling infrastructure. Ohio Hub assumed a PTC systems cost of $197k/ mile in 2002 dollars plus a re-signalling cost of $183k/mile. In 2019 dollars, this would come to $534k/ mile. However, Alstom provided a cost of just $320k/mile for overlaying ITCS on an existing I-ETMS system.

For example, ITCS PTC could be further extended from Dearborn to New Center Station, 10.1 miles over CSAO and CN, at $320k/mile, or $3.3 million, which is just a small fraction of the $60.7 million cost that has been allocated to this segment. Extending the ITCS system all the way to Pontiac would avoid the need for Amtrak trains to make a time consuming switch from ITCS to I-ETMS PTC at the Dearborn station and would allow passenger trains using ITCS to continue all the way to their destinations under the control of a single PTC system.

In summary it is believed that the cost for outfitting the rail lines for passenger use may be less than what has been estimated, but the purchase cost, or even CSX's willingness to sell the line or reroute any of its freight trains remains unknown at this time. For this reason the more conservative estimates based on the original Ohio Hub study will be carried forward.

4.3 Equipment and Total Capital Cost

The overall equipment requirement for 10 round trips on each line in 2030 is for six 300-seat trainsets to cover the service. Train capital costs are consistent with the earlier Traverse City and Coast to Coast rail studies. The overall system is 86 route miles. This results in a utilization of around 400 miles per train per day, just half of what MWRRS which featured much longer routes, was able to accomplish:

- 79-mph trains are assumed to cost $20 million each or $120 million total.
- 110-mph trains are assumed to cost $30 million each or $180 million total.

Overall capital costs are summarized in Exhibit 4-4.

Exhibit 4-4: Capital Cost Summary, in 2019 Dollars

Option	Infrastructure	Equipment	TOTAL	$/Mile* Overall
79-mph	$269.2	$120.0	$389.2	$4.6
110-mph	$344.0	$180.0	$524.0	$6.1

Chapter 5

Demographics, Socioeconomic and Transportation Databases

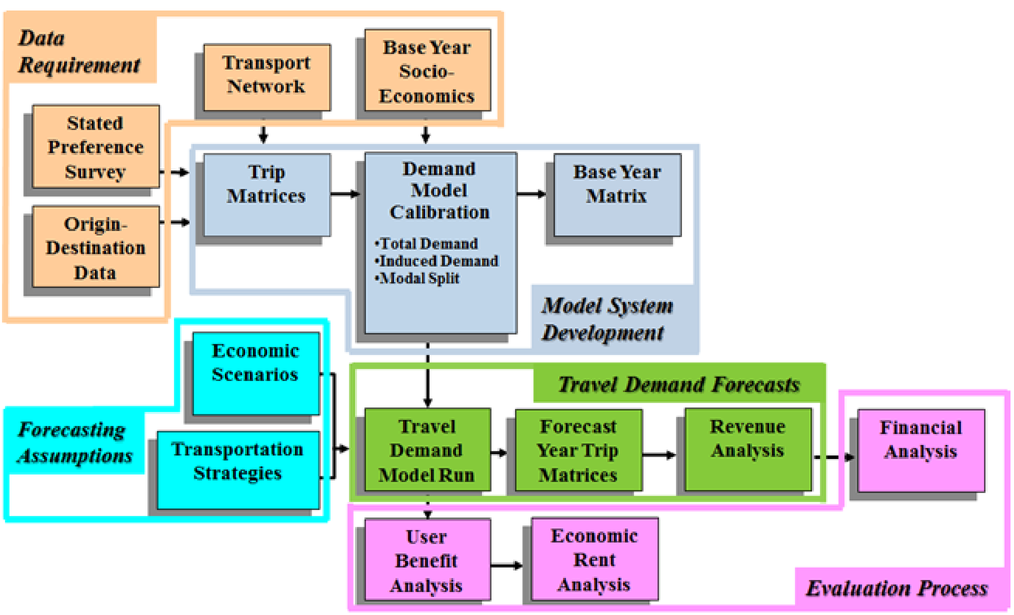
SUMMARY

This chapter describes the zone system, socioeconomic data, transportation networks, origin-destination data, and stated preference survey data upon which the forecast will be based.

5.1 Introduction

To better represent the travel market that covers a large area, the study area is divided into zones to reflect the characteristics of travelers and trips of different origin-destinations pairs which are the basic building blocks of the COMPASS™ Model (See Exhibit 5-1). In order to forecast the future Total Travel Demand in the corridor, base year and future socioeconomic data for each zone are developed and inputted into the model. All databases: socioeconomic characteristics, transportation networks, and trips, are also built at the zonal level. In particular, the main drivers of the travel market, namely, population, employment and income, are developed at the zonal level. The COMPASS™ Model then processes the data and outputs the Travel Demand Forecast including passenger rail ridership and revenue results, at the zonal level.

Exhibit 5-1: COMPASS™ Model Diagram

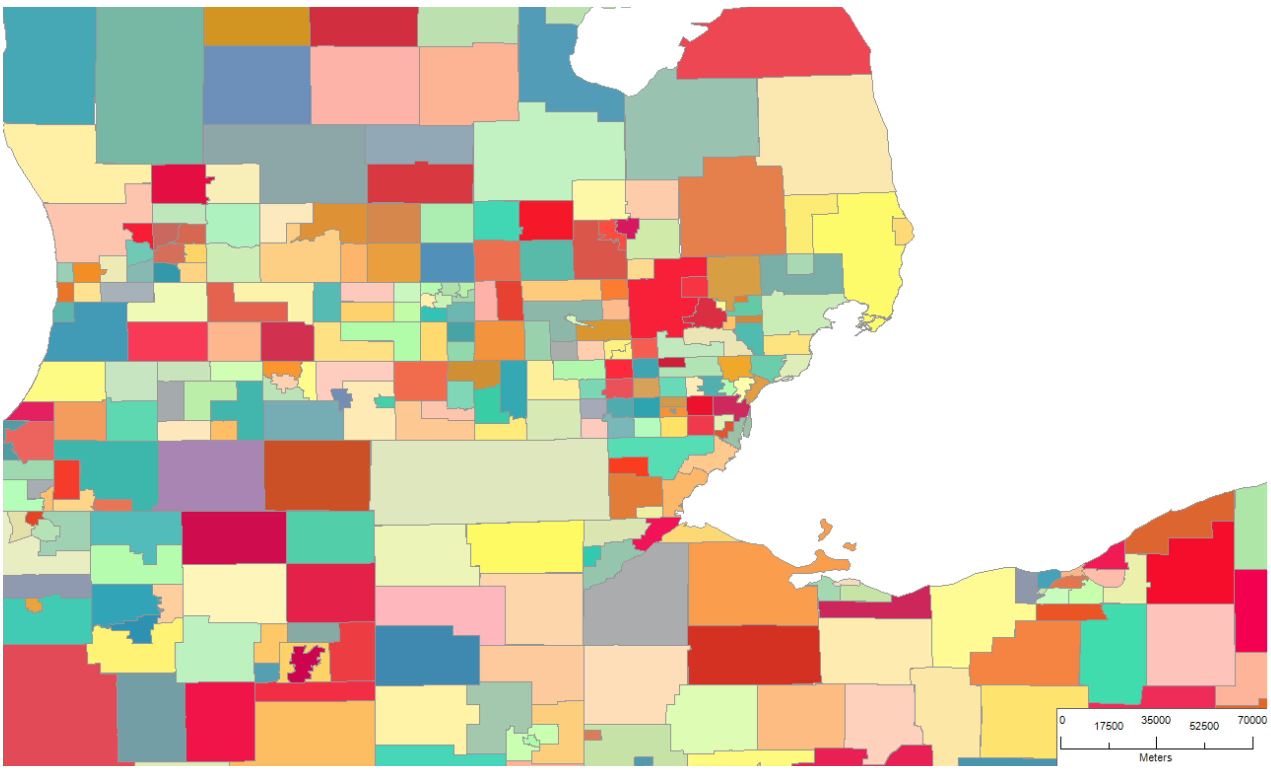


5.2 Zone System

In order to understand the level of intercity and interurban travel in a corridor, a zone system is defined that allows the number of trips between one location (zone) and another (zone) to be measured. As such, the system provides a representation of the travel occurring from zone origins to zone destinations for any given market in the corridor (e.g., business, commuter, social travel). For passenger rail planning, most rural zones are represented by larger areas. However, where it was important to identify more refined trip origins and destinations in urban areas, finer zones are typically used. The Travel Demand Model forecasts the total number of trip origins and destinations by mode and by zone pair.

For the Toledo-Detroit Rail study, an effective zone system was developed based on aggregation of the census tracts and traffic analysis zones (TAZs) of local transportation planning agencies. Exhibit 5-2 shows the zone system for study area.

Exhibit 5-2: Study Area Zone System



5.3 Socioeconomic Database Development

In order to estimate the base and future travel market total demand, the travel demand forecasting model requires base year estimates and future growth forecasts of three socioeconomic variables of population, employment and per capita income for each of the zones in the study area. A socioeconomic database was established for the base year (2018) and for each of the forecast years (2020-2050).

The data was developed at five-year intervals using the most recent data collected from the following sources:

- U.S. Census Bureau
- American Community Survey 5-Year Estimates
- U.S. Bureau of Economic Analysis
- Woods & Poole Economics
- Michigan Department of Transportation
- SEMCOG, the Southeast Michigan Council of Governments
- Toledo Metropolitan Area Council of Governments

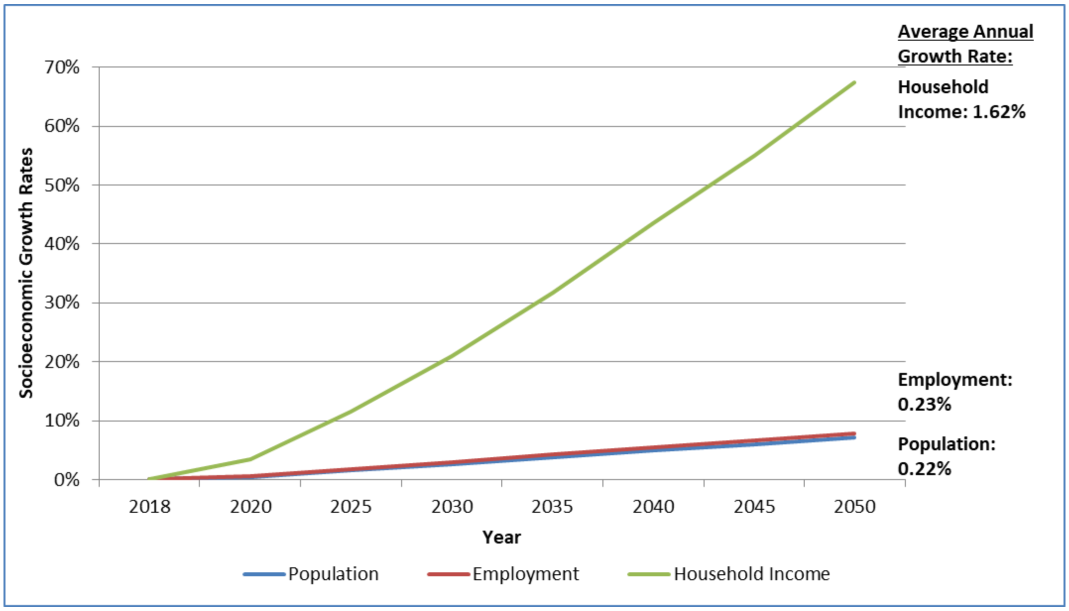
Exhibit 5-3 shows the base year and TEMS socioeconomic projections for Toledo-Detroit corridor. According to the data developed by TEMS, the population of the corridor will increase from 5.37 million in 2018 to 5.75 million in 2050, employment will increase from 3.13 million to 3.37 million in 2050, and average household income will increase from $76,991 in 2018 to $128,907 in 2050.

Exhibit 5-3: Michigan Base and Projected Socioeconomic Data

	2018	2020	2025	2030	2035	2040	2045	2050
Population	5,369,988	5,393,230	5,452,648	5,513,375	5,573,772	5,633,667	5,693,942	5,755,607
Employment	3,125,830	3,141,463	3,180,494	3,219,127	3,256,878	3,293,812	3,330,647	3,367,723
Household Income	76,991	79,585	85,817	93,102	101,417	110,524	119,351	128,907

Exhibit 5-4 shows the socioeconomic growth projections for the study area. The exhibit shows that there growth rates of employment and population are similar in the study area, income has high growth rate. Furthermore, travel increases are historically strongly correlated to increases in employment and income, in addition to changes in population. Therefore, travel in the study area is likely to continue to increase faster than the population growth rates, as changes in employment and income outpace population growth, and stimulate more demand.

Exhibit 5-4: Study Area Socioeconomic Data Growth Rate



The exhibits in this section show the aggregate socioeconomic projection for the whole study area. It should be noted that in applying socioeconomic projections to the model, separate projections were made for each individual zone using the data from the listed sources. Therefore, the socioeconomic projections for different zones are likely to be different and thus may lead to different future travel sub-market projections.

5.4 Base Year Transportation Database Development

To understand the existing travel market of the Toledo-Detroit Rail corridor, the base year existing travel networks and travel demand by mode and travel purpose in the corridor are developed. The travel modes include auto, bus, and air. The travel purposes are business, commuters, and other (social, tourist and etc.) trips. This separation of business and non-business trips is important since business trips are paid for by firms who have a willingness to use more expensive options and have a high value of time (VOT), while non -business trips are paid for by individuals who look for less expensive travel choices and who typically have a much lower value of time (VOT). In addition to calculating values of time (VOTs) for different travel purposes and travel modes, generalized costs for values of frequency (VOFs) and values of access time (VOAs) are also developed for the corridor.

5.4.1 Base Year (2018) Transportation Networks

In transportation analysis, travel desirability/utility is measured in terms of travel cost and travel time. These variables are incorporated into the basic transportation network elements that provide by mode the connections from any origin zone to any destination zone. Correct representation of the existing and proposed travel services is vital for accurate travel forecasting. Basic network elements are called nodes and links. Each travel mode consists of a database comprised of zones and stations that are represented by nodes, and existing connections or links between them in the study area. Each node and link is assigned a set of travel attributes (time and cost). The network data assembled for the study included the following attributes for all the zone pairs.

For public travel modes (air, rail, bus):

- Access/egress times and costs (e.g., travel time to a station, time/cost of parking, time walking from a station, etc.)
- Waiting at terminal and delay times
- In-vehicle travel times
- Number of interchanges and connection times
- Fares
- Frequency of service

For private mode (auto):

- Travel time, including rest time
- Travel cost (vehicle operating cost)
- Tolls
- Parking Cost
- Vehicle occupancy

The highway network was developed to reflect the major highway segments within the study area. The sources for building the highway network in the study area are as follows:

- State and Local Departments of Transportation highway databases
- The Bureau of Transportation Statistics HPMS (Highway Performance Monitoring System) database

The highway network of the study area coded in COMPASS™ is shown in Exhibit 5-5. Two networks were developed: one for business travel, one for non-business travel (commuter, social, tourist and etc.)

Exhibit 5-5: COMPASS™ Highway Network for the Study Area

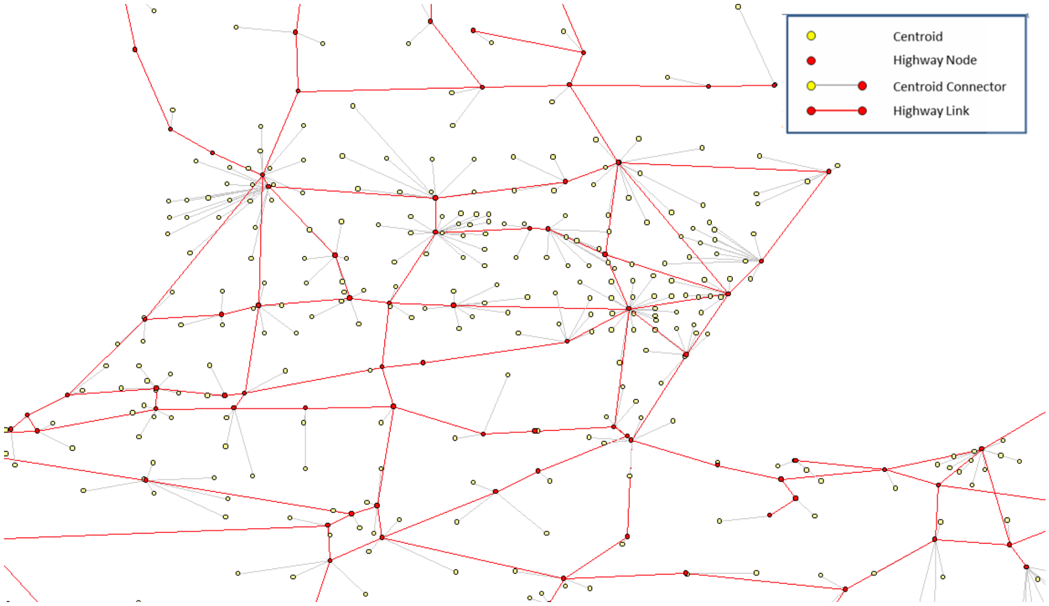
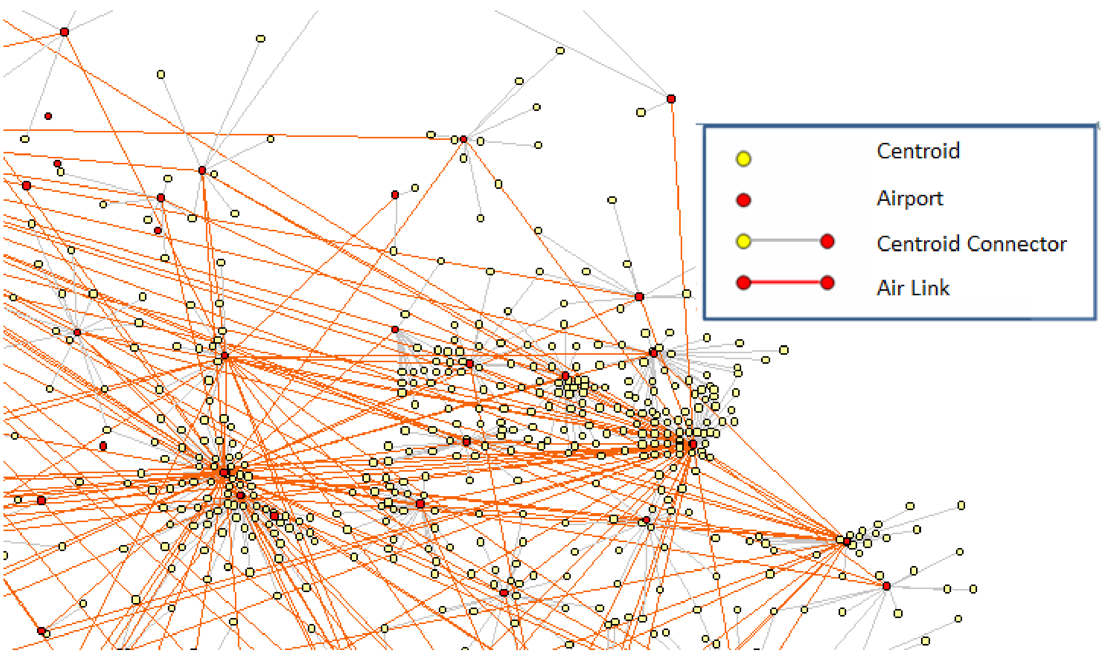


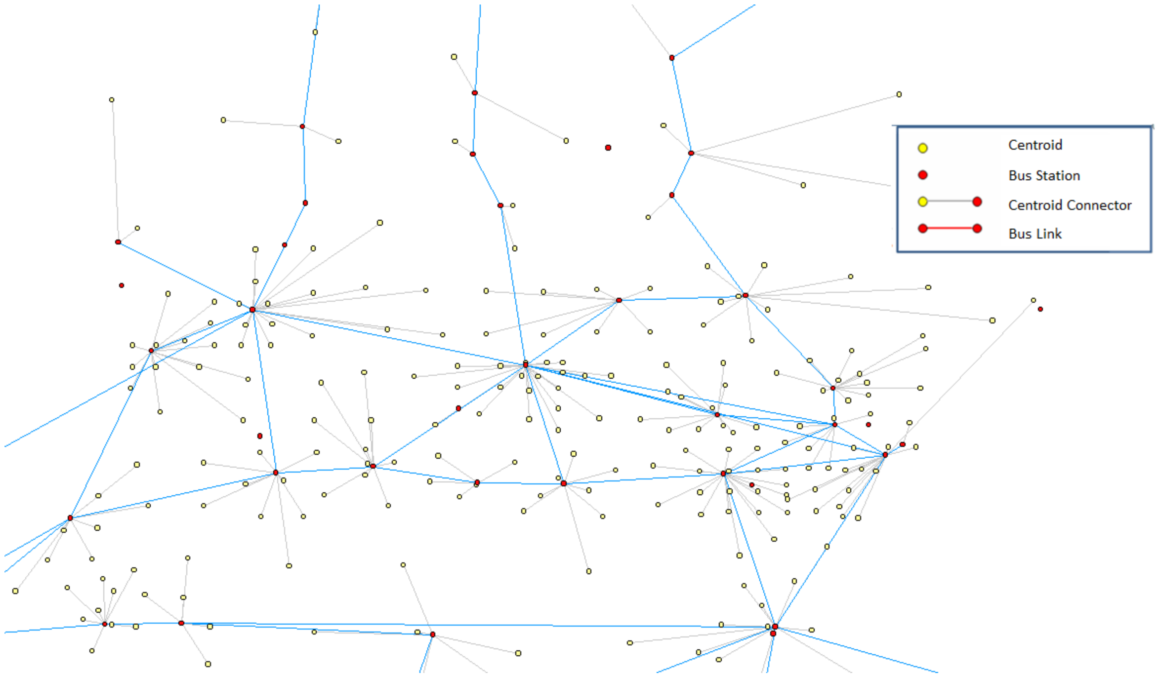
Exhibit 5-6 shows the air network coded in COMPASS™. Again, two networks were developed: one for business travel, one for non-business travel.

