MDOT

MICHIGAN DEPARTMENT OF TRANSPORTATION

State Long-Range Transportation Plan 2005-2030

Integration Technical Report

Prepared for
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Table of Contents

List of Tables

List of Figures

Appendices

Executive Summary

Introduction:

One goal of *MI Transportation Plan* is to present the different aspects of the transportation system in an integrated manner. The technical reports of *MI Transportation Plan* describe the separate programs and infrastructure assets that make up the system**.** In reality, however, all of Michigan's transportation assets and programs are part of one system, the integrated transportation system.

What is an integrated transportation system? The public, when using transportation, does not think in terms of separate sets of assets: highways, transit, non-motorized, aviation, intercity passenger, freight, and so on. For the user, there is simply a need to go from one place to another, whether it is to participate in an activity or to move goods.

> *An integrated transportation system allows users to easily and seamlessly go from one place to another, or move goods from one place to another, using a variety of modes.*

For example, if a user needs to get to work and does not own a car, he or she may walk on a sidewalk to the bus stop, board the bus, ride to a stop near work, cross the street at the crosswalk and get to work. The trip works for the user if it goes well: the walk to the bus is safe and easy, the bus is on time, the bus does not crash or break down, and it is possible to safely cross the street. If any of these conditions are not met, the trip really does not work. The system is not fully integrated if any one transportation element fails to perform.

From the user's perspective, the need for an integrated system is clear. Developing and delivering an integrated transportation system, from government's perspective, is more challenging, for a variety of reasons. Legal requirements, safety or engineering requirements, funding considerations, land use planning, or the need for coordination among civil jurisdictions may inhibit the ability to provide an integrated transportation system. Overcoming these limitations is no small task.

Within the context of *MI Transportation Plan*, the integration technical report examines a very complicated set of factors that impact the public's need for and the state's ability to deliver an integrated transportation system. The report offers concepts and principles for decision-making that can support an integrated system at the state level. The report is not intended as a stand-alone document; it is most meaningful when taken in the greater context of *MI Transportation Plan* and the other technical reports that support it.

This executive summary synopsizes the information in the integration technical report, but for a complete understanding of the principles offered here, it may be necessary to read the full report.

The Integrated System and Michigan's Economy:

Michigan's existing transportation network has functioned well for many years. Businesses rely on transportation to help them produce and ship goods, or perform services. People use transportation to shop, work, recreate, attend school or visit the doctor, as well as many other daily activities.

A more fully integrated transportation system can boost Michigan's economic vitality. An integrated variety of transportation modes will encourage the economic participation of people and businesses in a greater number and variety of activities, all of which have the potential to enhance Michigan's economic performance. An integrated transportation can also save money by reducing transportation costs or increasing efficiency. The more integrated the transportation system is, the easier and more cost-effective it is for people and businesses to participate in the activities that drive Michigan's economy.

The User's Need for an Integrated System:

Some transportation user needs are more complex than others. A person with simple transportation requirements may drive straight to a workplace with on-site parking, eat lunch in the office or work through lunch, and then drive straight home again at the end of the day, encountering only the roadway aspect of the transportation system.

A person with more complex transportation needs may drive to work, wait at a railroad crossing while a train passes, park a few blocks away, walk to the office, take a break at lunch to go jogging, walk to a market near work on the way back to the car at the end of the day and then drive home. This person's transportation requirements are more complex. The person with complex transportation needs requires more aspects of infrastructure and services for the system to work. Some aspects of the user's complex needs arise from necessity (crossing the railroad tracks, parking a few blocks from the office) while others arise from choices that the user makes (jogging at lunch, walking to the market). Delivering an integrated system becomes more challenging in locations where transportation user needs are more complex.

Activities Supported by an Integrated System:

Just like transportation users, some activities have more complex transportation requirements than others. Some activities, like a doctor's visit, are essential, and must occur using whatever transportation alternative is most directly available. This activity will probably occur in one place and will be directly accessed by the person's primary mode of transportation. Even the doctor and his staff probably used a single primary means of transportation to get to the office. Office supplies probably arrive by a single primary mode of transportation: a single unit delivery truck. Overall, this activity involves limited transportation choices and a limited number of aspects of the transportation system. For that reason, it is seen as having less complex transportation requirements.

Other activities rely on more complex transportation use, especially discretionary activities that may or may not occur, depending on how convenient or accessible the activity is. For example,

if an individual plans to attend a sporting event, he or she could simply drive to the event and drive home. But if the transportation options are there, that individual may choose to get off the highway to stop at a restaurant on the way to the arena, ride a shuttle to the game, and then decide to unwind at a club across the street from the arena before going home. The social and recreational activities (eating at a restaurant, attending the sporting event, socializing at the club) are part of a chain of activities where decisions are made somewhat spontaneously about where to go, when, and how. The chain of activities involves a wider range of transportation choices (stopping at the restaurant, walking to the club). The chain is further complicated when you consider that the opposing sports team probably flew to town for the game, or that during the winter the restaurant uses fresh produce trucked in from the south.