Exhibit 5-6: COMPASS™ Air Network for Study Area



Bus travel data of travel time, fares, and frequencies, were obtained from official schedules of Greyhound and MegaBus. Exhibit 5-7 shows the bus network of the study area coded in COMPASS™.

Exhibit 5-7: COMPASS™ Bus Network for the Study Area



5.4.2 Origin-Destination Trip Database

The multi-modal intercity travel analyses model requires the collection of base origin-destination (O-D) trip data describing annual personal trips between zone pairs. For each O-D zone pair, the annual personal trips are identified by mode (rail, auto, air, and bus) and by trip purpose. Because the goal of the study is to evaluate intercity travel, the O-D data collected for the model reflects travel between zones (i.e., between counties, neighboring states and major urban areas) rather than within zones.

TEMS extracted, aggregated and validated data from a number of sources in order to estimate base travel between origin-destination pairs. The data sources for the origin-destination trips in the study are:

- Michigan Department of Transportation
- SEMCOG, the Southeast Michigan Council of Governments
- Toledo Metropolitan Area Council of Governments
- Bureau of Transportation Statistics 10% Ticket Sample
- TEMS 2012 Michigan Travel Survey
- Midwest Regional Rail Initiative Study

The travel demand forecast model requires the base trip information for all modes between each zone pair. In some cases this can be achieved directly from the data sources, while in other cases the data providers only have origin-destination trip information at an aggregated level (e.g., AADT data, station-to-station trip and station volume data). Where that is the case, a data enhancement process of trip simulation and access/egress simulation needed to be conducted to estimate the zone-to-zone trip volume. The data enhancement process is shown in Exhibit 5-8.

For the auto mode, the quality of the origin-destination trip data was validated by comparing it to AADTs and traffic counts on major highways and adjustments have been made when necessary. For public travel modes, the origin- destination trip data was validated by examining station volumes and segment loadings.

Exhibit 5-8: Zone-to-Zone Origin-Destination Trip Matrix Generation and Validation

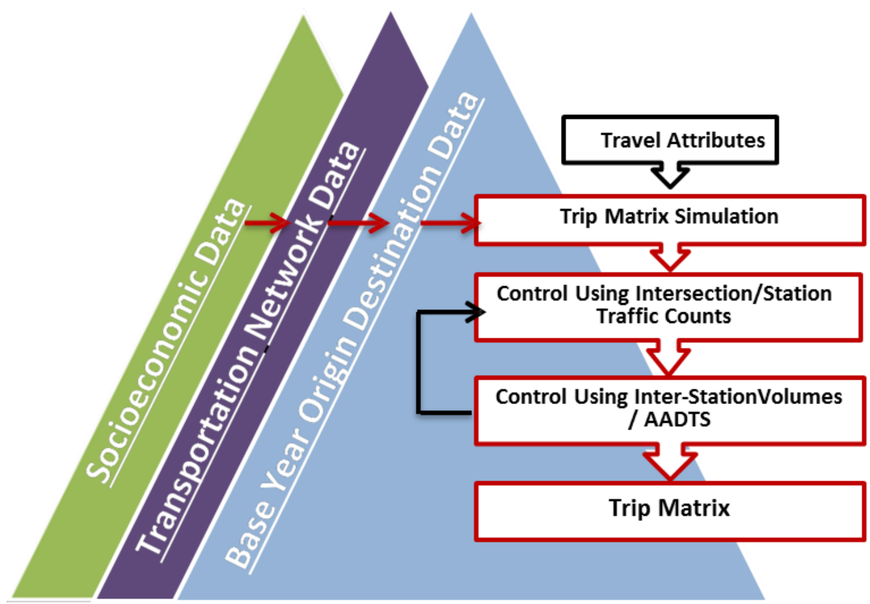
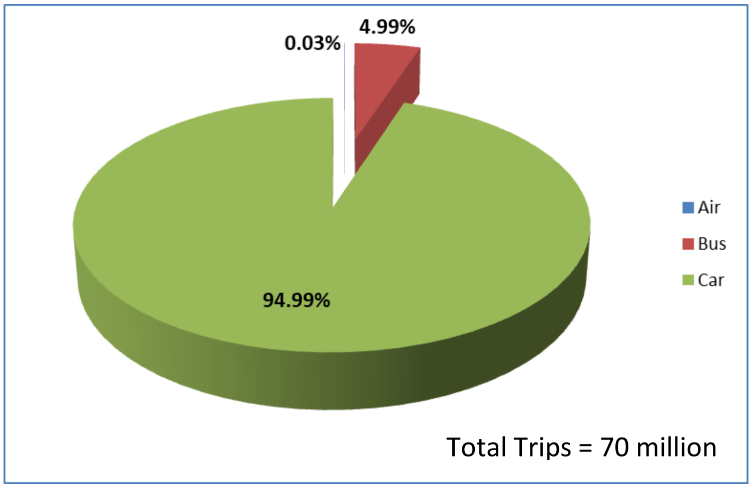


Exhibit 5-9 shows the base 2018 study area travel market share of air, bus, and auto modes. The total intercity and interurban travel demand in the corridor is 70 million in 2018. It can be seen that auto mode dominates the travel market with more than 95 percent of market share. Public modes have five percent of travel market share.

Exhibit 5-9: Base Year Travel Market (2018)



5.4.3 Values of Time, Values of Frequency, and Values of Access Times

Generalized cost of travel between two zones estimates the impact of improvements in the transportation system on the overall level of trip making. Generalized Cost includes all the factors that are key to an individual's travel decision (such as travel time, fare, frequency) that are all included in the Generalized Cost equation for the COMPASS™ Model. Generalized Cost is typically defined in travel time (i.e., minutes) rather than cost (i.e., dollars). Costs are converted to time by applying appropriate conversion factors such as Value of Time, derived from Stated Preference Surveys. In this case the Michigan DOT Chicago-Detroit/Pontiac Stated Preference Survey. The generalized cost (GC) of travel between zones i and j for mode m and trip purpose p is defined as follows:

$$GC_{ijmp} = TT_{ijm} + \frac{TC_{ijmp}}{VOT_{mp}} + \frac{VOF_{mp} * OH}{VOT_{mp} * F_{ijm}}$$

Where,

TT_{ijm} = Travel Time between zones i and j for mode m (in-vehicle time + station wait time + connection time + access/egress time), with waiting, connect and access/egress time multiplied by a factor (waiting and connect time factors is 1.8, access/egress factors were determined by ratios from the Michigan Detroit-Chicago SP survey) to account for the additional disutility felt by travelers for these activities.

TC_{ijmp} = Travel Cost between zones i and j for mode m and trip purpose p (fare + access/egress cost for public modes, operating costs for auto)

VOT_{mp} = Value of Time for mode m and trip purpose p

VOF_{mp} = Value of Frequency for mode m and trip purpose p

F_{ijm} = Frequency in departures per week between zones i and j for mode m

OH = Operating hours per week (sum of daily operating hours between the first and last service of the day)

Value of Time (VOT) is the amount of money (dollars/hour) an individual is willing to pay to save a specified amount of travel time, the Value of Frequency (VOF) is the amount of money (dollars/hour) an individual is willing to pay to reduce the time between departures when traveling on public transportation. Access/Egress time is weighted higher than in-vehicle time in generalized costs calculation, and its weight is derived from value of access stated preference surveys. Station wait time is the time spent at the station before departure and after arrival. On trips with connections, there would be additional wait times incurred at the connecting station. Wait times are weighted higher than in-vehicle time in the generalized cost formula to reflect their higher disutility as found in previous stated preference surveys.

Exhibits 5-10 and 5-11 shows the values of time and values of frequency from the TEMS Michigan Chicago-Detroit/Pontiac Stated Preference Travel Survey. The values have been updated from 2012 to 2018 dollars. These will be used in the Toledo-Detroit Corridor Study, which has considerable overlap with the existing rail services.

Exhibit 5-10: VOT values by Mode and Purpose of Travel ($2018/hour)

Value of Time (VOT)	Business	Non-business
Auto	$30.06	$27.11
Bus	$22.35	$16.46
Rail	$42.87	$30.68
Air	$54.06	$42.97

Exhibit 5-11: VOF values by Mode and Purpose of Travel ($2018/hour)

Value of Frequency (VOF)	Business	Non-business
Bus	$5.82	$5.78
Rail	$11.42	$9.66
Air	$27.99	$20.14

Chapter 6
Travel Demand Forecast

SUMMARY

This chapter develops the market analysis of the potential for passenger rail, presenting the Travel Demand Forecast for the Toledo-Detroit-Ann Arbour corridor including ridership, revenue and market share results.

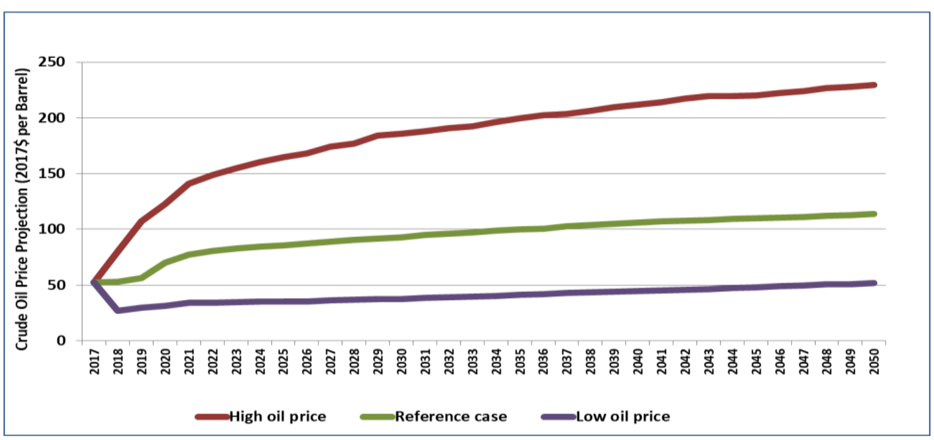
6.1 Future Travel Market Strategies

In order to forecast the future potential for rail ridership, consideration has to be given to how future travel markets will be impacted by changing transportation conditions. The critical factors that will change future travel conditions include: fuel price, vehicle fuel efficiency, as well as highway traffic congestion. In addition, the forecasts need to assess the different levels of rail service that might be developed, and how it will compete with auto, air, and bus markets. This includes the improvements planned as part of the Detroit-Chicago improvement program that are relevant to the different route options.

6.1.1 Fuel Price Forecasts

One of the important factors in the future attractiveness of passenger rail is fuel price. Exhibit 6-1 shows the Energy Information Agency (EIA)[10] projection of crude oil prices for three oil price cases: namely a high world oil price case that is for an aggressive oil price forecast; a reference world oil price case that is moderate and is also known as the central case forecast; and a conservative low world oil price case. In this study, the reference case oil price projection is used to estimate transportation cost in future travel market. The EIA reference case forecast suggests that crude oil prices are expected to be $70 per barrel in 2020 and will increase to $114 per barrel in 2050.

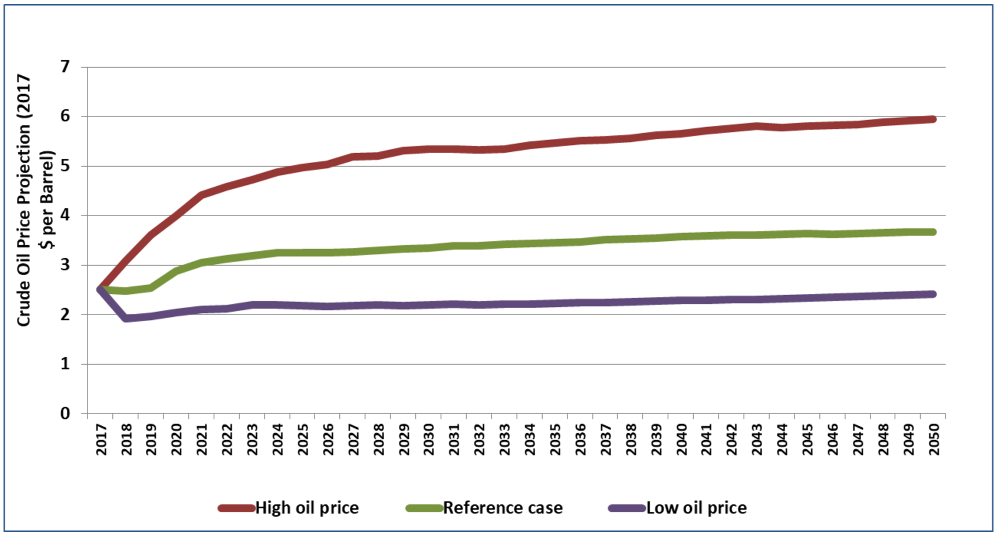
Exhibit 6-1: 2018 Crude Oil Price Forecast by EIA



[10] EIA periodically updates historical and projected oil prices at www.eia.gov/forecasts/aeo/tables_ref.cfm

EIA has also developed a future retail gasoline price forecast, which is shown in Exhibit 6-2. The implication of this is a reference case gasoline price of $2.88 per gallon in 2020, with a high case price of $4 per gallon, and a low case price of $2.03 per gallon. The reference case gasoline price will increase to $3.67 per gallon in 2050. The impact of rising energy prices will clearly impact the competition between the modes of travel in the corridor. Typically rising energy and therefore gas prices will most severely impact auto travel followed by air mode, bus mode and finally rail. Rail is very fuel efficient and its market share typically increases with rising energy and gas prices. Increasing energy prices has been largely responsible for the recent dramatic increases in Amtrak traffic.

Exhibit 6-2: U.S. Retail Gasoline Prices Forecast by EIA



6.1.2 Vehicle Fuel Efficiency Forecasts

Future improvement in automobile technology is likely to reduce the impact of high gas prices on automobile fuel cost with better fuel efficiency. The Oak Ridge National Laboratory (ORNL) Center for Transportation Analysis (CTA) provides historical automobile highway energy usage in BTU (British thermal unit) per vehicle-mile data for automobiles since 1970 (Exhibit 6-3).

Exhibit 6-3: ORNL Historical Highway Automobile Energy Intensities Data

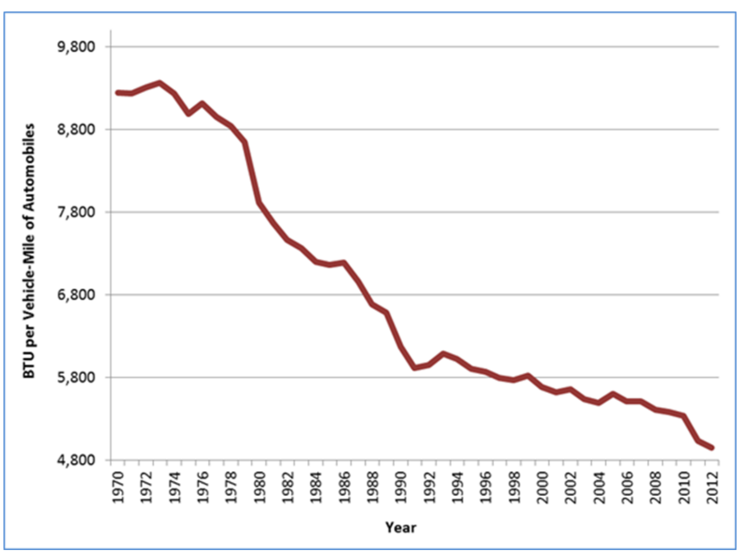
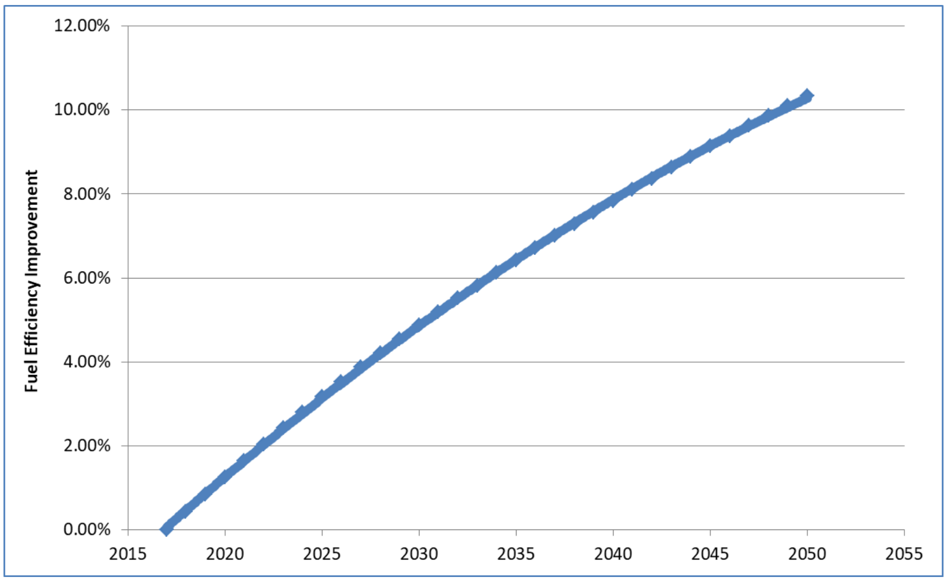


Exhibit 6-3 shows the historical highway automobile energy intensities from 1970 to 2012. It can be seen that automobile fuel efficiency has been improving gradually during the past few decades but the improvement perhaps surprisingly has slowed down in recent years. Future automobile fuel efficiency improvement was projected by TEMS as shown in Exhibit 6-4. The TEMS forecast reflects the actual performance of the vehicle fleet, which is much lower and slower to be implemented than the regulated Corporate Average Fuel Economy (CAFE) standards for new cars. The auto fleet simply changes at a much slower pace than the standards for new cars. It was based on the historical automobile fuel efficiency data. The TEMS forecast shows a slow but consistent increase in car fuel efficiency to 2050, and beyond. It shows that the automobile fleet fuel efficiency is expected to improve by more than 10 percent by 2050 as compared to fuel efficiency of today.

Exhibit 6-4: Auto Fuel Efficiency Improvement Projections



6.1.3 Highway Traffic Congestion

The average annual auto travel time growth in the corridor was estimated with the projected highway traffic volume data and the Bureau of Public Roads (BPR) function that can be used to calculate travel time growth with increased traffic volumes:

$$T_f = T_b * [1 + \alpha * \left(\frac{V}{C}\right)^{\beta}]$$

where

T_f is future travel time,

T_b is highway Average travel time,

V is traffic volume,

C is highway Average capacity,

α is a calibrated coefficient (0.56), it describes the volume of traffic required for the capacity of the road to become limited by traffic (i.e., when it will begin to slow traffic speed)

β is a calibrated coefficient (3.6), it describes the slope or sensitivity of the highway to congestion once capacity becomes limited (i.e., how quickly traffic speed falls as traffic increases).

The projected travel times were calculated by computing travel time on each segment of the highway route between two cities. The key assumptions are as follows:

- α = 0.56
- β = 3.6

The above two coefficients are from the Highway Capacity Manual, they determine how traffic volume will affect travel speed.

6.2 The Travel Demand Forecast Results

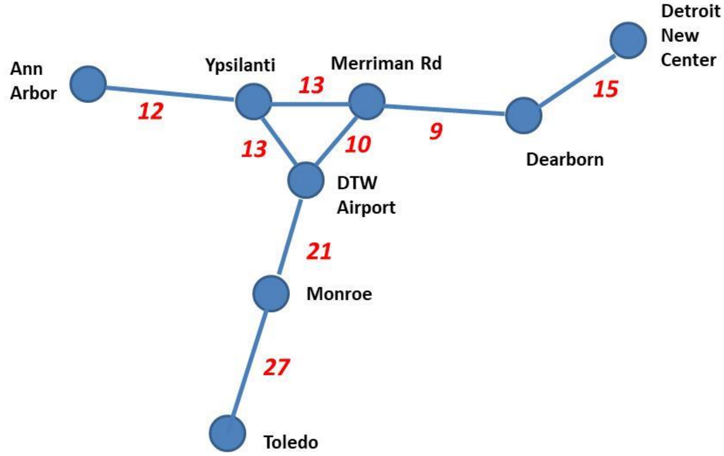
Applying the COMPASS™ Total Demand Model with the data inputs discussed in Chapter 5 (demographics, socio-economics and transportation databases), generated the Total Demand Forecast presented in the follow sections of this chapter, including the rail Ridership and Revenue results.

6.2.1 Rail Scenarios

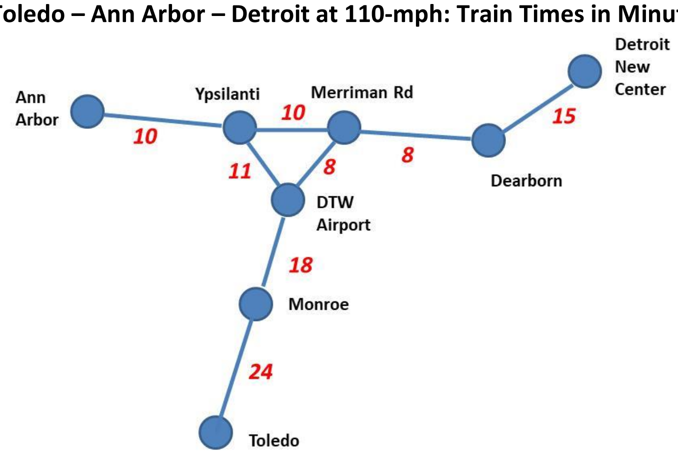
For the purpose of the rail ridership and revenue analysis, 79-mph and 110-mph technologies will be used. Exhibit 6.5 shows the running times of the two technologies used in the analysis.

Exhibit 6-5: Rail Scenarios of 79 MPH and 110 MPH Technologies

Toledo – Ann Arbor – Detroit at 79-mph: Train Times in Minutes



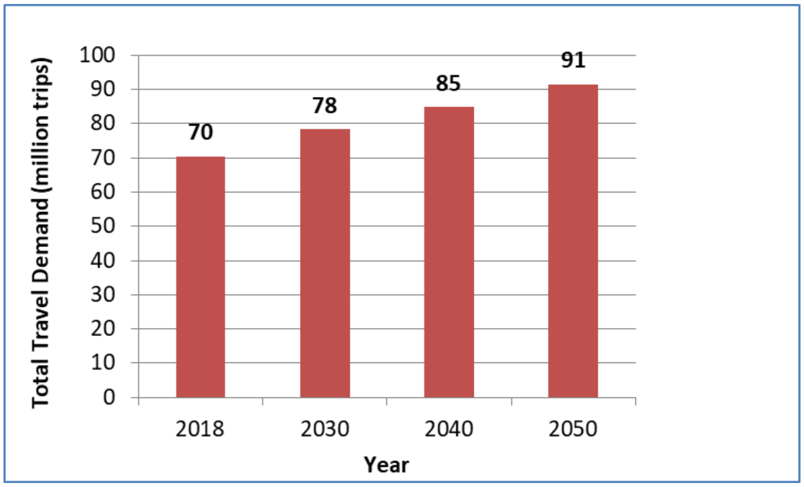
Toledo – Ann Arbor – Detroit at 110-mph: Train Times in Minutes



6.2.2 Total Demand

Exhibit 6-6 shows the Toledo-Detroit Corridor total intercity Travel Demand Forecasts for 2018, 2030, 2040 and 2050. It can be seen that the travel demand will increase from 70 million in 2018, to 78 million in 2030, and increases to 91 million in 2050. The average annual corridor travel market growth rate is 0.8 percent per year, which is in line with the socioeconomic growth within the travel market for the corridor.

Exhibit 6-6: Toledo-Detroit Corridor Total Travel Demand Forecast (millions)

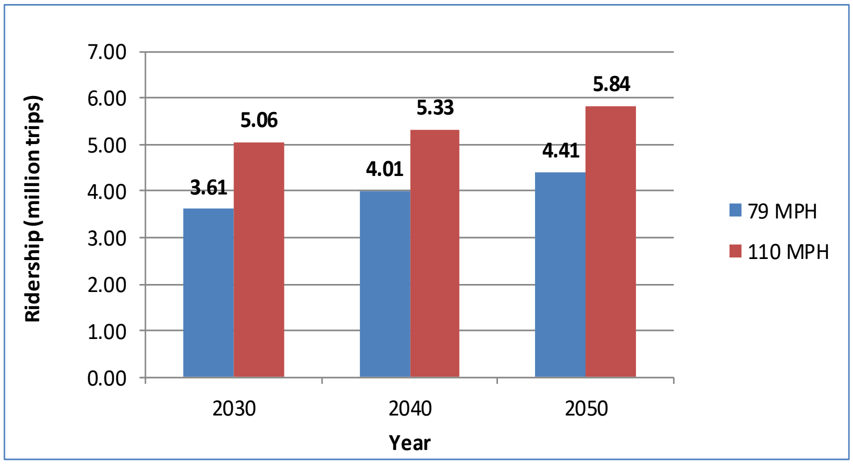


6.2.3 Ridership Forecasts

The passenger rail ridership for each scenario and year is shown in Exhibits 6-7.

- The 79-mph service is estimated to have 3.61 million trips in 2030, 4.01 million trips in 2040, and 4.41 million trips in 2050.
- The 110-mph service is estimated to have 5.06 million trips in 2030, 5.33 million trips in 2040, and 5.84 million trips in 2050.

Exhibit 6-7: Toledo-Detroit Passenger Rail Ridership Forecast (annual millions of trips)

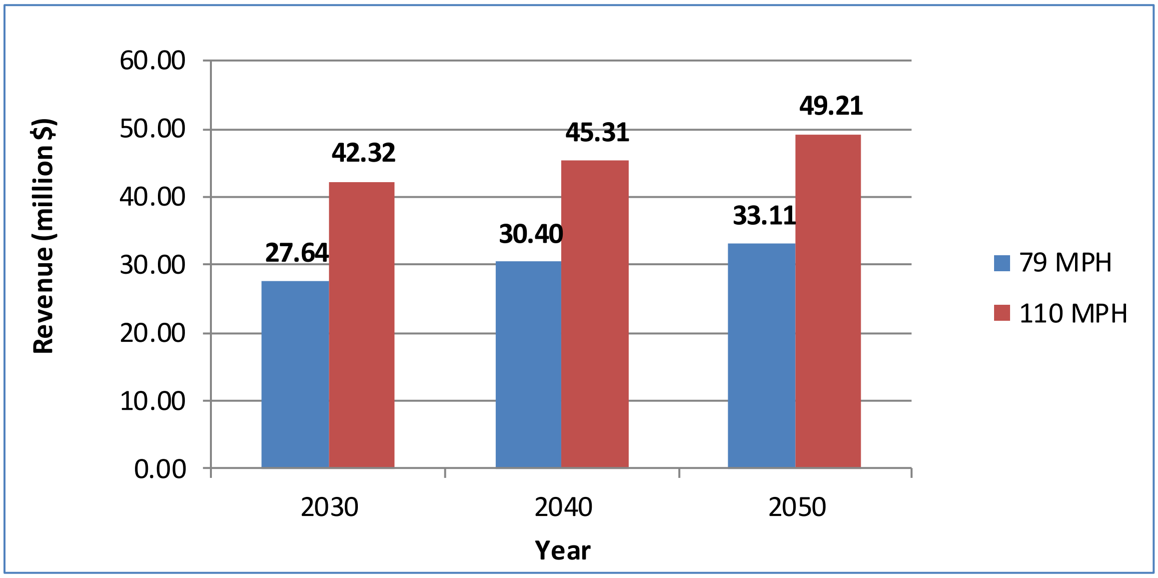


6.2.4 Revenue Forecasts

The passenger rail revenue forecast is shown in Exhibits 6-8.

- The 79-mph rail is estimated to have $27.64 million revenue in 2030, $30.40 million revenue in 2040, and $33.11 million revenue in 2050.
- The 110-mph rail is estimated to have $42.32 million revenue in 2030, $45.31 million revenue in 2040, and $49.21 million revenue in 2050.

Exhibit 6-8: Toledo-Detroit Passenger Rail Revenue Forecast (annual millions $)



6.2.5 Station Volumes

Exhibit 6-9 shows the station volumes. The strongest station volumes are projected to be at Detroit, DTW, Toledo, Ann Arbor, and Dearborn with over one million passengers each year. A review of the OD matrix shows that there is substantial traffic from the DTW airport due to high volume of air travelers and airport employee commuting trips. Also, it can be seen that there are high volume of rail trips between Detroit area and Toledo.

Exhibit 6-9: 2030 Station Volumes for Route 1 (millions of passengers)

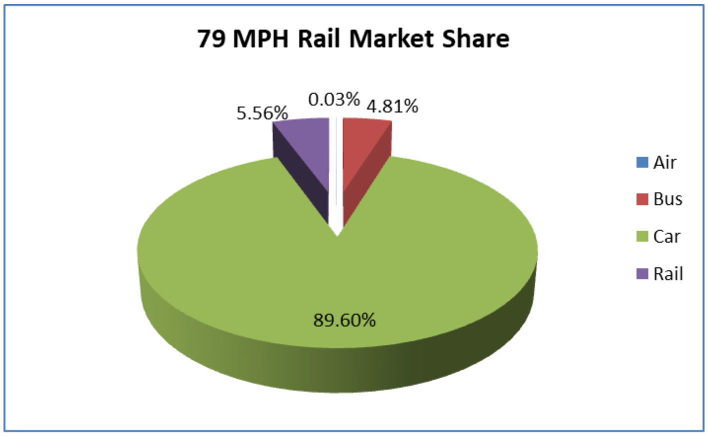
Station	2030 79 MPH	2040 79 MPH	2050 79 MPH	2030 110 MPH	2040 110 MPH	2050 110 MPH
Ann Arbor	1.09	1.25	1.42	1.53	1.74	1.96
Ypsilanti	0.37	0.42	0.46	0.52	0.58	0.64
Merriman Rd	0.37	0.44	0.52	0.51	0.60	0.69
Dearborn	0.93	1.03	1.13	1.36	1.34	1.46
Detroit New Center	1.73	1.88	2.04	2.39	2.49	2.69
DTW Airport	1.37	1.52	1.67	1.94	1.89	2.08
Monroe	0.29	0.31	0.34	0.40	0.44	0.47
Toledo	1.08	1.17	1.25	1.48	1.58	1.69

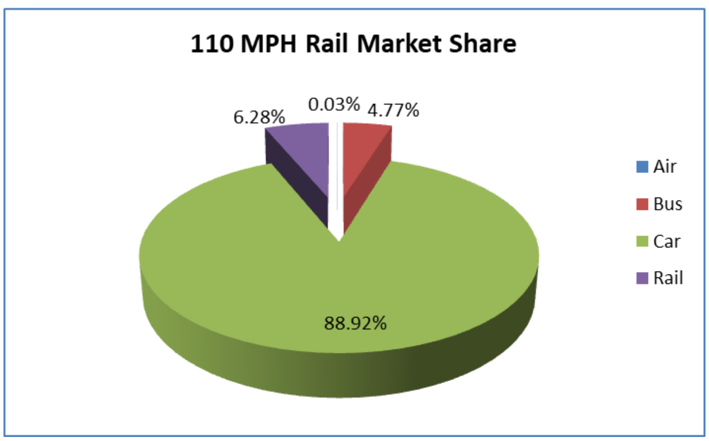
6.3 Market Shares

6.3.1 Travel Market Modal Split

Exhibit 6-10 shows the corridor travel market shares in 2040. Rail travel market share is 5.56% for 79 MPH service and 6.28% for 110 MPH service. Auto trips still dominate the travel market while its market share drops from 95% to 89% due to the new rail service. However, the rail system could absorb 30 percent of the ***new*** trips being added to the corridor by 2050.

Exhibit 6-10: 2040 Rail Market Share



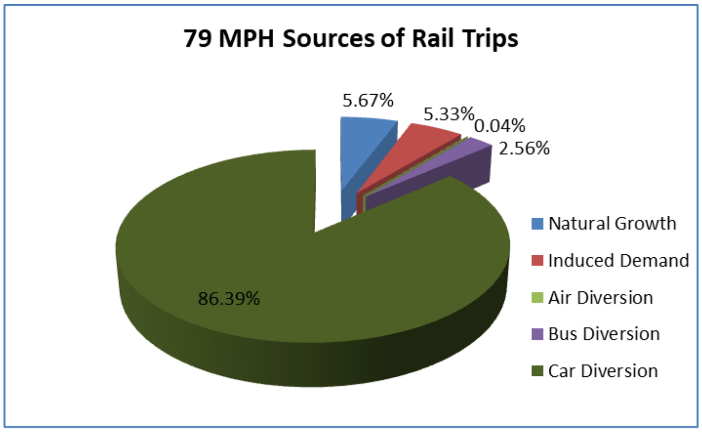


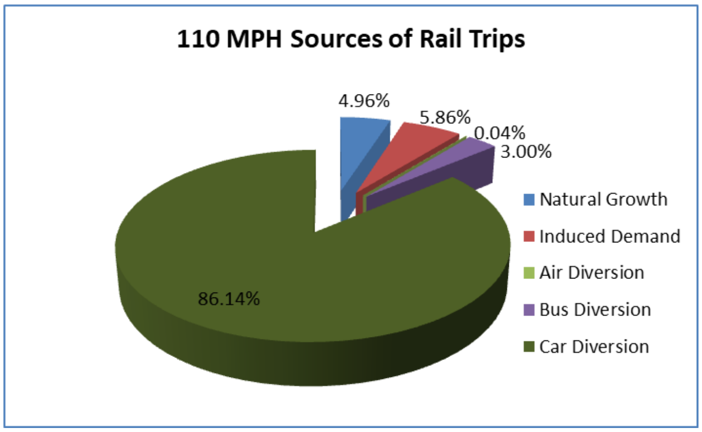
6.3.2 Source of Trips

Exhibits 6-11 illustrate the sources of the rail trips for the corridor in 2040

Trips diverted from other modes are the most important source of new rail trips, which is estimated to be nearly 90 percent of the overall rail travel market in 2040. Induced travel demand in the corridor as a result of the new passenger rail service is projected to be approximately 5 percent of the rail travel market then as well. As for the diverted trip from other modes, most trips are expected to be from personal vehicle travel. It should be noted however that driving still dominates the future travel market because it is the most popular travel choice in the corridor.

Exhibit 6-11: 2040 Rail Trip Sources Forecast





6.3.3 Airport Access Travel Market Benchmarking

Exhibit 6-12 shows the airport access travel market for rail in various airports. The market share for rail access to airports ranges from 4 to 40 percent in the chart. For US airports, typical market share for rail is around 5 percent for cities such as Philadelphia, Cleveland, Chicago, and Atlanta. Washington, Boston, and New York airports have higher rail market share largely due better airport access from direct terminal connections, better public transit connections and more congested highways. This study show shows DTW airport rail access would have around 6 percent of market share, which is in line with similar cities such as Chicago and Cleveland.

Exhibit 6-13 shows the annual link loadings for a 79-mph system in 2030. As might be expected the highest volumes are between DTW Airport and downtown Detroit. However, there is significant ridership beyond DTW Airport, of about 1 million each to both Ann Arbor and Toledo. This is sufficient to support development of passenger rail service on all three legs of the “T” radiating out of DTW Airport.