This example also helps clarify how an integrated transportation system can better support economic activity. If any aspect of the transportation system makes it more difficult, or less desirable, for an individual to engage in the chain of activities, he or she may simply not bother with them. The economic activity that might occur is lost.

Integrating Activity Centers and Corridors:

An activity center exists wherever a large number of transportation users and a large variety of activities (businesses, education, shopping, health care, industry, recreation) are clustered. Corridors connect activity centers with each other and with users outside the activity center itself.

Delivering an integrated system is far more challenging in activity centers, because the transportation users and their activities have more complicated transportation requirements. Integrated connections are needed at the corridor and throughout the activity center. Activity centers require a greater emphasis on modal balance and integration to ensure the best possible access to the widest variety of activities. Integrating transportation in an activity center means making decisions about how to arrange and deliver a transportation system that connects to the corridor and meets the needs of a variety of potential users and activities.

Removing Barriers and Realizing Opportunities for Integrated System Performance:

A performance "barrier" is a condition on the transportation system that makes it more difficult, more expensive or impossible for an activity to take place. Suppose, for example, a person drives on a congested road to a unique market, only to find that the nearest parking is across the street. The congestion on the road to the market and lack of a crosswalk or sidewalk could be barriers to system performance. The individual may find it harder, more dangerous, or more expensive to go to the market. Even if the crosswalk exists, but the road is highly congested, there is still a performance barrier.

"Opportunities" are conditions on the transportation system that make it easier, less expensive, or possible for an activity to take place that may not otherwise occur. For example, if a scenic byway could attract people from throughout the nation to vacation, hike, and walk in Michigan, the byway provides an opportunity to stimulate tourism, recreational, and health-related activities that would otherwise not occur.

Removal of transportation performance barriers and the realization of opportunities are key to improving the integrated system performance and fulfilling Michigan's economic potential.

Funding the Integrated System:

Transportation users desire seamless transportation access to activities, but the programs and revenues supporting Michigan's transportation system are not structured that way. Instead, they are geared to particular modes or particular aspects of transportation. For example, separate federal and state programs support roadways, airports, and transit. Some federal funds are geared to particular programs like safety, or improving air quality by reducing congestion.

There are not sufficient revenues overall to invest as much as might be desirable in all aspects of the transportation system. It is possible, however, to "leverage" transportation investments to integrate the system more completely. This can be done by investing in work that directly or indirectly provides benefit to more than one mode. A leveraged investment is one that improves the performance of more than one mode at the same time, or reduces the need for investment elsewhere in the integrated transportation system.

For example, investment in a roadway preservation project may also provide an opportunity to improve crosswalks and pedestrian access to transit stops. The roadway project may also improve the safety or reliability of transit and commercial vehicles. Investing funds where there is a high potential for leverage is a way to support the integrated system.

Decision Principles for the Integrated System:

An integrated transportation system for users can be achieved by making planning decisions consistent with systems integration. At the highest level, the first decision pertains to the investment of statewide revenues into funding categories and programs that can be leveraged to support integrated projects and programs. Key principles for statewide investment decisions are:

- Invest financial resources to preserve existing system components.
- When improving a system component, consider and make allowances for improvements that may be needed in integrated components.
- Seek investments that provide leverage, remove barriers, realize opportunities, and improve integration for multiple components.
- Assess performance objectives with respect to all modes.

When funding is available, additional decisions can be made about how and where to implement projects to better integrate transportation elements in Michigan's corridors and activity centers. These decisions should take into account the complexity of the transportation needs of the users and activities affected by the project. That assessment should occur in the scoping of transportation improvements. Key principles for corridor implementation strategies are:

- Implement strategies one project at a time;
- Assess the complexity of user needs and activities when conducting corridor studies;
- Allow greater flexibility and innovation in funding for needs that are more complex;
- Assess how connections to and within complex activity centers can be improved for overall corridor performance;
- Recognize that investments in one mode on a complex corridor or in an activity center are likely to generate needs or benefits on other modes;
- Coordinate with partners and stakeholders to understand corridor complexity and maximize financial and performance leverage for other modes or jurisdictions; and,
- Consider linkages between land use and performance of system components.

Integrating transportation hinges on the ability to keep all potential transportation users in mind when making choices about how to invest resources, implement programs, or develop projects. Ultimately, the development and delivery of an integrated transportation system occurs one project at a time, one decision at a time.

MI Transportation Plan provides concepts and principles for the decisions needed to realize the vision of a fully integrated system. The beneficiaries of an integrated system are Michigan's people and businesses, who will use the integrated system to achieve their greatest human and economic potential with greater freedom from the barriers to safety, mobility, and sustainability.

Chapter 1. Introduction

The *Integration Technical Report* is one of 17 technical reports developed to support *MI Transportation Plan*. Each report serves (1) as a resource for information about its substantive focus area and (2) as a component of the integrated transportation plan.

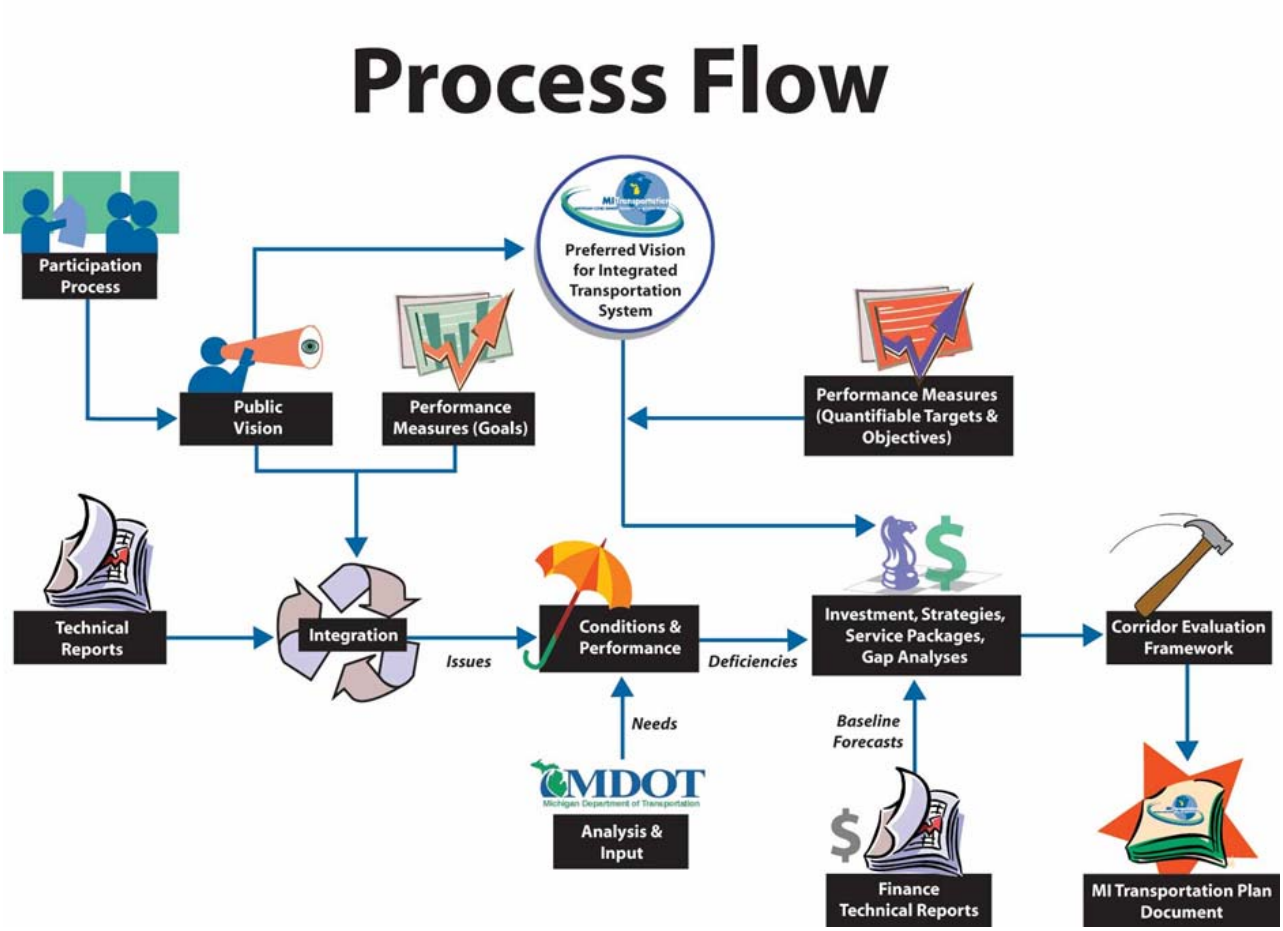
The technical reports can be grouped into four different categories based on the aspect of Michigan's transportation markets and policy environment addressed by each. As shown in **Table 1**, the technical reports include (1) reports describing the nature of transportation demand and markets in Michigan, (2) reports pertaining to Michigan's supply of transportation services and infrastructure, (3) reports addressing externalities bearing on Michigan's transportation system, and (4) synthesis reports addressing the implications of potential transportation improvement actions and strategies. The *Integration Technical Report* is the first of the synthesis reports, drawing on the major issues covered in the other reports and providing the rationale for the other synthesis reports of the plan.