Exhibit 6-12: Airport Access Travel Market

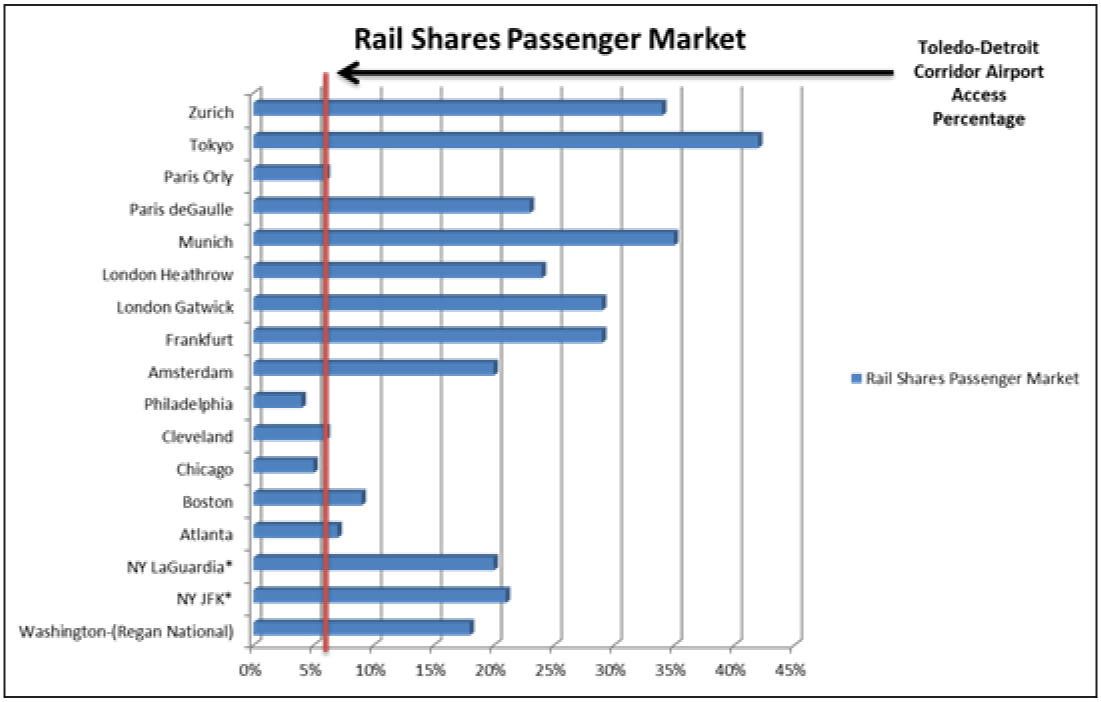
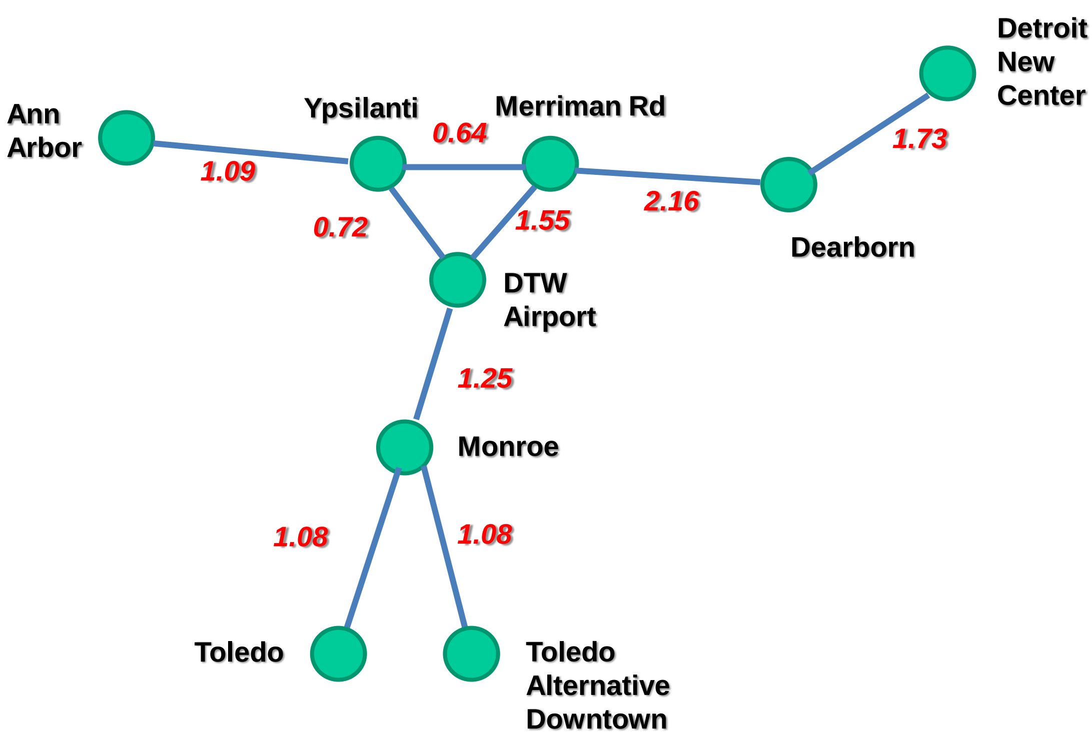


Exhibit 6-13: Toledo – Ann Arbor – Detroit: 2030 79-mph Link Loading (Millions of Riders)



6.3.4 Previous Studies

The TEMS forecasts are for three different corridors, from Toledo to Detroit via DTW, Toledo to Ann Arbor via DTW, and for travel in the corridor between Detroit and Ann Arbor. Previously, studies have been made by SEMCOG for sections of these routes including; Detroit to DTW, and Detroit to Ann Arbor. Exhibits 6-14 and 6-15 show the comparison of the TEMS and SEMCOG forecasts on an "Apples to Apples" basis of the two segments.

Exhibit 6-14 shows that the TEMS 2019 79 mph forecast (back cast). It can be seen that the TEMS forecast is comparable, but slightly lower than the SEMCOG 2001 Regional Rail forecast to the Airport, with 2,652 versus 3,600 daily riders.

Exhibit 6-14: DTW-Dearborn-Detroit Rail Ridership Benchmarking

	SEMCOG 2001 Regional Rail Study	TEMS 79 MPH	TEMS 110 MPH	TEMS 79 MPH	TEMS 110 MPH
Forecast Year	2010	2010	2010	2030	2030
Daily Ridership	3,600	2,652	3,800	3,236	4,637
Annual Ridership	1,123,200	829,049	1,187,971	1,009,596	1,446,683

Exhibit 6-15 shows the "Apples to Apples" comparison with the SEMCOG 2007 Detroit to Ann Arbor commuter rail study. It can be seen that the TEMS 79 mph 2018 forecast back dated to 2010 for 12 round trips, is comparable to the SEMCOG option, i.e., 2,241 daily trips for TEMS versus 2,131 daily trips for SEMCOG. The TEMS forecast is slightly higher but is well within the plus or minus 25% error range of the forecast.

Exhibit 6-15: TEMS Ann Arbor-Dearborn-Detroit Rail Ridership Benchmarking with SEMCOG Based Actual Economic Growth 2007 ~ 2010

	SEMCOG 2007 Regional Rail Study	TEMS 79 MPH	TEMS 110 MPH
Forecast Year and Scenario	2010 Option CRT1 A	2010 12 DRTs	2010 12 DRTs
Daily Ridership	2,131	2,241	3,215
Annual Ridership	664,872	699,340	1,003,021

In the Ann Arbor-Detroit corridor, the SEMCOG forecasts may be lower for the following reasons:

- Changes in gas price assumptions
- Changes in highway congestion assumptions
- Reduction in traffic due to the 2008 recession
- Calibration of forecasting model using 2007 base year data versus 2018 base year data.

Overall, the results of the "Apples to Apples" comparisons between SEMCOG and TEMS forecasts shows that both sets of forecasts are very similar, and that TEMS forecast results for the three segments Detroit to Detroit Metro Airport, Toledo to Detroit Metro Airport, and Ann Arbor to Detroit Metro Airport are very reasonable when compared to SEMCOG forecasts.

Chapter 7
Operating Costs

SUMMARY

Operating costs were calculated for each year the system is planned to be operational using operating cost drivers such as passenger volumes, train miles, and operating hours. As in the case of the Midwest Regional Rail Initiative (MWRRI) and Ohio Hub studies, the aim is to develop an affordable set of options that provide good service at a reasonable cost.

7.1 Operating Cost Methodology

This section describes the build-up of the unit operating costs that have been used in conjunction with the operating plans, to project the total operating cost of each corridor option. A costing framework originally developed for the Midwest Regional Rail System (MWRRS) was adapted for use in this study. However, it has also been validated against current Amtrak Passenger Rail Investment and Improvement Act of 2008 Costs (PRIIA) costs as part of the Coast-to-Coast study. PRIIA costs differ from standard MWRRS costs since PRIIA costs tend to include a larger share of allocated fixed (or overhead) costs than what the MWRRS methodology called for. However, in all other respects the PRIIA and MWRRS costing framework have been demonstrated to produce comparable results. Detail on this comparison can be found in the Coast-to-Coast study.

Following the MWRRS methodology[11], nine specific cost areas have been identified. As shown in Exhibit 7-1, variable train-mile driven costs include equipment maintenance, energy and fuel, and train and onboard service (OBS) crews. Passenger miles drive insurance liability, while ridership influences marketing, and sales. Fixed costs include administrative costs, station costs, and track and right-of-way maintenance costs. Signals, communications and power supply are included in track and right-of-way costs.

This framework enables the direct development of costs based on directly-controllable and route-specific factors, and allows sensitivity analyses to be performed on the impact of specific cost drivers. It also enables direct and explicit treatment of overhead cost allocations, to ensure that costs which do not belong to a corridor are not inappropriately allocated to the corridor, as would be inherent in a simple average cost-per-train mile approach. It also allows benchmarking and direct comparability of Michigan A2TC corridor costs with those developed by other high-speed rail studies across the nation, including those with which the proposed corridor route would connect.

[11] Follow the links under "Midwest Regional Rail Initiative (MWRRI)" at http://www.dot.state.mn.us/planning/railplan/studies.html

Exhibit 7-1: Operating Cost Categories and Primary Cost Drivers

Drivers	Cost Categories
Train Miles →	Equipment Maintenance Energy and Fuel Train and Engine Crews Onboard Service Crews
Passenger Miles →	Insurance Liability
Ridership and Revenue →	Sales and Marketing
Fixed Cost →	Service Administration Track and ROW Maintenance Station Costs

Operating costs can be categorized as variable or fixed. As described below, fixed costs include both Route and System overhead costs. Route costs can be clearly identified to specific train services but do not change much if fewer or additional trains were operated.

- Variable costs change with the volume of activity and are directly dependent on ridership, passenger miles or train miles. For each variable cost, a principal cost driver is identified and used to determine the total cost of that operating variable. An increase or decrease in any of these will directly drive operating costs higher or lower.
- Fixed costs are generally predetermined, but may be influenced by external factors, such as the volume of freight tonnage, or may include a relatively small component of activity-driven costs. As a rule, costs identified as fixed should remain stable across a broad range of service intensities. Within fixed costs are two sub-categories:
  - Route costs such as track maintenance, train control and station expense that, although fixed, can still be clearly identified at the route level.
  - Overhead or System costs such as headquarters management, call center, accounting, legal, and other corporate fixed costs that are shared across routes or even nationally. A portion of overhead cost (such as direct line supervision) may be directly identifiable but most of the cost is fixed. Accordingly, assignment of such costs becomes an allocation issue that raises equity concerns. These kinds of fixed costs are handled separately.

Operating costs have been developed based on the following premises:

- Based on results of recent studies, a variety of sources including suppliers, current operators' histories, testing programs and prior internal analysis from other passenger corridors were used to develop the cost data. However, as the rail service is implemented, actual costs will be subject to negotiation between the passenger rail authority and the contract rail operator(s).
- Freight railroads will maintain track and right-of-way that they own, but ultimately, the actual cost of track maintenance will be resolved through negotiations with the railroads. For this study, a track maintenance cost model will be used that reflects actual freight and passenger railroad cost data.
- Maintenance of train equipment will be contracted out to the equipment supplier.
- Train operating practices follow existing work rules for crew staffing and hours of service. Average operating expenses per train-mile for train operations, crews, management and supervision were estimated through a bottoms-up staffing approach based on typical passenger rail organizational needs.

The MWRRS costing framework was originally developed in conjunction with nine states that comprised the MWRRS steering committee and with Amtrak. In addition, freight railroads, equipment manufacturers and others provided input to the development of the costs. However, the costing framework has been validated with recent operating experience based on publicly available data from other sources, particularly the Midwest 403B Service trains, Northern New England Passenger Rail Authority's (NNEPRA) Downeaster costs, and data on Illinois operations that was provided by Amtrak. It has been updated and brought to a 2019 costing basis.

The original concept for the MWRRS was for development of a new service based on operating methods directly modeled after state-of-the-art European rail operating practice. Along with anticipated economies of scale, modern train technology could reduce operating costs when compared to existing Amtrak practice. In the original 2000 MWRRS Plan, European equipment costs were measured at 40 percent of Amtrak's costs. However, in the final MWRRS plan that was released in 2004, train-operating costs were significantly increased to a level that is more consistent with Amtrak's current cost structure. However, adopting an Amtrak cost structure for financial planning does not suggest that Amtrak would actually be selected for the corridor operation. Rather, this selection increases the flexibility for choosing an operator without excluding Amtrak, because multiple operators and vendors will be able to meet the broader performance parameters provided by this conservative approach.

7.1.1 Variable Costs

Variable costs include those that directly depend on the number of train-miles operated or passenger-miles carried. They include train equipment maintenance, train crew cost, fuel and energy, onboard service, and insurance costs.

7.1.1.1 Train Equipment Maintenance

Equipment maintenance costs include all costs for spare parts, labor and materials needed to keep equipment safe and reliable. The costs include periodical overhauls in addition to running maintenance. It also assumes that facilities for servicing and maintaining equipment are designed specifically to accommodate the selected train technology. This arrangement supports more efficient and cost-effective maintenance practices. Acquiring a large fleet of trains with identical features and components, allows for substantial savings in parts inventory and other economies of scale. In particular, commonality of rolling stock and other equipment will standardize maintenance training, enhance efficiencies and foster broad expertise in train and system repair.

The MWRRS study developed a cost of $9.87 per train mile for a 300-seat train in 2002. This cost was increased to $13.75 per train mile in 2019. The 79-mph conventional Amtrak train benchmarked at a higher cost of $16.70 due primarily to a lack of economies of scale associated with typical lighter density Amtrak corridors.

7.1.1.2 Train and Engine Crew Costs

The train operating crew incurs crew costs. Following Amtrak staffing policies, the operating crew would consist of an engineer, a conductor and an assistant conductor and is subject to federal hours of service regulations. Costs for the crew include salary, fringe benefits, training, overtime and additional pay for split shifts and high mileage runs. An overtime allowance is included as well as scheduled time-off, unscheduled absences and time required for operating, safety and passenger handling training. Fringe benefits include health and welfare, Federal Insurance Contributions Act (FICA) and pensions. The cost of employee injury claims under Federal Employers Liability Act (FELA) is also treated as a fringe benefit for this analysis. The overall fringe benefit rate was calculated as 55 percent. In addition, an allowance was built in for spare/reserve crews on the extra board. Costing of train crews was based on Amtrak's 1999 labor agreement, adjusted for inflation to 2017.

Crew costs depend upon the level of train crew utilization, which is largely influenced by the structure of crew bases and any prior agreements on staffing locations. Train frequency strongly influences the amount of held-away-from-home-terminal time, which occurs if train crews have to stay overnight in a hotel away from their home base. Since a broad range of service frequencies and speeds have been evaluated here, a parametric approach was needed to develop a system average per train mile rate for crew costs. Such an average rate necessarily involves some approximation, but to avoid having to reconfigure a detailed crew-staffing plan whenever the train schedules change, an average rate is appropriate for a Feasibility study. A more specific and detailed level of assessment would be appropriate for a Tier 2 EIS. For this study, a value of $5.33 per train mile was assumed for both the 79-mph and 110-mph options. This is a moderate level of crew cost that still includes the need for some away from home layover.

7.1.1.3 Fuel and Energy

An average consumption rate of 2.42 gallons/mile was estimated for a 110-mph 300-seat train, based upon nominal usage rates of all three technologies considered in Phase 3 of the MWRRS Study. While fuel prices were $3.60 a gallon in late 2012 for diesel fuel according to Energy Information Administration (EIA)[12], by 2014 they had fallen to approximately $3/gallon, and the EIA price forecast has been lowered. Subsequently they have started to rise again. For the 110-mph trains, a fuel cost of $8.96 per train mile is being assumed rising to $10.53 per mile by 2040, consistent with the latest EIA forecasts that were used for preparation of the ridership forecasts. The slower 79-mph train will burn less fuel, so a cost of $7.17 per train mile is being assumed rising to $8.42 per mile for an equivalent-sized 300-seat train. Obviously these rising fuel costs will have a corresponding favorable impact on the ridership forecast as well. Energy costs are adjusted each year in line with the relevant Energy Information Administration forecasts.

7.1.1.4 Onboard Services (OBS)

Onboard service (OBS) costs are those expenses for providing food service onboard the trains. OBS adds costs in three different areas: equipment, labor and cost of goods sold. Equipment capital and operating cost is built into the cost of the trains and is not attributed to food catering specifically. Small 200-seat trains cannot afford a dedicated dining or bistro car. Instead, if food service were to be offered, an OBS employee or food service vendor would move through the train with a trolley cart, offering food and beverages for sale to the passengers.

The goal of OBS franchising should be to ensure a reasonable profit for the provider of on-board services, while maintaining a reasonable and affordable price structure for passengers. In previous studies, it has been found that the key to attaining OBS profitability is selling enough products to recover the train mile related labor costs. For example, if small 200-seat trains were used, given the assumed OBS cost structure, even with a trolley cart service the OBS operator will be challenged to attain profitability. However, the expanded customer base on larger 300-seat trains can provide a slight positive operating margin for OBS service.

[12] EIA diesel retail price in 2012 excluding the taxes http://www.eia.gov/petroleum/gasdiesel/

Because the trolley cart has been shown to double OBS revenues, it can result in profitable OBS operations in situations where a bistro-only service would be hard-pressed to sell enough food to recover its costs. While only a limited menu can be offered from a cart, the ready availability of food and beverages at the customer's seat is a proven strategy for increasing sales. Many customers appreciate the convenience of a trolley cart service and are willing to purchase food items that are brought directly to them. While some customers prefer stretching their legs and walking to a bistro car, other customers will not bother to make the trip.

The cost of goods sold is estimated as 50 percent of OBS revenue, based on Amtrak's route profitability reports. For labor costs, including costs for commissary support and OBS supervision, an intermediate value of $2.77 per train mile has been estimated for both the 79-mph and 110-mph diesel options. This is a moderate level of crew cost that includes the need for some away from home layover.

These costs are generally consistent with Amtrak's level of wages and staffing approach for conventional bistro car services. However, this study recommends that an experienced food service vendor provide food services and use a trolley cart approach. A key technical requirement for providing trolley service is to ensure the doors and vestibules between cars are designed to allow a cart to easily pass through. Since trolley service is a standard feature on most European railways, most European rolling stock is designed to accommodate the carts. Although convenient passageways often have not been provided on U.S. equipment, the ability to support trolley carts is an important equipment design requirement for the planned service.

7.1.1.5 Insurance Costs

Liability costs were estimated 1.516¢ per passenger-mile, the same rate that was assumed in the earlier MWRRS study brought to 2019. Federal Employees Liability Act (FELA) costs are not included in this category but are applied as an overhead to labor costs.

The Amtrak Reform and Accountability Act of 1997 (§161) originally provided for a limit of $200 Million on passenger liability claims. In 2015, that limit was raised to $295 Million[13]. Amtrak carries that level of excess liability insurance, which allows Amtrak to fully indemnify the freight railroads in the event of a rail accident. However, a General Accounting Office (GAO) review[14] concluded that this liability cap applies to commuter railroads as well as to Amtrak. If the GAO's interpretation is correct, the liability cap may also apply to other passenger rail operators as well. It is recommended that qualified legal advice be sought on this matter to determine whether an operator of the Toledo-Detroit service would be similarly protected under this law.

7.1.2 Fixed Route Costs

This cost category includes those costs that, while largely independent of the number of train-miles operated, can still be directly associated to the operation of specific routes. It includes such costs as track maintenance, which varies by train technology, and station operations.

7.1.2.1 Track and Right-of-Way Costs

Currently, it is industry practice for passenger train operators providing service on freight-owned rights-of-way to pay for track access, dispatching and track maintenance. Rates for all these activities are ultimately

[13] See: https://www.nbcnews.com/news/us-news/amtrak-derailment-liabilities-capped-200-million-due-1997-law-n831071
[14] See: http://www.gao.gov/highlights/d04240high.pdf

based upon a determination of the appropriate costs that result from negotiations between the parties. The purpose here is to provide estimates based on the best available information; however, as the project moves forward, additional study and discussions with the railroads will be needed to further refine these costs.

The costing basis assumed in this report is that of incremental or avoidable costs[15] for shared tracks. The passenger operator, however, must take full cost responsibility for maintaining any tracks that it must add to the corridor either for its own use, or for mitigating delays to freight trains. The following cost components are included within the Track and Right-of-Way category:

- **Track Maintenance Costs.** Costs for track maintenance were estimated based on Zeta-Tech's January 2004 draft technical monograph Estimating Maintenance Costs for Mixed High-Speed Passenger and Freight Rail Corridors[16]. Zeta-Tech costs have been adjusted for inflation to 2019. However, Zeta-Tech's costs are conceptual and subject to negotiation with the freight railroads.
- **Dispatching Costs and Out-of-Pocket Reimbursement.** Passenger service must also reimburse a freight railroad's added costs for dispatching its line, providing employee efficiency tests and for performing other services on behalf of the passenger operator. If the passenger operator does not contract a freight railroad to provide these services, it must provide them itself. As a result, costs for train dispatching and control are incurred on dedicated as well as shared tracks and are now shown under a separate "Operations and Dispatch" cost category.
- **Costs for Access to Track and Right-of-Way.** Access fees, particularly train mile fees incurred as an operating expense, are specifically excluded from this calculation. Any such payments would have to be calculated and negotiated on a route-specific and railroad-specific basis. Such a calculation would have to consider the value of the infrastructure improvements made to the corridor for balancing up-front capital with ongoing operating payments.[17]

Exhibit 72 shows the conceptual relationship between track maintenance cost and total tonnage that was calibrated from the 2004 Zeta-Tech study. It shows a strong relationship between tonnage, FRA track class (4 through 6, corresponding to a 79-mph to 110-mph track speed) and maintenance cost.