Table 1: Technical Reports in *MI Transportation Plan*

System Users and Transportation Demand	*System Components and Transportation Supply*	*Externalities*	*Synthesis*
• Travel Characteristics • Socioeconomic • Freight Profile	• Aviation • Non-Motorized • Intercity Passenger • Transit • Highway/Bridge • Finance	• Highway Safety • Security • Environmental • Land Use	• Integration • Conditions and Performance • Economic Outlook • MPO/RPA

Figure 1 illustrates how the *Integration Technical Report* links the other technical reports of *MI Transportation Plan* to the statewide strategies and priorities ultimately resulting from the plan itself.

Figure 1*: MI Transportation Plan* Process Flow



Source: MDOT

Chapter 2. Objective and Scope

MI Transportation Plan is being delivered within the context of Michigan's policy environment. The state seeks to leverage its assets, programs, and policies to support jobs and economic vitality. The integrated transportation system plays an important role in Michigan's economic vitality. Transportation infrastructure and programs connect system users with economic activities. Michigan's economy depends on connections that are safe, efficient, and sustainable. The chief objective of this *Integration Technical Report* is to identify how the integrated transportation system can best connect people and businesses with economic activities in Michigan. A seamless and integrated transportation system empowers people to make the

most of opportunities. An integrated transportation system supports economic vitality by removing barriers to economic activity.

The transportation system is comprised of many components. The system as a whole enables a diversity of people and businesses to engage in a broad range of economic activities. The other technical reports have examined each system component in detail. Some of the technical reports have also examined the travel characteristics. Other reports have examined the socioeconomic, land use, and environmental context in which the system operates. Each technical report in *MI Transportation Plan,* addressing a specific system component, includes a specific section on integration issues. The *Integration Technical Report* uses these insights from the other technical reports to build a statewide, multi-modal approach for planning an integrated transportation system supporting Michigan's economy.

The report closes with a set of decision principles. These decision principles are offered to guide statewide planning and decision-making. The decision principles emphasize the importance of providing an integrated transportation system to connect people, businesses, and activities.

The transportation system is complex. The system is complex because it is used by many different people for different reasons. It is also complex because it is made up of different programs and components. Some concepts can make it easier to manage the complexity of the integrated system. The purpose of introducing integration concepts is to identify relationships between different aspects of the system.

Therefore, the scope of this report includes the following elements:

Define Key Concepts of the Integrated System:

There are many different aspects of an integrated transportation system. Planning for an integrated system requires defining concepts for relationships between:

- System components;
- System users;
- Activities supported by the system; and
- The goals and objectives of system performance.

The scope of this *Integration Technical Report* entails introducing and defining the concepts associated with planning for the integrated system.

Relate Integrated System Performance to Economic Vitality:

Transportation system performance is a factor contributing to economic performance. It is important to understand the role of the integrated transportation system in Michigan's overall economy. It is equally important to understand how integrated system planning may provide leverage to remove barriers to economic performance and realize opportunities. The scope of

this *Integration Technical Report* addresses the role of the state's integrated transportation system in the state's economic vitality.

Identify System Users and Activities:

Michigan's economic potential lies in its people, businesses, and natural resources. To realize this potential, people and businesses rely on different components of the transportation system. People or businesses may use components of the transportation system in different combinations. The scope of this *Integration Technical Report* identifies groups of people and businesses using the integrated system and examines which groups of people and businesses rely on different combinations of transportation resources.

To realize their economic potential people and firms must use the integrated transportation system to access economic activities. Different economic activities rely on system components combined in different ways. The scope of this *Integration Technical Report* addresses how the transportation system supports different types of activities. This report also examines which types of activities depend on different combinations of transportation resources.

Identify the Role of Corridors and Activity Centers:

Activities supported by the system are often concentrated in activity centers throughout Michigan. These activity centers are accessible by different system components that can be organized both within activity centers, and on corridors between activity centers. The scope of this *Integration Technical Report* addresses how Michigan's system corridors support economic activities and activity centers.

Describe Barriers and Opportunities for Integrated Performance:

Conditions on the integrated system may create economic barriers or opportunities for system users. Performance barriers are conditions on the transportation system that make it more difficult, more expensive, or impossible for an economic activity to take place. Opportunities are conditions on the transportation system that make it easier, less expensive, or possible for an activity to take place that may not otherwise occur.

Barriers and opportunities affect the degree to which Michigan's transportation conditions help or hinder economic performance. The performance goals and objectives of *MI Transportation Plan* address barriers and opportunities at the system level. The scope of this *Integration Technical Report* relates system barriers and opportunities identified in the technical reports to statewide system performance objectives.

Identify Challenges of Financing an Integrated System:

The financial resources available for the transportation system are often tied to individual system components. It is costly to maintain and improve the condition and performance of each individual component. Leverage is a way to manage the costs of preserving and improving the transportation system. Leverage is obtained when an investment in one

component of the system enhances the performance of other components as well. The scope of this *Integration Technical Report* addresses the challenges of leveraging available resources to meet the complex needs of an integrated system.

Decision Principles for an Integrated Approach to System Planning:

MI Transportation Plan involves decisions. The plan involves decisions about the allocation of resources. It also involves decisions about the implementation of programs. Decision principles are practical ways to apply integration concepts in statewide and corridor planning. This *Integration Technical Report* derives actionable decision principles for *MI Transportation Plan* based on the findings of this report.

Chapter 3. Integration Concepts Defined

To achieve the objectives of this report, key concepts of system integration are consistently defined. The concepts of system integration concern relationships between system users, the economic activities accessed on the system, and the components of the system. Simple Webster's definitions do not describe how these relationships are pertinent to Michigan's transportation system. Terms are defined in **Appendix A** to clarify how the terms used in this report pertain to Michigan's transportation system and *MI Transportation Plan*. **Appendix A** is a glossary of terms used throughout this report to understand planning for the integrated system. The definitions are important for understanding this *Integration Technical Report* within the context of *MI Transportation Plan.* Integration concepts defined in this chapter are available in the glossary for reference throughout this report.

3.1 Concepts Pertaining to the Role of the Integrated System

Economic potential is defined as the natural, human, capital, and cultural resources of the state that can generate value, income, and improve the quality of life in Michigan's economy. Economic potential may lead to economic "vitality" if it can be realized through the activities of business, workers, and consumers. One key to realizing economic potential is providing access and mobility through an integrated transportation system. Economic vitality occurs when economic potential is transformed into value, income, and quality of life in Michigan.

3.2 Concepts Pertaining to Uses of the Integrated System

System users are those who depend on the transportation system to engage in activities. They may include direct and indirect users. Direct users are travelers and freight carriers who physically use the system. Indirect users include businesses, residents, and other stakeholders who would be unable to engage in activities if the system were not in place or failed to perform.

User segments are groups of system users who use the transportation system in a similar way, with similar travel characteristics and purposes (as defined in the *Travel Characteristics Technical Report*). User segments are helpful for understanding how users are affected by different aspects of system performance. Any given user may belong to more than one segment. For example, if a businessman lives in the city, he shares the needs and choices of city residents. When he drives around town, walks on urban sidewalks, or uses urban transit, he uses the system as a city resident. If he works in an industry that involves traveling on an air charter carrier once a month, he then also participates in the air charter travel segment and, therefore, has needs not common to other city residents.

The complexity of a user segment refers to the breadth of transportation system components that may be required to support a particular user segment. A user segment can also have complex needs when it is sensitive to other considerations. Some groups of users can be especially sensitive to safety; land use or environmental quality may be involved with meeting transportation needs.

Activities are specific actions undertaken by system users that require movement of people or goods to access places, people, or other resources. The movement itself is not the activity. The activity is the action that requires the movement of people or goods. For example, if an individual drives to the supermarket, the activity is shopping at the market, not driving. Activities are associated with trip purposes, defined in the *Travel Characteristics Technical Report* as "the reason for travel, or the main activity at the trip destination." For example, if a manufacturer relies on delivery of wood and the commuting of workers to produce furniture, furniture production is the activity, which depends on the transportation system for both the delivery of the wood and the accessibility of workers. For the workers in the furniture factory, the ultimate activity is work in the factory. The workers depend on the transportation system to make the work activity possible. Activities are the way economic potential is transformed into economic vitality.

Activities can have complex transportation requirements. Activities requiring more transportation system components have more complex requirements than activities requiring only one component. Sensitivity to other transportation issues like safety, land use, or environmental quality impacts can add to the complexity of transportation planning for an activity.

3.3 Concepts Pertaining to Activity Centers and Corridors

Activities are concentrated in activity centers. Activity centers are geographic locations with concentrations of people, jobs, educational and health facilities, tourist attractions, and other economically important facilities or services. Activity centers are important because the transportation needs of many system users come together in activity centers. They are important nodes of transportation infrastructure and services.

Corridors are transportation systems that link activity centers to each other and to system users. Corridors are not limited to highway routes. Corridors include the combinations of modes, infrastructure, and transportation services required to link activity centers and system users to other activity centers.