At low tonnage, the cost differential for maintaining a higher track class is not very large, but as tonnage grows, so too does the added cost. For shared track, if freight needs only Class 4 track, the passenger service would have to pay the difference, called the “maintenance increment”, which for a 25 MGT line as shown in Exhibit 7-2, would come to about $22,000 per mile per year, including capital costs, in 2002 dollars[18] . The required payment to reimburse a freight railroad for its added cost would be less for lower freight tonnage, more for higher freight tonnage.

Exhibit 7-2 also shows the total track maintenance cost per mile as a function of traffic density, it also breaks out the operating versus total cost, showing that capital (the difference between total and operating cost) is a significant share of the total cost. For track maintenance:

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[15] Avoidable costs are those that are eliminated or saved if an activity is discontinued. The term incremental is used to reference the change in costs that results from a management action that increases volume, whereas avoidable defines the change in costs that results from a management action that reduces volume.

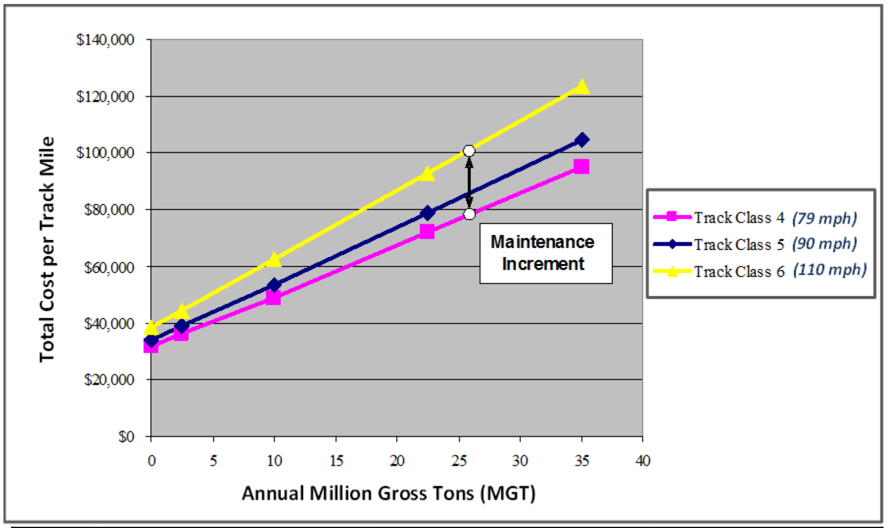
[16] Zeta-Tech, a subsidiary of Harsco (a supplier of track maintenance machinery) is a rail consulting firm who specializes in development of track maintenance strategies, costs and related engineering economics. See a summary of this report athttp://onlinepubs.trb.org/onlinepubs/trnews/trnews255rpo.pdf. The full report is available upon request from the FRA.

[17] For 110-mph service, the level of infrastructure improvements to the corridor called for in this study should provide enough capacity to allow superior on-time performance for both freight and passenger operations

[18] Calculated as $38,446 - $31,887 + ($2.440 – $1.810) * 25 = $22,309 per year. Note that the yellow highlighted cells in the table correspond to the three lines shown on the graph.

- **Operating Costs** cover expenses needed to keep existing assets in service and include both surfacing and a regimen of facility inspections.
- **Capital Costs** are those related to the physical replacement of the assets that wear out. They include expenditures such as for replacement of rail and ties, but these costs are not incurred until many years after construction. In addition, the regular maintenance of a smooth surface by reducing dynamic loads actually helps extend the life of the underlying rail and tie assets.

Exhibit 7-2: Zeta-Tech 2004 Calibrated Track Class vs. Tonnage Total Cost Function "Middle Line" Case, in 2002



TOTAL COST	LOW		MIDDLE		HIGH	
	Intercept	Slope	Intercept	Slope	Intercept	Slope
Class 3	$17,880	$0.917	$21,683	$1.231	$25,487	$1.548
Class 4	$26,294	$1.348	$31,887	$1.810	$37,481	$2.277
Class 5	$28,072	$1.509	$33,937	$2.020	$39,801	$2.530
Class 6	$31,714	$1.837	$38,446	$2.440	$45,178	$3.035

** Intercept is where the line meets the Y axis at the 0 ton level. The slope represents the added cost per MGT.*

OPER COST	LOW		MIDDLE		HIGH	
	Intercept	Slope	Intercept	Slope	Intercept	Slope
Class 3	$6,558	$0.579	$8,216	$0.726	$9,873	$0.872
Class 4	$9,644	$0.852	$12,082	$1.067	$14,519	$1.283
Class 5	$11,283	$0.997	$14,135	$1.249	$16,987	$1.501
Class 6	$14,640	$1.293	$18,371	$1.623	$22,101	$1.953

Exhibit 7-2 shows that the cost of shared track depends strongly on the level of freight tonnage, since passenger trains are relatively lightweight and do not contribute much to the total tonnage. In fact, following the Zeta-Tech methodology, the "maintenance increment" is calculated based on freight tonnage only, since a flat rate of $1.56 per train mile as used in the Zeta-Tech report (in 2002) was already added to reflect the direct cost of added passenger tonnage regardless of track class. This cost, which was developed by Zeta-Tech's TrackShare® model, includes not only directly variable costs, but also an allocation of a freight railroad's fixed cost. Accordingly, it complies with the Surface Transportation Board's definition of "avoidable cost." Inflated to 2019 (an approximate 60 percent increase, a higher rate of inflation than CPI, reflecting the energy-intensity of construction materials) this avoidable cost allocation would come to $2.57 per train mile.

On top of this, an allowance of 39.5¢ per train-mile (in 2002) was added by Zeta-Tech for freight railroad dispatching and out-of-pocket costs. Inflated to 2017 based on the Consumer Price Index (approx. 29 percent increase) this dispatching and out-of-pocket cost now comes to 55.0¢ per train mile, which is applied both to dedicated and shared tracks. This cost is now separated from track maintenance under the "Operations and Dispatch" category.

The same cost function shown in Exhibit 74-2 can also be used for costing dedicated passenger track. With dedicated track, the passenger system is assumed to cover the entire operating cost for maintaining its own track. (Freight may then have to reimburse the passenger operator on a car-mile basis for any damage it causes to the passenger track.) Because passenger train tonnage is very low however, it can be seen that the cost differential between Class 4, 5 and 6 track is very small. Adjusting Zeta-Tech's 2002 costs shown in Exhibit 4-2 up to 2017:

The Total Cost per track-mile for maintaining dedicated Class 3 track is about $35,671; Class 4 track is about $52,458; for Class 6 track, the cost rises to $63,249. The shared-use scenario assumes that the owning freight railroad will require this level of support each year for maintaining the additional tracks that it must add to its existing rail corridor, for supporting the needs of passenger rail service.

- The Operating Cost per track-mile for maintaining dedicated Class 3 track is about $13,516; Class 4 track is about $19,876; for Class 6 track, the cost rises to $30,223. This figure is used for Amtrak or State owned tracks since these entities will bear the maintenance cost directly. In this case a Cyclic Maintenance additive is included in the Cost Benefit ratio calculation to account for the timing of needed capital maintenance expenditures that will not need to be incurred until much later in the project life. For upgrading track from Class 3 to Class 6 the passenger service pays the operating cost difference of $16,706 per mile per year.

- The Capital Cost per track-mile for maintaining dedicated Class 3 track reflects the cost of about $22,155; for Class 4 track $32,582; similarly for Class 6 track is $33,026. The capital cost for maintaining Class 4 versus Class 6 track under light tonnage density is not much different; most of cost differential is in operating cost needed to maintain the more precise alignment of the higher class track. For upgrading track from Class 3 to Class 6 the passenger service pays the capital cost difference of $10,871 per mile per year.

While operating costs are needed every year, capital maintenance costs for dedicated tracks are gradually introduced using a table of ramp-up factors provided by Zeta-Tech, see Exhibit 7-3.

Exhibit 7-3: Capital Cost Ramp-Up Following Upgrade of a Rail Line

Year	% of Capital Maintenance	Year	% of Capital Maintenance
1	0%	11	50%
2	0%	12	50%
3	0%	13	50%
4	20%	14	50%
5	20%	15	75%
6	20%	16	75%
7	35%	17	75%
8	35%	18	75%
9	35%	19	75%
10	50%	20	100%

A fully normalized capital maintenance level is not reached until 20 years after completion of the rail construction program. This is used for calculating "Cyclic Maintenance" in the Benefit Cost Analysis. But because Cyclic Maintenance is not an Operating Cost under generally accepted accounting principles (GAAP) accounting methodology, it is not normally included in the Operating Ratio calculation.

7.1.2.2 Station Operations

A simplified fare structure, heavy reliance upon electronic ticketing and avoidance of a reservation system will minimize station personnel requirements. Station costs include personnel, ticket machines and station operating expenses.

The cost for unstaffed stations covers the cost of utilities, ticket machines, cleaning and basic facility maintenance, costing $87,313 per year Volunteer personnel such as Traveler's Aid, if desired could staff these stations. Since four stations already exist, it is assumed that the system would add 4 unstaffed stations at a cost of $349,252 per year. Consistent with modern approaches it is assumed that the local communities would staff the station using Traveler's Aid or local tourism volunteers. Any additional station services would be provided by the local communities.

7.1.2.3 System Overhead Costs

The category of System Overhead largely consists of Service Administration or management overheads, covering such needs as the corporate procurement, human resources, accounting, finance and information technology functions as well as call center administration. A stand-alone administrative organization appropriate for the operation of a corridor system was developed for the MWRRS and later refined for the Ohio Hub studies. This organizational structure, which was developed with Amtrak's input and had a fixed cost of $8.9 Million plus $1.43 per train-mile (in 2002) for added staff requirements as the system grew. Inflated to 2019, this became $12.5 Million plus $1.99 per train mile. However, the Sales and Marketing category also has a substantial fixed cost component for advertising and call center expense, adding another $3.2 Million per year fixed cost, plus variable call center expenses of 76.8¢ per rider, all in 2019 dollars[19]. Finally, credit card (1.8 percent of revenue) and travel agency commissions (1 percent) are all variable. In addition, the system operator was allowed a 10 percent markup on certain direct costs as an allowance for operator profit.

Therefore, the overall financial model for a stand-alone organization therefore has $15.6 Million ($12.5 + $3.2 Million) annually in fixed cost for administrative, sales and marketing expenses. Since this service is costed on an incremental basis the $15.6 Million in fixed administrative, sales and marketing expenses can be ignored since the rail operator would incur these costs regardless of whether the new service is added or not. The $1.99 per train mile cost for incremental management staff is still included however, along with the variable call center (76.8¢ per rider), credit card and travel agency commissions (combined, 2.8 percent of revenue) and 10 percent markup on selected items that was agreed by the MWRRS committee as a reasonable allocation to operator profit.

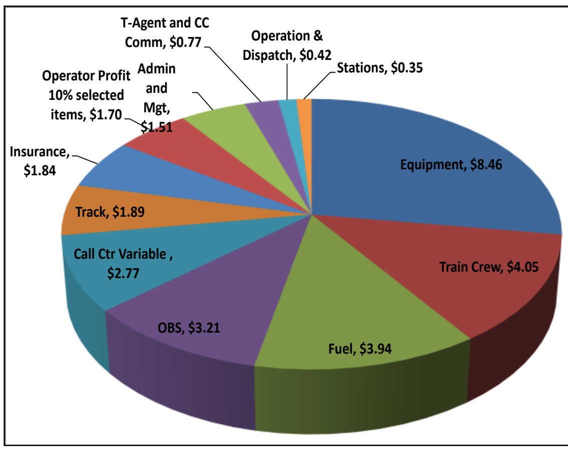
[19] In the MWRRS cost model, call center costs were built up directly from ridership, assuming 40 percent of all riders call for information, and that the average information call will take 5 minutes for each round trip. Call center costs, therefore, are variable by rider and not by train-mile. Assuming some flexibility for assigning personnel to accommodate peaks in volume and a 20 percent staffing contingency, variable costs came to 57¢ per rider. These were inflated to 66¢ per rider in $2008 and now 74.5¢ per rider in 2017.

7.1.3 Operating Cost Breakdown

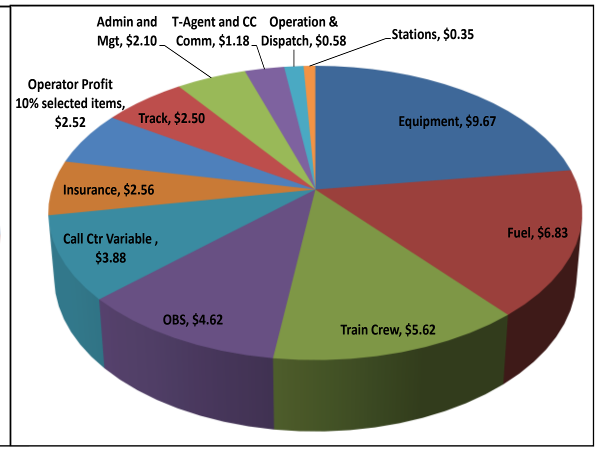
Exhibit 7-4 gives a breakdown of projected 2030 operating costs for options that run 10 daily round trips at 79-mph vs. 110-mph. Including the built-in 10 percent operator profit margin, these costs fall in the range of $31-$43 million per year. For the 79-mph option this comes to $55.04 per Train-Mile for a 300-seat train. For the 110-mph option because of higher demand, a larger 375-seat train is needed to satisfy demand if only 10 daily round trips were operated. This has been costed at a higher average rate of $75.50 per Train-Mile, or else the same operating cost could support a proportional increase (up to 33%) in train frequency to 13-14 daily round trips using the smaller 300-seat trains.

Exhibit 7-4: 2030 Operating Cost Breakdown for 10 Round Trips

$30.9 million at 79-mph



$42.4 million at 110-mph



Chapter 8
Financial and Economic Analysis

SUMMARY

This chapter presents a detailed financial and economic analysis for the Toledo–Detroit–Ann Arbor corridor, including key financial measures such as Operating Surplus and Operating Ratio. A detailed Economic Analysis was carried out using criteria set out by the 1997 FRA Commercial Feasibility Study including key economic measures such as NPV Surplus and Benefit/Cost Ratio at a 3 percent discount rate which are also presented in this chapter.

8.1 Introduction

Two measures, Operating Ratio and Benefit Cost ratio will be assessed here to evaluate the economic returns of the Toledo–Detroit–Ann Arbor rail system. The financial performance of the system, reflected by the Operating Ratio, is a key driver of the economic evaluation since it strongly influences the ability to franchise the operation of the system to the private sector. ***System Revenues*** include the fare box revenues and revenues from onboard sales. ***Operating Costs*** are the operating and maintenance costs associated with running the train. The Operating Ratio is defined as Revenues/Costs.

- Operating Ratios as calculated here include direct operating costs only. Operating ratio calculations do not include capital costs, depreciation or interest.
- It should be noted that freight railroads and intercity bus companies typically define it as the reciprocal Costs/Revenues.

By this analysis, a positive operating ratio does not imply that a passenger service can fully cover its capital costs, but having a positive cash flow does at least allow the operation to be franchised and run by the private sector. This requirement of the FRA *Commercial Feasibility Study* puts passenger rail on the same basis as other modes of transportation, such as intercity bus and air, where the private sector operates the system but does not build or own the infrastructure it uses. Other modes do pay access fees for using the infrastructure, which supports some cost recovery which varies by mode. For a passenger rail system, track access costs would fall into this category. All calculations are performed using the standard financial formula, as follows:

Financial Measure:

$$\text{Operating Ratio} = \frac{\text{Financial Revenues (by year or PV)}}{\text{Operating Costs (by year or PV)}}$$

Economic Measures:

$$\text{Net Present Value} = \text{Present Value of Benefit} - \text{Present Values of Costs}$$

$$\text{Benefit Cost Ratio} = \frac{\text{Present Value of Benefits}}{\text{Present Value of Costs}}$$

Present Value is defined as:

$$PV = \sum_t \frac{C_t}{(1+r)^t}$$

Where:

PV = Present value of all future cash flows

C_t = Cash flow for period t

r = Discount rate reflecting the opportunity cost of money

t = Time

Benefit Cost ratio requires development of a project's year-by-year financial and economic returns, which are then discounted to the base year to estimate present values (PV) over the lifetime of the project[20]. In terms of Economic Benefits, a positive NPV and Benefit Cost Ratio imply that the project makes a positive contribution to the economy. Consistent with standard practice, Benefit Cost ratios are calculated from the perspective of the overall society without regard to who owns particular assets receives specific benefits or incurs particular costs.

By comparison, the Operating Ratio can be presented either on a specific year-to-year basis, or it can be summarized based on the discounted values of operating revenue and operating cost, and presented as a single number for the entire life of the project.

- **If the operating surplus is positive**, the system will not require any operating subsidy, and it will even be able to make a contribution towards its own Capital cost. Because the system is generating a positive cash flow, a Private-Public Partnership or other innovative financing methods can be used to construct and operate the system. This absolves the local governmental entity of any need for providing an operating subsidy but more than this, it is not uncommon for the operating cash flow to be sufficient to cover the local capital match requirement as well.

- **If the operating surplus is negative**, the system will not only require a grant of capital to build the system, but in addition it will also require an ongoing operating subsidy. An operating subsidy not only prevents the project from being a Public Private Partnership, but casts doubt on the efficiency of the system and the reason for the project. In addition, a subsidy will reduce the economic performance of the system as it will actually offset part of the economic benefits of the system (e.g. Consumer Surplus, Environmental Benefits). This will depress the Benefit Cost ratio as well. If the subsidy is not too great and the capital cost is not too high, in some cases it may still be possible to maintain a positive Benefit Cost ratio. But the larger the subsidy and the higher the capital cost, the harder it is to show a positive Benefit Cost ratio. It is not uncommon for slow passenger rail systems to fail both FRA's Operating Ratio and Benefit Cost criteria.

[20] For this analysis, a 25-year project life from 2025 to 2050 was assumed, with a six year implementation period from 2019-2024. Revenues and cost cash flows were discounted to the 2017 base year using 3 and 7 percent discount rates. The 3 percent discount rate reflects the real cost of money in the market as reflected by the long term bond markets (5 percent).

8.2 Financial and Economic Results

A demandside economic evaluation has been completed for the 110-mph full build option. This followed typical financial/economic cash flow analysis, and USDOT-Tiger Grant guidelines, as well as OMB discount procedures for the economic analysis. The analysis was completed using data derived from the Ridership and Revenue Analysis, the Infrastructure Analysis, and the Operating Analysis. This provided:

- System Revenues: Fare box, onboard and freight railroad revenue
- Operating Costs: Operating and maintenance costs
- Capital costs: Infrastructure costs

In addition, the Economic Analysis calculated other factors that are required for the analysis.

- Consumer Surplus - benefit to system users
- Highway Congestion Savings - benefits to road users of less congestion
- Airport Delay Savings - benefits to air travelers
- Safety Benefits - benefit of less accidents
- Reduced Emissions - benefit of lower emissions levels

8.2.1 Key Assumptions

The analysis projects travel demand, operating revenues and operating and maintenance costs for all years from 2025 through 2050. The financial analysis has been conducted in real terms using constant 2017 dollars. Accordingly, no inflation factor has been included, and real discounting rate of 3 and 7 percent have been used. Revenues and operating costs have also been projected in constant dollars over the time frame of the financial analysis. A summary of the key efficiency measure inputs are presented below.

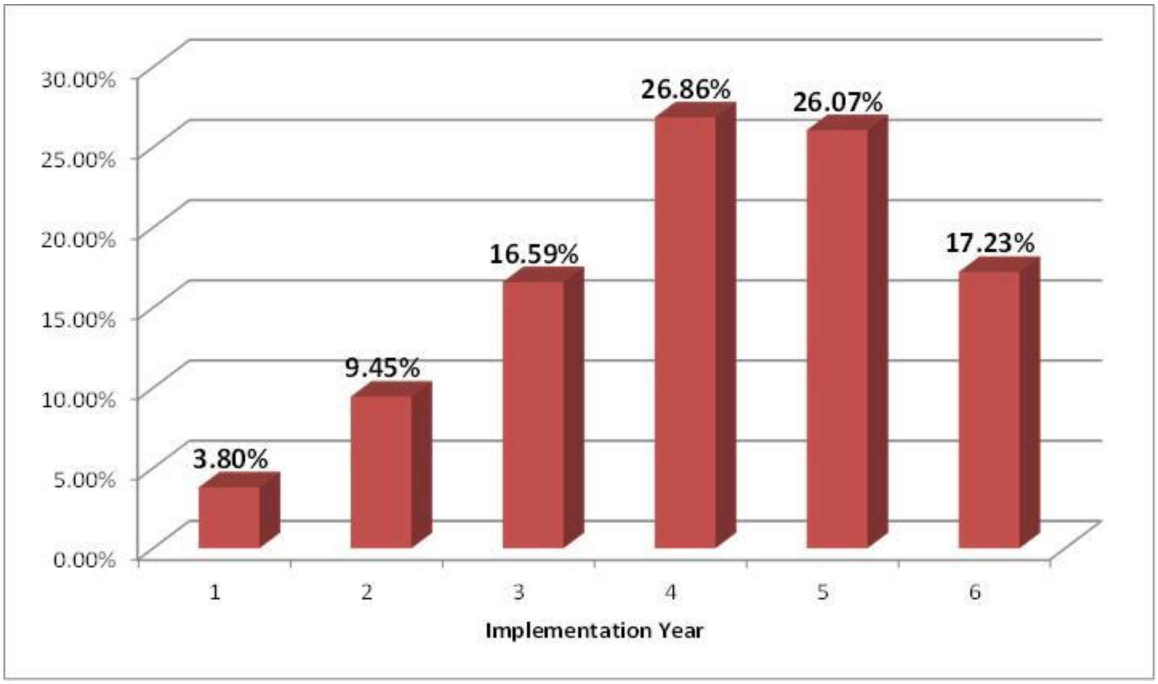
8.2.1.1 Ridership and Revenue Forecasts

Ridership and revenue forecasts were originally prepared for 2020, 2030, 2040 and 2050. Revenues in intervening years were projected based on interpolations, reflecting projected annual growth in ridership. Revenues included not only passenger fares, but also onboard service revenues.

8.2.1.2 Capital Costs

Capital costs of in the $400-500 million range include rolling stock, track, freight railroad right-of-way purchase or easement fees, bridges, fencing, signaling, grade crossings, maintenance facilities and station improvements. The capital cost projections are based on year-by-year projections of each cost element and include all of the capital costs, plus some selected elements of additional costs as needed to support year-by-year capacity expansion of the system. A year-by-year implementation plan was developed which detailed the Capital cash flows and funding requirements. Using this information, the Benefit Cost calculations were able to be assessed. For the purpose of this study it is assumed that the Capital Costs will be spent over a nine year period with the distribution shown in Exhibit 8-1. Over 80 percent of funds are spent in the last four years of the implementation period as construction occurs.

Exhibit 8-1: Assumed Capital Spend Distribution



8.2.1.3 Operating Expenses

Major operating and maintenance expenses include equipment maintenance, track and right-of-way maintenance, administration, fuel and energy, train crew and other relevant expenses. Operating expenses were estimated in 2019 constant dollars so that they would remain comparable to revenues. However, these costs do reflect the year-by-year increase in expense that is needed to handle the forecasted ridership growth, in terms of not only directly variable expenses such as credit card commissions, but also the need to add train capacity and operate either larger trains, or more train-miles every year in order to accommodate anticipated ridership growth.

Operating costs are included as a cost, whereas system revenues are included as a benefit in the discounting calculation over the life of the system. In this way they directly offset one another in the Net Present Value calculation and are also reflected in the Benefit Cost calculation. It can be seen that a system that requires an operating subsidy, e.g., where costs exceed revenues, will tend also to reflect this in the Benefit Cost ratio. This is why slow speed options such as conventional Amtrak services often fail on both the Operating Ratio and Benefit Cost ratio criteria.

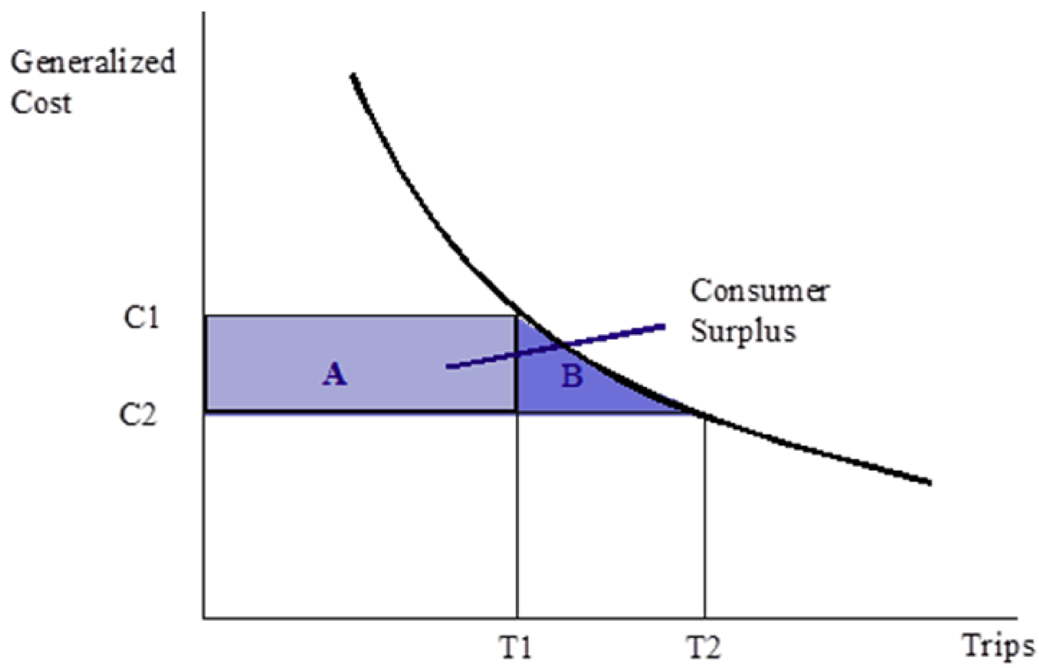
8.2.1.4 User Benefits

The analysis of user benefits for this study is based on the measurement of Generalized Cost of Travel, which includes both time and money. Time is converted into money by the use of Values of Time. The Values of Time (VOT) used in this study were derived from stated preference surveys conducted in the Chicago-Detroit/Pontiac EIS and used in the COMPASS™ Multimodal Demand Model for the ridership and revenue forecasts. These VOTs are consistent with previous academic and empirical research and other transportation studies conducted by TEMS.

Consumer Surplus and Revenues: Benefits to users of the rail system are measured by the sum of system revenues and consumer surplus. Consumer surplus is used to measure the demand side impact of a transportation improvement on users of the service. It is defined as the additional benefit consumers (users of the service) receive from the purchase of a commodity or service (travel), above the price actually paid for that commodity or service. Consumer surpluses exist because there are always consumers who are willing to pay a higher price than that actually charged for the commodity or service, i.e., these consumers receive more benefit than is reflected by the system revenues alone. Revenues are included in the measure of consumer surplus as a proxy measure for the consumer surplus forgone because the price of rail service is not zero. This is an equity decision made by the USDOT to compensate for the fact that highway users pay zero for use of the road system (the only exception being the use of toll roads.) The benefits apply to existing rail travelers as well as new travelers who are induced (those who previously did not make a trip) or diverted (those who previously used a different mode) to the new passenger rail system.

The RENTS™ financial and economic analysis estimates passenger travel benefits (consumer surplus) by calculating the increase in regional mobility, traffic diverted to rail, and the reduction in travel cost measured in terms of generalized cost for existing rail users. The term generalized cost refers to the combination of time and fares paid by users to make a trip. A reduction in generalized cost generates an increase in the passenger rail user benefits. A transportation improvement that leads to improved mobility reduces the generalized cost of travel, which in turn leads to an increase in consumer surplus. Exhibit 8-2 presents a typical demand curve in which Area A represents the increase in consumer surplus resulting from cost savings for existing rail users and Area B represents the consumer surplus resulting from induced traffic and trips diverted to rail.

Exhibit 8-2: Consumer Surplus Concept



The formula for consumer surplus is as follows –

Consumer Surplus = $(C_1 – C_2)*T1 + ((C_1 – C_2)*(T_2 – T_1))/2$

Where:

C_1	=	Generalized Cost users incur before the implementation of the system
C_2	=	Generalized Cost users incur after the implementation of the system
T_1	=	Number of trips before operation of the system
T_2	=	Number of trips during operation of the system

The passenger rail fares used in this analysis are the average optimal fares derived from the revenue-maximization analysis that was performed for each alternative. User benefits incorporate the measured consumer surplus, as well as the system revenues, since these are benefits are merely transferred from the rail user to the rail operator.

8.2.1.5 Non-User Benefits

In addition to rail-user benefits, travelers using auto or air will also benefit from the rail investment, since the system will contribute to highway congestion relief and reduce travel times for users of these other modes. For purposes of this analysis, these benefits were measured by identifying the estimated number of auto passenger trips diverted to rail and multiplying each by the updated monetary values derived from previous stated preference studies updated to 2019.

Highway Congestion: The highway congestion delay savings is the time savings to the remaining highway users that results from diversion of auto users to the rail mode. To estimate travel time increase within the corridor, historical highway traffic volumes were obtained from the State DOTs and local planning agencies. The average annual travel time growth in the corridor was estimated with the historical highway traffic volume data and the BPR (Bureau of Public Roads) function that can be used to calculate travel time growth with increased traffic volumes.

Airport Congestion Delay Savings: Airport Congestion Delay Savings would include the airport operation delay saving and air passenger delay saving, but since the share of air travel diverted to rail is practically nonexistent in this corridor, this benefit was not assessed. Many travelers do come into Traverse City by air, but nearly all of them come from faraway locations that are well beyond the study area.

Auto Operating Cost (Non Business): Vehicle operating cost savings for non-business travelers have been included in the current analysis as an additional resource benefit. This reflects the fact that social/leisure travelers do not accurately value the full cost of driving when making trips. As a result, the consumer surplus calculation for commuters, social, leisure and tourist travelers has not fully reflected the real cost of operations of an automobile, but only the cost of gas. The difference between the cost of gas and the full cost of driving reflects a real savings that should be included in a Benefit Cost analysis.

Emissions: The diversion of travelers to rail from the auto mode generates emissions savings. The calculated emissions savings are based on changes in energy use with and without the proposed rail service. This methodology takes into account the region of the country, air quality regulation compliance of the counties served by the proposed rail service, the projection year, and the modes of travel used for access/egress as well as the line-haul portion of the trip. Highway Reduced Emissions were estimated from the vehicle miles traveled (VMT) and flight reductions derived from the ridership model, however there were no forecasted reductions in airline flights. The assumption is that a reduction in VMT or flights is directly proportional to the reduction in emissions. The pollutant values were taken from the latest TIGER III Grant Benefit-Cost Analysis (BCA) Resource Guide[21] .

Public Safety Benefits: Public Safety is calculated from the diverted Vehicle-Miles times the NHTSA[22] fatality and injury rate per Vehicle mile and then times the values of fatality and injury from the latest TIGER III Grant Benefit-Cost Analysis (BCA) Resource Guide.

8.3 Economic Results

The results of the Cost Benefit analysis show in Exhibits 8-3 and 8-4 show that both the 79-mph and 110-mph rail upgrade projects produces strong economic returns having Benefit Cost ratios greater than 1.0 at a rationing interest rate of 7%. This would meet the FRA's requirements that a project must be able to demonstrate a favorable Benefit Cost return.

- At a real interest rate of 3%, which approximates the government's cost for borrowing money; the 79-mph project generates a 1.34 Benefit Cost ratio which means that the project returns $1.34 in value for every dollar spent. The 110-mph project does even better returning a 1.44 Benefit Cost ratio.
- At the much higher 7.0 percent interest rate, which is really a capital rationing rate, the project still produces a healthy 1.05 Benefit Cost ratio at 79-mph, and 1.13 at 110-mph. This reflects a heavier weighting of the up-front capital in terms of the timing of expenditures, but the result is still producing a positive (>1.0) result which shows that the project is still justified even at the very high real interest rate of 7.0 percent.
- Over the life of the project the Operating Ratio for the 79-mph project is negative at 0.96, but for the 110-mph project it is positive at 1.07. This means that a 110-mph project would not need an operating subsidy since it could cover its operating cost out of its own fare box revenues.

[21] http://www.dot.gov/sites/dot.dev/files/docs/TIGER_BCA_RESOURCE_GUIDE.pdf
[22] http://www.nhtsa.gov/

Exhibit 8-3: Toledo-Detroit Financial and Cost Benefit Analysis Results at 79-mph

Discount Rate		3.0%	7.0%
Benefits to Users			
	System Passenger Revenues	$366.55	$150.66
	On Board Service Revenues	$29.32	$12.05
	Total Operating Revenues	**$395.87**	**$162.71**
	Users Consumer Surplus	$262.86	$108.19
	Total User Benefits	**$658.73**	**$270.90**
Benefits to Public at Large			
	Airport Passenger Delay Savings (million 2017$)	$0.00	$0.00
	Highway Congestion Delay Savings (million 2017$)	$173.88	$68.79
	Highway Reduced Emissions (million 2017$)	$21.11	$8.25
	Highway Safety Savings (million 2017$)	$100.11	$39.95
	Total Public at Large Benefits	**$295.10**	**$116.99**
Total Benefits		**$953.83**	**$387.90**
Costs			
	Capital Cost	$288.67	$196.86
	O&M Costs	$412.07	$169.11
	Cyclic Mtn	$11.26	$3.78
Total Costs		**$712.00**	**$369.75**
Benefits Less Costs		**$241.84**	**$18.14**
Benefit/Cost Ratio		***1.34***	***1.05***
Operating Ratio		***0.96***	***0.96***

Exhibit 8-4: Toledo-Detroit Financial and Cost Benefit Analysis Results at 110-mph

Discount Rate		3.0%	7.0%
Benefits to Users			
	System Passenger Revenues	$554.16	$228.70
	On Board Service Revenues	$44.33	$18.30
	Total Operating Revenues	**$598.49**	**$247.00**
	Users Consumer Surplus	$337.64	$138.99
	Total User Benefits	**$936.13**	**$385.99**
Benefits to Public at Large			
	Airport Passenger Delay Savings (million 2017$)	$0.00	$0.00
	Highway Congestion Delay Savings (million 2017$)	$262.35	$104.21
	Highway Reduced Emissions (million 2017$)	$31.84	$12.49
	Highway Safety Savings (million 2017$)	$151.12	$60.56
	Total Public at Large Benefits	**$445.30**	**$177.26**
Total Benefits		**$1,381.43**	**$563.25**
Costs			
	Capital Cost	$388.65	$265.04
	O&M Costs	$558.23	$230.01
	Cyclic Mtn	$11.09	$3.73
Total Costs		**$957.97**	**$498.78**
Benefits Less Costs		**$423.46**	**$64.47**
Benefit/Cost Ratio		***1.44***	***1.13***
Operating Ratio		***1.07***	***1.07***

8.4 Economic Rent/Community Benefits

In order to estimate the economic impact of the Toledo – Ann Arbor – Detroit Rail Corridor project, it is important to understand the character of the different economic benefits that can be quantified.

Benefits will arise from the development and the presence of the passenger rail system. The impact of these benefits will be significant both at a firm and household level (see Exhibit 8-5 below). However, it is important to understand that the sets of benefits quantified in this report, assume equilibrium in the economy. In order for the economy to be in equilibrium, the Supplyside Benefits must equal Demandside Benefits. Supplyside and Demandside benefits should not be added together in the assessment of the full benefits of the project, as they are merely two different measurements of the same benefits.23

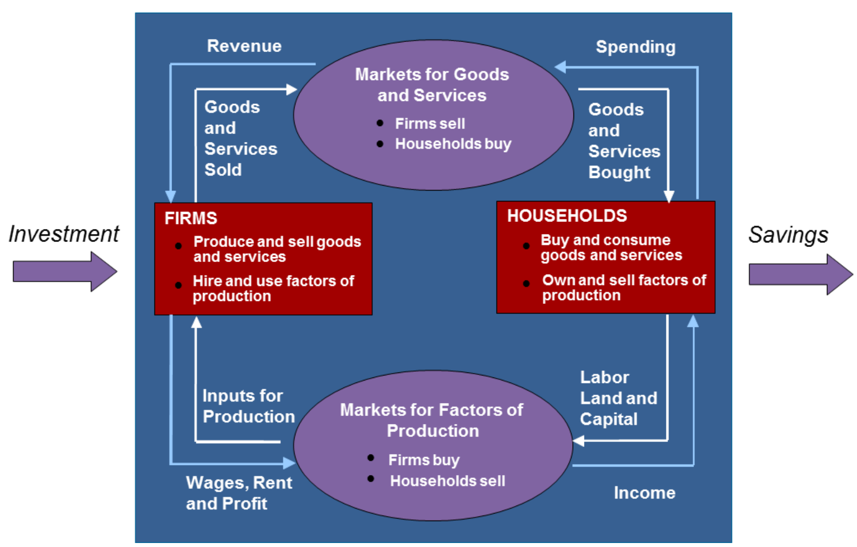
8.4.1 The Character of the Overall Economy

The model of the economy[24] shows that an economy is circular in character, with two equal sides (Exhibit 8-5).

On one side of the economy is the consumer side – the market for goods and services – in which consumers buy goods and services by spending the income earned by working for a commercial enterprise. If a transportation investment improves travel times and costs for individuals, it increases consumer surplus. An analysis of the impact of a transportation investment on the market for goods and services quantifies the level of Consumer Surplus generated by a project, by showing how much time, money and resources individuals save.

The notion that a transportation project will be worthwhile if travel is made more cost effective is based on the idea that not only the cost, but also the travel time of a trip has value. Academic and empirical research has shown that this concept holds true for commuters and recreational travelers as well. Considerable research has been carried out to both identify the theoretical justification for value of travel time and to quantify its value.

Exhibit 8-5: Simple Model of the Economy



[23] See: Mishan, E. 'Cost Benefit Analysis,' New York, NY: Praeger Publishers, 1976.
[2] See Samuelson, P. & Nordhaus, W. Economics. 14th Edition. New York: McGraw-Hill. 1992.

On the other side of the economy is the market for factors of production. Most importantly, it is the market for land, labor and capital, which individuals provide to firms in exchange for wages, rent and profit. From the perspective of policy makers and the local community, this side of the economy is very interesting as it shows how investment in a new transportation infrastructure changes the productivity of the economy by creating new business opportunities; and therefore, increases jobs, income and wealth.

One of the most important aspects of the circular economy model is that it shows that any project has two impacts, one in the consumer market – the benefits to travelers; the second, in the factor markets or Supplyside of the economy[25] – which identifies benefit to the community in terms of improved welfare due to increases in jobs, income and wealth. The supplyside benefits can be quantified as the increase in Economic Rent. This is shown in Exhibit 8-6.

For the economy to reach equilibrium, both sets of benefits must be realized. As such, the benefits of a project are realized twice, once on the Demandside and once on the Supplyside. As a result, there are two ways to measure the productivity benefits of a transportation project; and theoretically, both measurements must equal each other. This is a very useful property since in any specific analysis one measure can be used to check the other, at least at the aggregate level. This is very helpful and provides a check on the reasonableness of the estimates of project benefits.