3.4 Concepts Pertaining to Integrated System Performance

Performance barriers are conditions on the transportation system that make it more difficult, more expensive, or impossible for an activity to take place. In the economic impact element of *MI Transportation Plan*, performance barriers increase the cost of doing business. Performance barriers can also create costs for households and individuals. In the *Conditions and Performance Technical Report* of *MI Transportation Plan*, some performance barriers are described by performance measures.

Opportunities are conditions on the transportation system that make it easier, less expensive, or possible for an activity to take place that may not otherwise occur. In the economic impact element of *MI Transportation Plan*, opportunities are represented as amenities for firms. Opportunities can also include amenities for households or individuals. They make Michigan a more attractive and valuable place to live and work. For the purposes of this report, opportunities are understood as special ways in which system performance may stimulate users to engage in more or better activities without significantly increased transportation costs.

System components are the individual elements of modal infrastructure, services, programs, and assets that help the integrated system connect system users with activities.

Component performance is the effectiveness with which any given system component connects system users with activities. Failures or shortfalls in component performance may cause system performance barriers. They prevent users from engaging in activities. Performance measures for specific modes or components can show how severely performance barriers are affecting different aspects of the system.

The integrated system is the full combination of transportation infrastructure, services, programs, and assets in place to connect system users with activities. The arrangement of all system components comprises the integrated system.

System performance is the effectiveness with which the integrated system enables users to engage in activities. System performance depends on the performance of each component of the system. It also depends on the strategic arrangement of all system components to support users in seamless manner. A goal of system performance is to overcome and prevent performance barriers that may stand between users and activities.

Performance objectives are statements that indicate desired conditions on the statewide transportation system. They are based on statewide performance goals and can be benchmarked by performance measures.

3.5 Concepts for Planning the Integrated System

An investment package is an investment scenario. An investment package offers a combination of investments in transportation programs to support system performance. An investment package can be understood as a "mix of fixes." The *Revenue Gap and Investment Packages Report* of *MI Transportation Plan* compares different investment packages.

A decision principle is a consideration for qualitatively assessing a statewide investment package based on the complex relationships affecting integrated system performance.

A funding category describes a way transportation funds can be invested in a specific element of the system. Funding for the transportation system is organized into these categories to ensure revenues for each individual system component, or because the law requires it.

Leverage is the potential to improve system performance through multiple modes by investing resources into one funding category.

Direct leverage is the chance to save money by improving multiple physical system components or specific services within the scope of one project or improvement type.

Indirect leverage is the chance to improve system performance on multiple system components while investing money into only one component of the system.

Chapter 4. The Integrated System and Michigan's Economy

4.1 The Transportation System is a Sub-System of the Economy

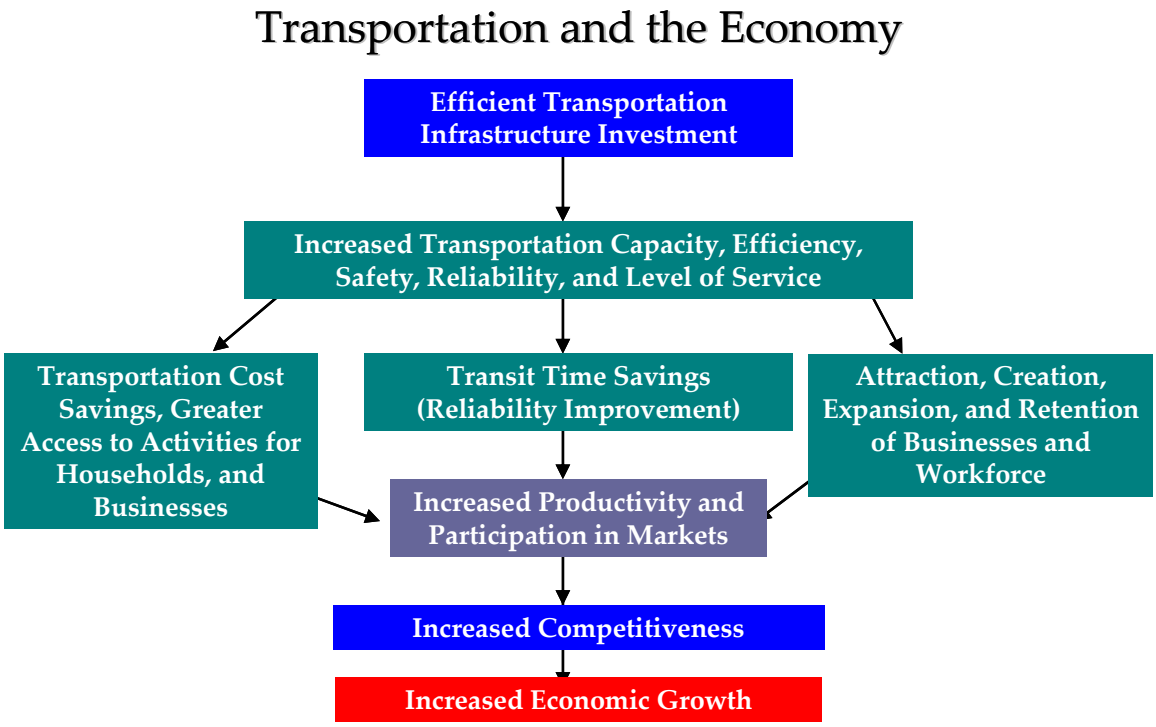
Michigan's integrated multi-modal transportation system is an asset to the state's economy. It is comprised of both public and private assets, private services, and travel markets that operate within the state's economy. The system includes 9,716 miles of state trunkline roadway, with more than 200 carpool parking lots in addition to approximately 120,000 miles of non-state roadways. It includes 40 marine cargo ports and another 55 recreational harbors, 236 airports, 3,590 miles of operating rail track, 78 transit service providers, 1,420 miles of non-motorized rail trails, and hundreds of miles of sidewalks and bike lanes maintained and developed by public and private entities across the state.

The system also includes all of Michigan's businesses that depend on the daily transportation of workers and commodities, and all of Michigan's people, who depend on the system for most of their activities. Michigan's system is a critical asset to the United States, with over 44 million tons of commodities passing through the state each year by truck alone, and over $300 billion worth of imports and over $276 billion worth of exports exchanged with the rest of the United States and the world.

4.2 System Performance and Economic Performance

The transportation system is affected by economic trends. The performance of the transportation system also has an impact on economic performance. For example, changes in workforce participation, business hours of service, and Michigan's basic industry mix have impacts on peak-hour traffic levels, parking availability, truck and port through tonnages and the associated wear and tear on physical infrastructure. At the same time, bottlenecks, safety and environmental costs, modal disconnects, and noncontiguous services across jurisdictional boundaries limit the performance of Michigan's labor and consumer markets, industrial sectors, and trade. **Figure 2** illustrates this linkage in very high-level terms; Increased Economic Growth (shown at the bottom of the figure) provides the tax base and other resources to further support Efficient Transportation Infrastructure Investment, (shown at the top of the figure) reinforcing the cycle of growth.

Figure 2: Transportation and the Economy



Source: Adapted From FHWA Office of Freight Management and Operations, 2004

Transportation system capacity is one of the constraints on the development capacity of Michigan's economy. Economic development is one of the drivers placing pressure on system capacity. When businesses prosper and engage in more economic activities, utilization, and dependence on the transportation system increases. Increasing economic activity places further demands on the infrastructure. When infrastructure and transportation services become

deficient for the demands of system users the costs of doing business increase. Higher costs of doing business, due to transportation system deficiencies, are an impediment to economic vitality by negatively impacting industry and economic performance.

4.3 Transportation Dependence of Industry Sectors

Many of the technical reports of *MI Transportation Plan* address different aspects of personal travel demand. They explore segments of the traveling public that depend on transportation systems to engage in Michigan's economy. Industry sectors use different modes of transportation in different mixes as well. The linkage between transportation system capacity and industry economic performance varies in different sectors of the economy.

The 2000 US Bureau of Transportation Statistics report, *Transportation Satellite Accounts,* describes the reliance of different industries on transportation modes/sectors. The *Transportation Satellite Accounts* show the value of transportation services each industry must consume in order to produce a dollar of output. The report is based on national data. It provides a general basis for comparing the degree to which each industry may be affected by changes in transportation services, costs, and performance. **Figure 3** compares the direct requirements of different types of transportation by industry as reported in the *Transportation Satellite Accounts*.