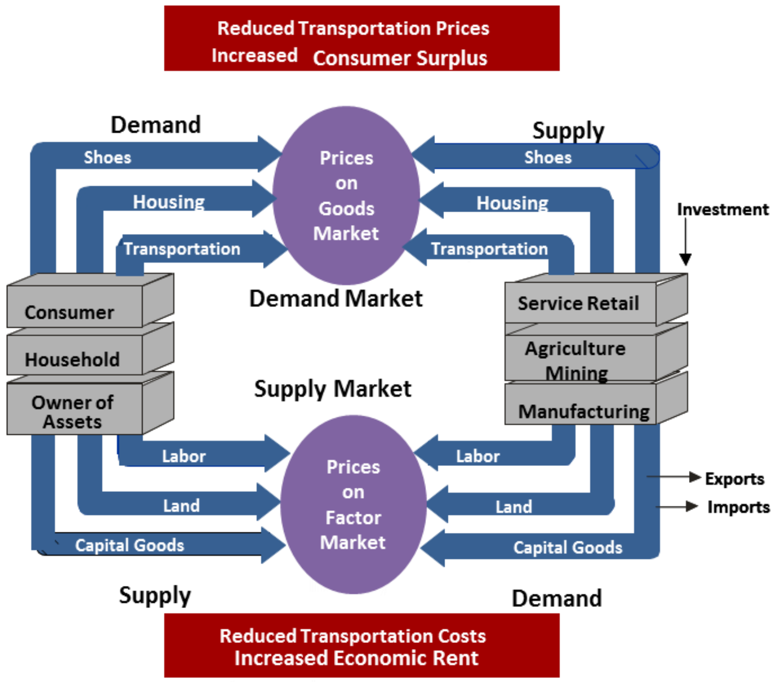
However, in assessing the benefits of a transportation project, it is important not to double-count the benefits by adding Supplyside and Demandside benefits together. It must be recognized that these two sets of benefits are simply two different ways of viewing the same benefit. The two markets are both reflections of each other and measure the same thing. For example, if both sets of benefits equal $50 million, then the total benefit is only $50 million as expressed in two different ways: travelers get $50 million of travel benefits and the community gets $50 million in jobs, income, and increased profits. As a ripple effect (or transfer payment), the economy also gets an expanded tax base and temporary construction jobs.

Therefore, if a given transportation project is implemented, equivalent productivity benefits will be seen in both the consumer market for goods and services (as the economy benefits from lower travel times and costs); as well as in the Supplyside factor markets. In the Supplyside side market, improved travel efficiency is reflected in more jobs, income and profit. Therefore, for a given transportation investment, the same benefit occurs on both sides of the economy. In the consumer markets, users enjoy lower travel costs and faster travel times. On the Supplyside of the economy, the factor markets take advantage of the greater efficiency in transportation. As a result, both sides of the economy move to a new level of productivity in which both sides of the economy are balanced in equilibrium.

Improved efficiency will generate Supplyside spending and productivity benefits that have a very real impact on the performance of the local economy. The method that develops estimates of productivity jobs and wealth creation is an Economic Analysis. It measures how the performance of a new transportation investment raises the efficiency of the economy. This efficiency improvement creates jobs and income, and raises local property values to reflect the improved desirability of living or working in the area.

[25] See: Mishan, E. 'Cost Benefit Analysis,' New York, NY: Praeger Publishers, 1976.

Exhibit 8-6: Relation between Consumer Surplus and Economic Rent in the Economy

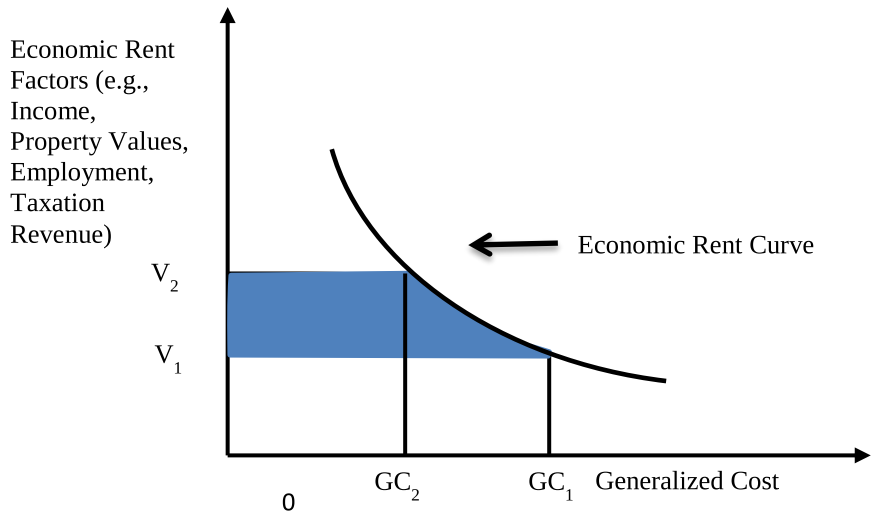


8.4.2 Assessing Supplyside Benefits

The Economic Rent theory builds from the findings of Urban Economics and The Economics of Location that support Central Place Theory[26]. Central Place Theory argues that in normal circumstances, places that are closer to the "center" have a higher value or economic rent. This can be expressed in economic terms; particularly jobs, income, and property value. There is a relationship between economic rent factors (as represented by employment, income, and property value) and impedance to travel to market centers (as measured by generalized cost). As a result, lower generalized costs associated with a transport system investment lead to greater transportation efficiencies and increased accessibility. This, in turn, results in lower business costs/higher productivity and, consequently, in an increase in economic rent. This is represented by moving from point V1 to point V2 in Exhibit 8-7, as a result of the improved accessibility as measured by moving from GC1 to GC2.

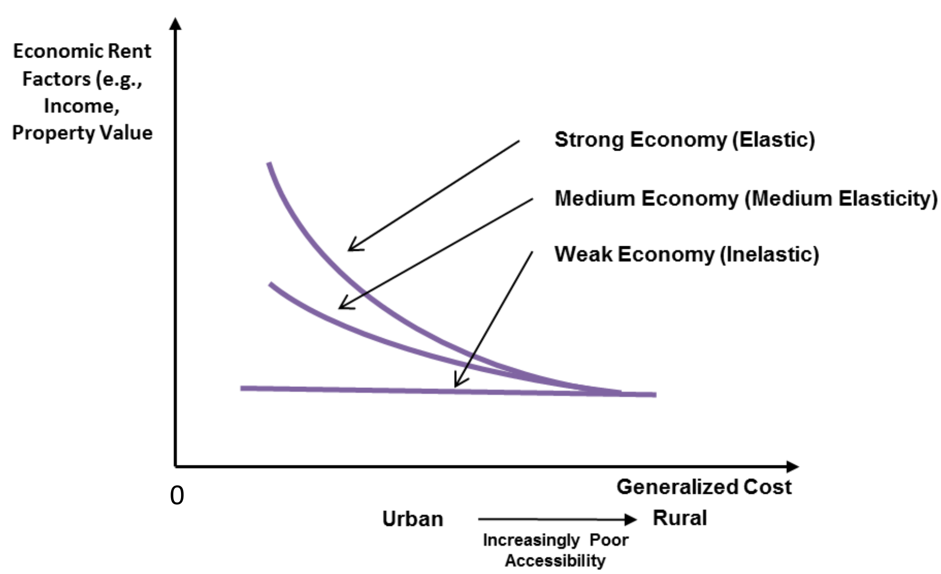
[26] Metcalf, A.E. 'Economic Rent: A New Dimension in the Economic Evaluation Process', Transportation Research Board, 71st Annual Meeting, January 12-16, Washington, DC, 1992.

Exhibit 8-7: Economic Rent Illustration



It should be noted that the shape of the economic rent curve reflects the responsiveness (elasticity) of the economy to an improvement in accessibility. Large cities typically have very large economic rent activity (represented by a steep Economic Rent Curve), which indicates that a project improving transportation accessibility will have a significant economic impact; smaller communities have less economic rent activity (less steep curves), and rural areas have very flat curves that indicate lower economic responsiveness. Similarly, depressed areas will experience flatter curves than better off areas. This is due to factors not directly related to transportation, such as level of education, population structure and industrial structure. A significantly improved transportation provision may bring a useful contribution to alleviating the problems faced by disadvantaged areas, but will not by itself solve the economic issues and problems that these areas face. See Exhibit 8-8.

Exhibit 8-8: Representation of Different Economic Rent Curves by Strength of Economy



Finally, the strength of the relationship between generalized cost and economic factors is established by calculating the relationship between economic rent factors and generalized cost weighted by the amount of trips completed for the particular region of study. This ensures that when calculating the Supplyside effect of a transportation improvement, real gains in accessibility that benefit a large number of users, produce greater Supplyside benefits than projects that provide real accessibility gains for a small number of individuals.

The mathematical expression of the Economic Rent Curve is therefore:

$SE_i = ß_0 \, GC_i$

Where:

SE_i – Economic rent factors – i.e., socioeconomic measures, such as: employment, income, property value of zone i;

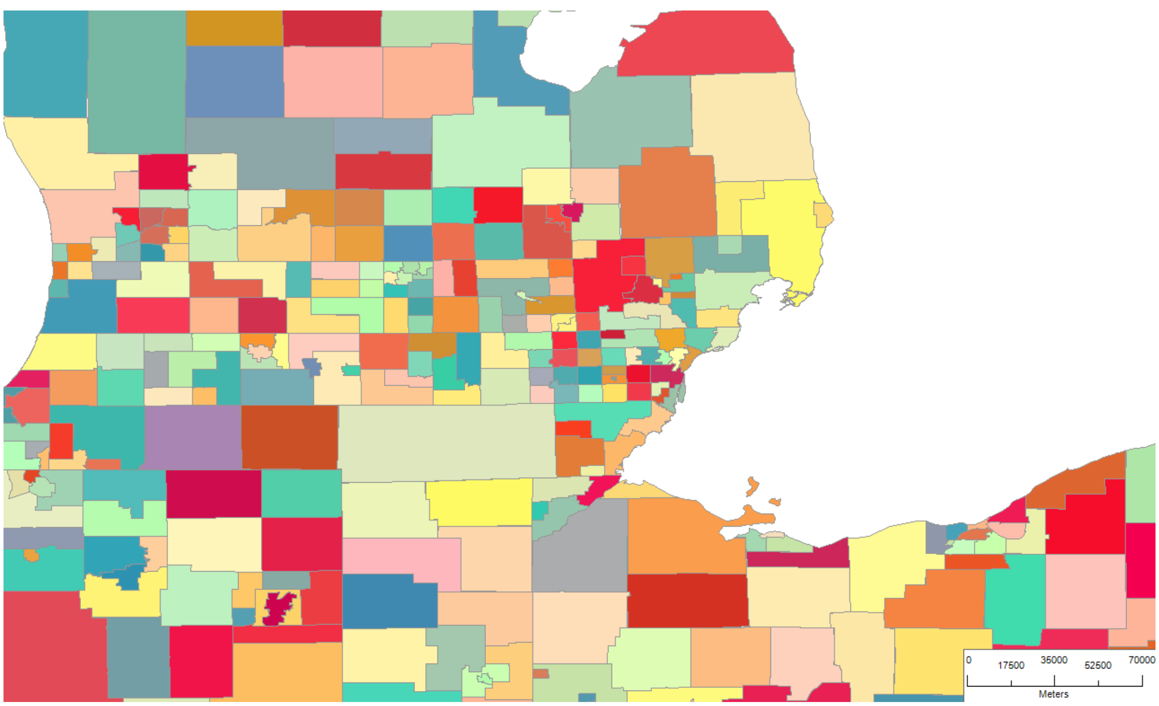
GC_i - Weighted generalized cost of auto travel for all purposes from (to) zone i to (from) other zones in the study area;

$ß_o$ - Calibration parameters.

8.4.3 Data Sources and Study Database

For the economic impact study, zones developed in the Toledo – Ann Arbor – Detroit Rail Corridor Study were adopted as shown in Exhibit 8-9.

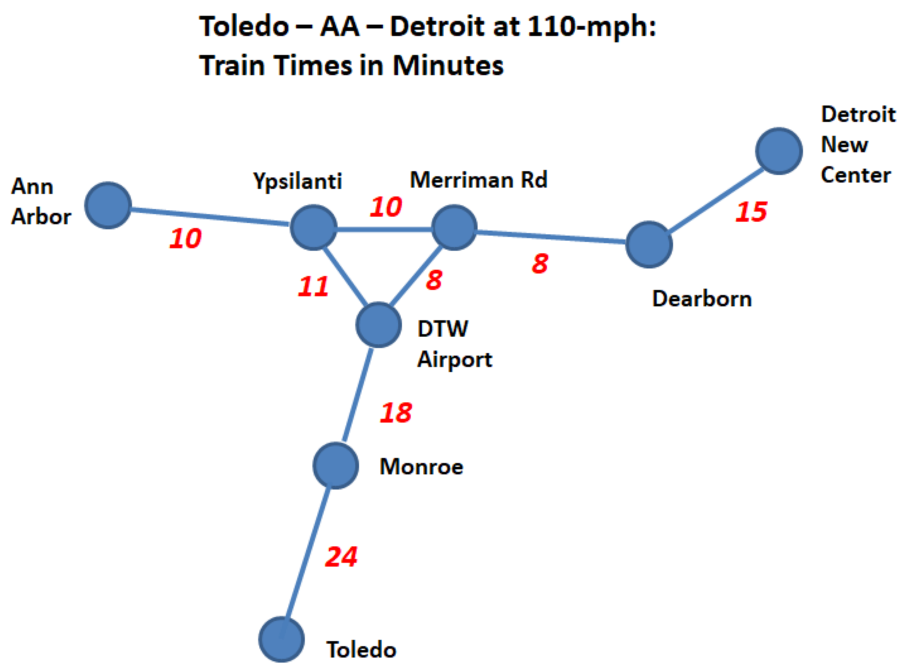
Exhibit 8-9: Zonal System used for the Purpose of the Study



In order to estimate the economic impact, base year 2018 socioeconomic database established in the ridership and revenue study were used for the supplyside model calibration, and socioeconomic forecasts were used in calculating supplyside benefits in the 30 year period from 2020 to 2050.

This information enabled TEMS to use the rail network of 110 MPH service shown in Exhibit 8-10 to establish transportation service improvements for the zones in the corridor, and to calculate both the current and future generalized costs.

Exhibit 8-10: 110 MPH Passenger Rail Network



8.4.4 Supplyside Analysis Results: Deriving Economic Rent Elasticities

Economic Rent theory proposes that for a transportation project to have value there will be a strong relationship between socioeconomic variables and accessibility. As such, the relationship between accessibility and income, employment, and property density in the Northern Michigan Passenger Rail Corridor was calculated through regression analysis. This analysis established the level of sensitivity of the region's economy to transportation improvements. Exhibits 8-11, 8-12, and 8-13 show the relationship established between accessibility and employment, income, and real property value, along with the statistical measures indicating the strength of the relationship found.

As can be seen in the relationship exhibits, the relationship between accessibility and socioeconomic characteristics is a linear relationship of the following form:

$$\ln(SE_i) = \beta o + \beta 1 \ln(GC_i)$$ **Equation 1**

Where:

SE_i - Economic rent factor (socioeconomic variable) of zone i;

GC_i - Weighted generalized cost of travel for all purposes from (to) zone i to (from) other zones in the zone system;

βo and $\beta 1$ - Regression coefficients.

Exhibit 8-11: Relation between Accessibility and Employment in the Toledo-Detroit-Ann Arbor Corridor

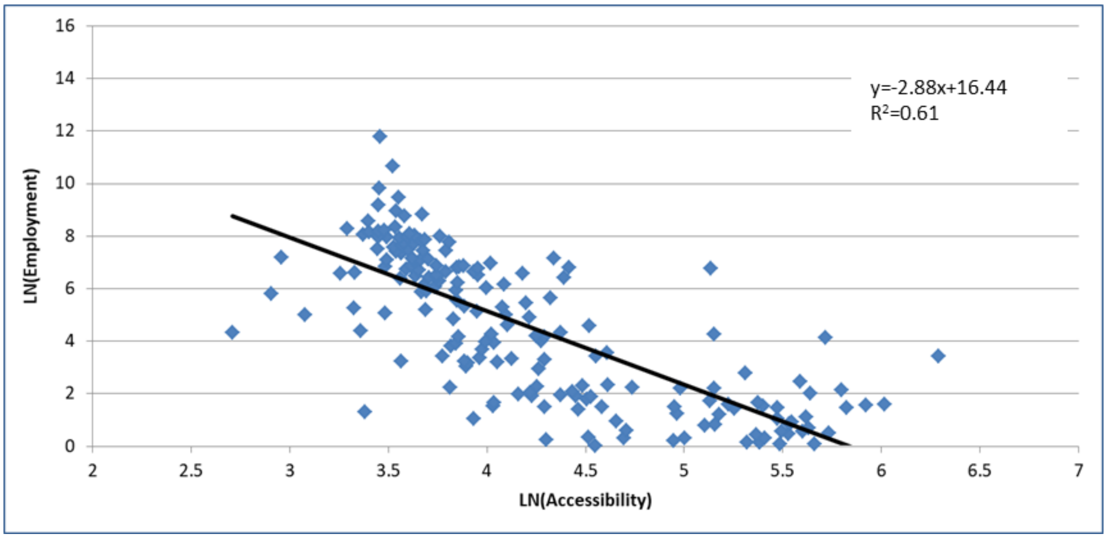


Exhibit 8-12: Relation between Accessibility and Income in the Toledo-Detroit-Ann Arbor Corridor

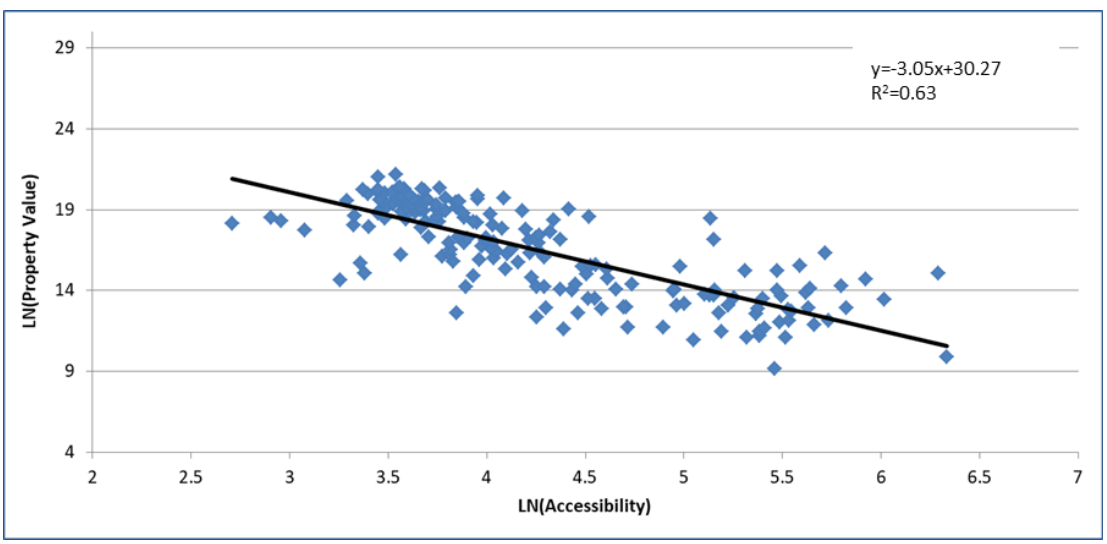
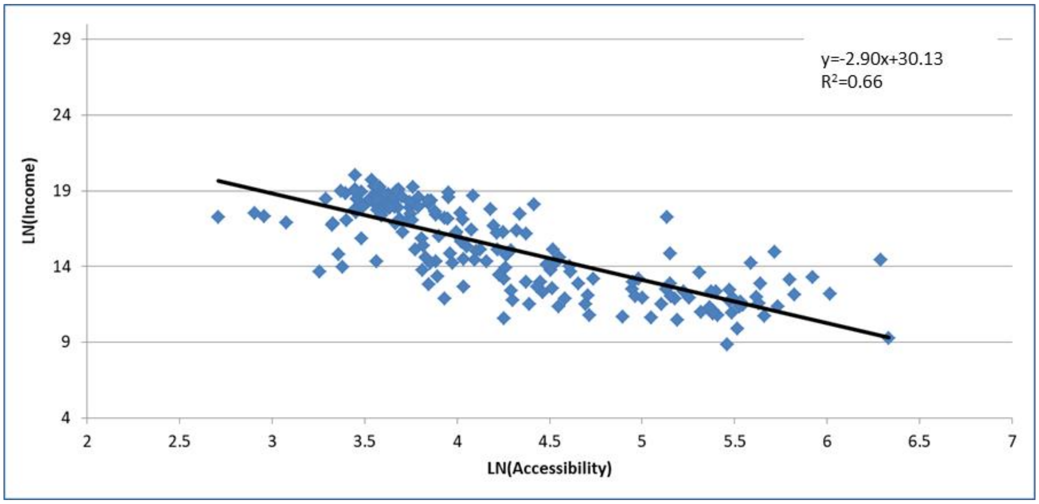


Exhibit 8-13: Relation between Accessibility and Real Property Values in the Toledo-Detroit-Ann Arbor Corridor



The value of the coefficients of determination (R^2) shows how much the dependent variable (e.g. employment) is influenced by the predictor variable (accessibility). In other words, the coefficient of determination measures how well the model explains the variability in the dependent variable. R^2 therefore illustrates the strength of the relationship between the dependent and predictor variables.

Student's t statistics were calculated for the two regression coefficients - $\beta 0$ (the intercept) and $\beta 1$ (the slope) indicate the significance of the regression coefficients. A t-statistics above the value of two in absolute terms is generally accepted as statistically significant.

It can be seen that for the current study, the calibration was successful and regression coefficients in each equation were shown to be significant. (See Exhibits 8-11, 8-12, and 8-13). This shows that the economic rent profiles are well developed for the Toledo-Detroit-Ann Arbor Passenger Rail Corridor. Each equation has highly significant 't' values and coefficients of determination (R^2). This reflects the strength of the relationship and, given the fact that there is a strong basis for the relationship, shows firstly, that the socioeconomic variables selected provide a reasonable representation of economic rent; and, secondly, that generalized cost is an effective measure of market accessibility.

Exhibit 8-14 shows the detailed calibration results for employment, income, and property values.

Exhibit 8-14: Detailed Calibration Results

Economic Rent Factor	Intercept (βo)	T-statistics for βo	Slope ($\beta 1$)	T-statistics for $\beta 1$	Coefficient of Determination – 'R square' (R^2)
Employment	16.44	22.99	-2.88	-17.87	0.61
Personal Income	30.27	40.49	-3.05	-18.15	0.63
Real Property Value	30.13	-18.40	-2.90	-17.70	0.66

The impact on the socioeconomic indicators gathered for the current study, with regard to the improvement in accessibility provided by the new Passenger Rail system, is calculated according to the elasticities (i.e. the sensitivity of the socioeconomic parameters to accessibility) established through the differentiation of the economic rent function in equation (1) with respect to generalized cost. The result of such differentiation is present in Equation 2. It is easy to see that slope β_1E in the regression equation represent economic rent elasticities.

$$\Delta SE_I = \frac{\partial SE_I}{SE_I} = \beta_1^E \frac{\partial GC_I}{GC_I}$$ **Equation 2**

The resulting elasticities were then applied to each zone pair according to the specific generalized cost improvement calculated for each zone for each phase of the project. This allows for the effect of Passenger Rail to be calculated from a Supplyside perspective.

The resulting effect on the socioeconomic parameters are presented below. The results are estimated for each zone, and for the purpose of reporting, socioeconomic benefits for each station hinterland will be shown in the following session.

8.4.5 Direct Socioeconomic Benefits Results

Direct socioeconomic benefits include employment benefits, income benefits, and real property value benefits. Employment benefits are derived from the Toledo – Ann Arbor – Detroit Rail Corridor transportation service improvement. These are productivity jobs and not temporary construction jobs associated with building the project. Income benefits are derived from the increased attractiveness of the region due to the accessibility improvement. Income benefits result from both the increase in the number of households in the corridor and the increase in the average household income per household. Real property value benefits result from the increase of the number of properties in the region as well as increase in the average value of commercial and residential buildings.

8.4.5.1 Employment Growth Estimates

Exhibit 8-15 shows that the total employment growth in man year from 2025 to 2050 in the Toledo – Ann Arbor – Detroit Rail Corridor will be over 40 thousand. The urban areas in Michigan including Detroit, Dearborn, Ann Arbor, DTW Airport, Ypsilanti, and Merriman Rd. will receive over 30 thousand employment growth. The Toledo-Monroe area on the south end will have more than nine thousand employment growth.

Exhibit 8-15: Employment Improvement by Station Coverage Area

Station Name	Employment Improvement (man year) 2025~2050
Ann Arbor	5,374
Ypsilanti	1,447
Merriman Rd	1,448
Dearborn	3,963
Detroit New Center	16,314
DTW Airport	2,743
Monroe	915
Toledo	8,231
Total	**40,436**

8.4.5.2 Personal Income Growth Estimates

The personal income growth is shown in Exhibit 8-16. It can be seen that the total income growth in the Toledo – Ann Arbor – Detroit Rail Corridor will be $2,167 million from 2025 to 2050. Detroit, Dearborn, Ann Arbor, DTW Airport, Ypsilanti, and Merriman Rd. areas will receive nearly $1,700 million income growth. The Toledo-Monroe area will have more than $468 million growth in income during the 25 year period.

Exhibit 8-16: Personal Income Improvement by Station Coverage Area

Station Name	Income Improvement 2025~2050 (million $)
Ann Arbor	286.8
Ypsilanti	74.6
Merriman Rd	70.0
Dearborn	224.5
Detroit New Center	885.8
DTW Airport	156.8
Monroe	45.5
Toledo	423.0
Total	**2,166.9**

8.4.5.3 Real Property Value Growth Estimates

Exhibit 8-17 shows the real property value growth in the Toledo – Ann Arbor – Detroit Rail Corridor from 2025 to 2050. The real property value in the corridor will also increase as result of the proposed passenger rail service. The total amount of real property value increase from 2025 to 2050 will be $2,868 million. Detroit, Dearborn, Ann Arbor, DTW Airport, Ypsilanti, and Merriman Rd. areas will get $2,251 million real property value increase in 25 years. The Toledo-Monroe area's real property value increase is $617 million, with Toledo itself receiving $566 million.

Exhibit 8-17: Property Value Improvement by Station Coverage Area

Station Name	Property Value Improvement 2025~2050 (million $)
Ann Arbor	384.8
Ypsilanti	84.2
Merriman Rd	82.6
Dearborn	293.3
Detroit New Center	1,200.1
DTW Airport	206.4
Monroe	51.4
Toledo	565.8
Total	**2,868.7**

8.4.6 Transfer Payments (Tax Benefits)

Transfer payments play an exceptional role in the overall project evaluation. The tax benefits include real property tax increase as result of real property value appreciation, the federal and local income taxes will also benefit as result of personal income increase in the corridor. The rates used reflect current 2018 tax rates.

8.4.6.1 Real Property Tax Growth Estimates

Exhibit 8-18 shows the real property tax increase in the Toledo – Ann Arbor – Detroit Rail Corridor from 2025 to 2050. The real property tax in the corridor will increase as result of the increased real property value in the corridor. The total amount of real property tax increase from 2025 to 2050 will be $61.8 million. Detroit, Dearborn, Ann Arbor, DTW Airport, Ypsilanti, and Merriman Rd. areas will get $48 million real property tax increase in 25 years. The Toledo-Monroe area's real property tax value increase will be $13.7 million.

Exhibit 8-18: Property Tax Improvement by Station Coverage Area

Station Name	Property Tax Improvement 2025~2050 (million $)
Ann Arbor	8.2
Ypsilanti	1.9
Merriman Rd	1.7
Dearborn	6.3
Detroit New Center	25.6
DTW Airport	4.4
Monroe	1.2
Toledo	12.5
Total	**61.8**

8.4.6.2 Federal Tax Growth Estimates

The federal income tax growth as result of income growth in the Toledo – Ann Arbor – Detroit Rail Corridor is shown in Exhibit 8-19. It can be seen that the total federal income growth in the corridor will be over $425 million from 2025 to 2050. Michigan areas will receive over $332 million federal tax growth. The Toledo-Monroe area on the south end will have more than $92 million growth in federal tax.

Exhibit 8-19: Federal Tax Improvement by Station Coverage Area

Station Name	Federal Tax Improvement 2025~2050 (million $)
Ann Arbor	57.4
Ypsilanti	11.2
Merriman Rd	14.3
Dearborn	44.4
Detroit New Center	175.5
DTW Airport	30.0
Monroe	8.0
Toledo	84.5
Total	**425.2**

8.4.6.3 Local Tax Growth Estimates

The local income tax growth as result of income growth in the Toledo – Ann Arbor – Detroit Rail Corridor is shown in Exhibit 8-20. It can be seen that the total local income growth in the corridor will be over $90 million from 2025 to 2050. Michigan areas will receive over $702 million local tax growth. The Toledo-Monroe area on the south end will have nearly $20 million growth in local tax.

Exhibit 8-20: Local Tax Improvement by Station Coverage Area

Station Name	Local Tax Improvement 2025~2050 (million $)
Ann Arbor	12.2
Ypsilanti	3.1
Merriman Rd	2.6
Dearborn	9.1
Detroit New Center	37.1
DTW Airport	6.5
Monroe	2.0
Toledo	17.9
Total	**90.5**

The projected expansion of the tax base is considerable and over the lifetime of the project the increase in Federal and Local income tax of $515 million is nearly sufficient to cover the projected $524 million in project costs for the 110-mph option. If property taxes were added this brings the added tax revenues up to $576 million which would be more than sufficient to cover the project costs.

8.4.7 Conclusions

Below is a summary of each set of benefits calculated for the project. As seen in the analysis, the proposed passenger rail project will not only generate financial and demandside economic benefits but will provide a strong stimulus the economy of the Northern Michigan Corridor. Supplyside benefits are the estimated benefits to business and the economy due to the increase in accessibility provided by improvements in transport infrastructure. It is based on the relationship (the elasticity) that the economy exhibits today to transportation accessibility (i.e., sensitivity to improved accessibility). Given the circular nature of the economy, Supplyside benefits under economic theory are equal to the Demandside benefits due to the integrated nature of the economy. The project will create long term well paid service employment due to improved productivity. Furthermore, it will benefit the general population through higher incomes and higher real property values. Federal and local government will be able to fully recoup the cost of their investment in the project through an expanded tax base. Exhibit 8-21 shows the overall socioeconomic and transfer payment benefits of the Toledo – Ann Arbor – Detroit Rail Corridor for the 25 year period from 2025 to 2050.

Exhibit 8-21: Socioeconomic and Transfer Payments Improvements Summary

Economic Supply Side Items	Economic Supply Side Improvements
Direct Socioeconomic Benefits	
Employment (2025~2050 man year)	40,436
Income (2025~2050, million $)	2,167
Property Value (2025~2050, million $)	2,869
Transfer Payments (Tax Benefits)	
Federal Income Tax (2025~2050, million $)	425.2
Local Income Tax (2025~2050, million $)	90.5
Property Tax (2025~2050, million $)	61.8

Estimates over the 25 year life of the project are:

- Long-term productivity employment will rise by 40,436 person years. The jobs will be created in the business services, logistics, maintenance, health care and retail sectors.
- $2.17 Billion increase in personal income over 25 years throughout the Corridor. This is four times the cost of the project.
- Property Values are estimated to rise by $2.87 Billion, with an opportunity for significant Transit Oriented development in the city centers of Toledo, Detroit, Ann Arbor and Dearborn.

The economic impacts of the project in terms of transfer payments are:

- $425 Million new federal tax over 25 years will be generated.
- $90 Million new local tax over 25 years will be generated.
- $62 Million in property tax will be collected at the local level.

Chapter 9

Conclusions and Next Steps

SUMMARY

This chapter outlines the key findings of the study, and the next steps that should be taken to move the Toledo-Detroit-Ann Arbor Passenger Rail Line project forward.

9.1 Summary of Findings

The results of this study have identified a strong case for development of a Toledo-Detroit-Ann Arbor rail service with a major hub at the DTW Airport. This includes potential benefits for all the communities along the corridor including jobs, income and property development opportunities. Additionally the project would generate benefits for travelers and would provide an effective integration of the Toledo, Detroit, Ann Arbor and DTW Airport economies. DTW is an international gateway airport which allows businesses to expand their reach to include both Asian and European markets.

The project also has significant benefits to government with a tax base expansion that more than covers the cost of the project. Furthermore, this system would have a significant potential to expand both north to reach additional destinations in Michigan as well as south into Ohio and west to Chicago. As it grows, so would the likely economies of scale, financial results and economic impacts.

Most intercity rail systems focus on trips in the 100-400 mile range, which are too long to comfortably drive but too short for air travel. However as currently envisioned, the proposed Toledo-Detroit-Ann Arbor service would be focused on relatively short trips and as a result, the service will handle a significant share of daily commuter trips, as the Chicago-Milwaukee corridor does. As a result, the service as proposed would closely resemble Amtrak's Hiawatha (Chicago-Milwaukee) service or other services such as Boston-Portland or Richmond to Washington DC.

However, not only commuters would use the train, but also Business and Social travel will also contribute strongly to the success of the rail service. At the DTW Airport, air connect travel will add large numbers of social and business riders who will pay higher fares than the average commuter.

Because it will serve a full range of trip purposes this study uses the Federal Railroad Administration (FRA) Commercial Feasibility Study criteria. On this basis of these criteria, it has been found that development of the proposed rail system shows very strong potential, and a real case for developing the service exists. It has been found that the system will satisfy the FRA's Cost Benefit requirements at both a 79-mph and 110-mph speed; and that if the system were developed to 110-mph standards, even with lower average revenue yields the system would be able to cover its own operating costs and run without a subsidy.

It is important to understand that the financial results of the rail service can be strongly influenced by the way a project is financed and who operates it. It is typical that rail corridor services need an operating subsidy. This is largely due to the fact that 79-mph operation is not competitive with the automobile. However, the Northeast corridor is clearly generating a positive cash flow thus it does not need an operating subsidy. In terms of what is driving the operating results of these rail systems, there are specific areas which need to be further assessed in future studies because of the potential for cost savings:

1. **Overhead and Administrative charges**. The allocation of Amtrak's headquarters overhead costs can add $5-10 per train mile over and above the operating costs that have been estimated here. This is not a real cost increase but simply a higher allocation of Amtrak's existing costs. Under PRIIA Amtrak was able to succeed in raising the amount of overhead it is able to charge to State supported trains. This gives Amtrak the ability to eliminate any operating surpluses generated by a corridor simply by increasing it overhead costs. If Amtrak were the operator there can be an expectation that the proposed 110-mph corridor service would need an operating subsidy rather than generating an operating surplus. Private sector firms have lower overhead rates and in a competitive bidding situation typically have shown their ability to operate rail services more efficiently. Many of these same firms are already operating commuter rail services over NS and CSX and therefore already have the necessary insurance coverages to be able to do so.
2. **Equipment (Unit-mile) charges**. It is recommended that Ohio and Michigan procure and supply their own locomotives and cars to prevent equipment capital charges from being added onto the operating subsidy invoice. The cost of equipment is a capital cost and should be treated as such.
3. **Infrastructure (Train-mile) charges**. It is that recommended that Ohio and Michigan purchase the tracks and rights of way if possible to prevent track usage fees from being added into the operating subsidy invoice. As noted above the cost of infrastructure is also a capital cost.

9.2 Next Steps

To move the project forward as a public or public/private project TEMS would advise the completion of a much more detailed Tier 1 EIS or Feasibility study. Such a study will advance development of the project by further refining the marketing, train equipment, infrastructure, operating and funding strategies for the corridor.

- The next study should define the optimal approach to development of the rail corridor, while developing all documentation needed for Michigan and Ohio to be able to apply for all available Federal funding. It must include enough scope to permit consultation with the freight railroads and the completion of enough capacity analysis to verify the adequacy of the infrastructure plan.
- Develop both a Service Development Plan (SDP) and a Service NEPA (Environmental Scan). A key determination of the next study will be the level of Environmental study that is needed to advance the project, since the vast majority of proposed rail improvements would be developed within the existing rail right of way.

A Tier 1 EIS or Feasibility study will need to address the following issues:

- **A Market Assessment** - Confirm and further refine the demand forecast with a view to gaining a more complete understanding of specific trip attractors within northern Ohio and southeastern Michigan –
    - Seasonality and trip chaining
    - The detailed characteristics of particular target markets such as daily commuters, air connect riders, business travelers, students and corporate groups, and how they travel.

- **A Network Assessment** - Consider additional possible service options such as –
    - Develop detailed pro-forma operating schedules and plans detailing the precise infrastructure requirements.
    - Analyze the relationship of the proposed service with existing and developing services, including the ability to coordinate operating schedules with the Wolverine, Toledo Amtrak services, and with future planned Coast to Coast, WALLY line, Traverse City services and a connection to Canada through the Detroit River tunnel.
    - Further develop the feasibility of alternative rail station sites that could more directly serve the downtown areas of Toledo and Detroit, including consideration of how such locations might also be connected with planned future passenger rail services towards Cleveland, Columbus, Chicago, Canada, and northern Michigan locations including Port Huron, Saginaw, Lansing, Grand Rapids and Ann Arbor.
- **An Institutional Assessment and Implementation Plan –**
    - Consider the potential for a PPP/franchise in order to attract private capital to the project.
    - Develop a detailed Implementation Plan, outlining the short and long term actions that need to be taken to initiate service at a minimum speed of 79-mph and over time, upgrading to the level proposed at 110-mph. This includes identifying the development steps of the corridor and aligning that with a funding plan, to allow the project to be phased in the most effective manner.
- **Joint Development and Local Economic Assessment –**
    - Complete a station location study with a particular view to optimizing the real estate development and value capture opportunities associated with the implementation of the rail service.
    - Identity existing connecting transit services and consider development, as necessary of additional feeder bus connections as appropriate and the ability to integrate with regional transit and airports.
    - Complete a supply side benefits assessment for being able to explain how the project will impact all the communities along the line as well as the States of Ohio and Michigan.
- **An Engineering and Operational Assessment** - Optimize the infrastructure investment strategy for the whole line, balancing the needs of freight and passenger service, and conduct a capacity analysis to confirm the adequacy of the plan for handling forecasts freight and passenger traffic.
- **An Equipment Strategy** - Develop a detailed plan for meeting the equipment needs of the start-up services at 79-mph, and with prospective new equipment vendors for procuring new trains for 110-mph service.
- **A Financial/Economic and Funding Plan –**
    - Work closely with the Chicago-Detroit/Pontiac corridor, Coast-to-Coast, North-South Commuter Rail (WALLY) and A2TC teams to identify infrastructure and facilities that might be mutually beneficial if the A2TC project moves forward.

  - A comprehensive benefits assessment is needed to identify benefits to freight, excursion trains and other potential future users of the corridor such as WALLY line and Coast-to-Coast services
  - Enhance the benefits assessment to reflect the fact that infrastructure investments will be mutually supportive to all users of the rail line. While some costs may clearly be the responsibility of one service or the other, other costs are shared.
  - A collaborative approach would help facilitate a better understanding of the synergies between the needs of different corridor users.
  - Developing a single integrated Cost Benefit calculation would avoid the need for developing allocations of shared costs, which often tend to be arbitrary.
  - This offers the best prospect for accelerating the time frames for badly-needed infrastructure improvements and would help to ensure that MDOT optimizes its return on investment for improving the Toledo-Detroit-Ann Arbor corridor.
- **Implement a public outreach effort** with a structured approach for communicating the study findings while engaging both the project stakeholders and the public at large