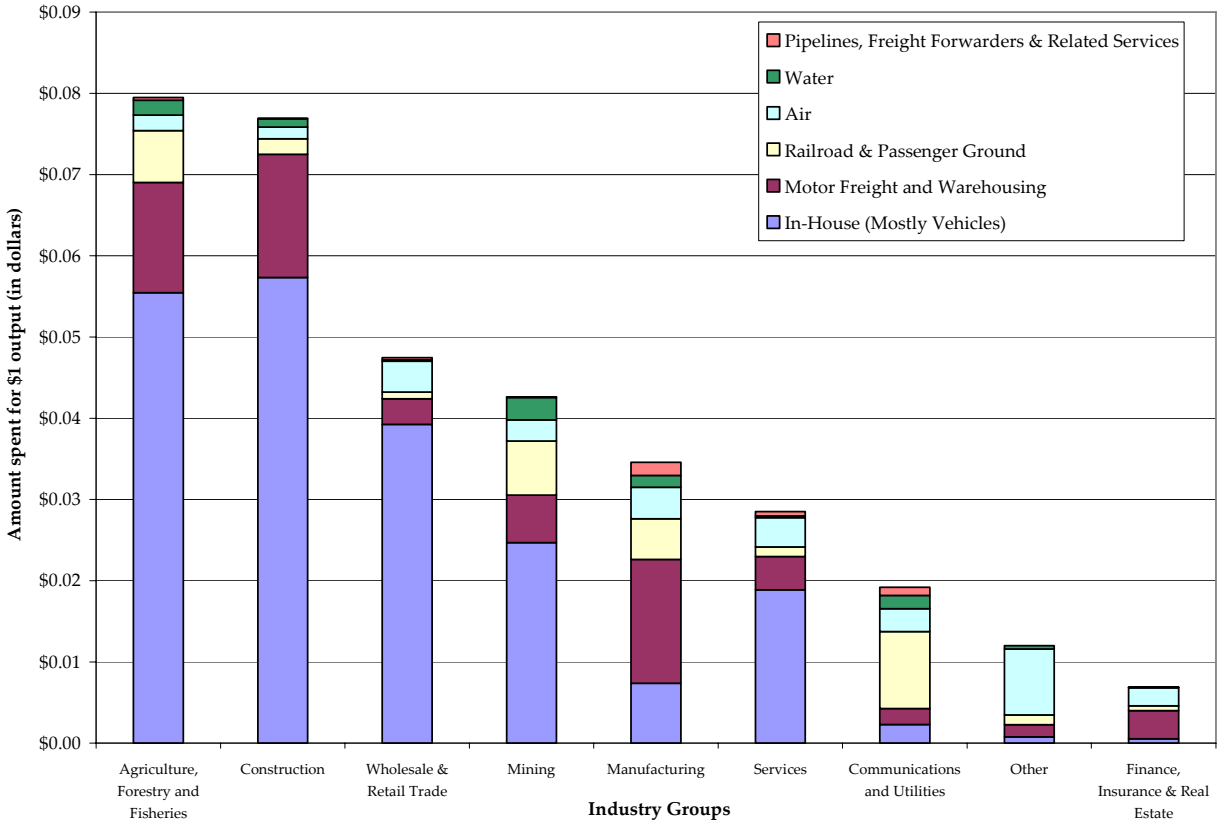
For most industries, the in-house transportation consumption accounts for the most common type of transportation consumed. It is considered in-house transportation if a firm provides its own transportation services as part of its transportation budget, as opposed to contracting with another firm. Because most in-house transportation consists of company cars, trucks, and other vehicles on the highway system, this cost is especially sensitive to highway system performance. Some firms do have other types of in-house transportation (such as company jets or boats). Industries that rely heavily on in-house transportation services are likely to benefit heavily by improved highway performance, and may also be expected to benefit from improved efficiencies in transportation costs across modes.

Figure 3 indicates the overall relative magnitude of dependency on transportation for each industry group. The size of the vertical bar representing each industry is a measure of the industry's overall dependence on transportation expenditures to produce output. For example, industries in the Agriculture and Construction groups consume significantly more transportation services per dollar of output than the Finance Insurance and Real Estate group.

The numbers on the vertical axis indicate amount of money each industry is expected to spend on transportation to produce one dollar of output. For instance, the agriculture industry spends about $0.055 on in-house transportation, $0.015 on freight and warehousing, $0.05 on rail, and about $0.02 on air and other related transportation services.

It is important to note that the *Transportation Satellite Account* records the expenditures for transportation services and does not necessarily reflect the order of importance in terms of ton-miles. For example, a coal company may use barge service to move the coal 75 percent of the total distance and truck service for the remaining 25 percent. However, due to the price differences between modes, the highway portion of the trip may represent the majority of the total transportation cost.

Figure 3: Comparative Transportation Requirements by Industry [add label on the vertical]



Source: Transportation Satellite Accounts US Bureau of Transportation Statistics, 2000

4.4 The Role of MDOT and the State Transportation System

The Michigan Department of Transportation (MDOT) is responsible for the management and development of the state-owned assets of the transportation system. One policy objective of the department is to manage its transportation assets to maximize their support of the state's economic performance. The decisions MDOT makes also have impacts on local roadway, transit, air, marine, and non-motorized systems that are not under the department's jurisdiction. The ripple effect of state planning decisions can affect all levels of transportation.

Transportation investment and management decisions are presented in this report as decisions about how to leverage all of MDOT's assets (across modes) to remove barriers to Michigan's economic performance. *MI Transportation Plan* and its corridor implementation strategies focus on ways in which decisions for funding and managing Michigan's system can remove barriers to key economic activities. Decisions pertain both to the statewide investment in different programs, and to supporting activity centers and corridors. The focus is on the transportation system as an interconnected whole, rather than a group of modal silos and programs.

4.5 Key Roles of the Transportation System Planning Economic Performance

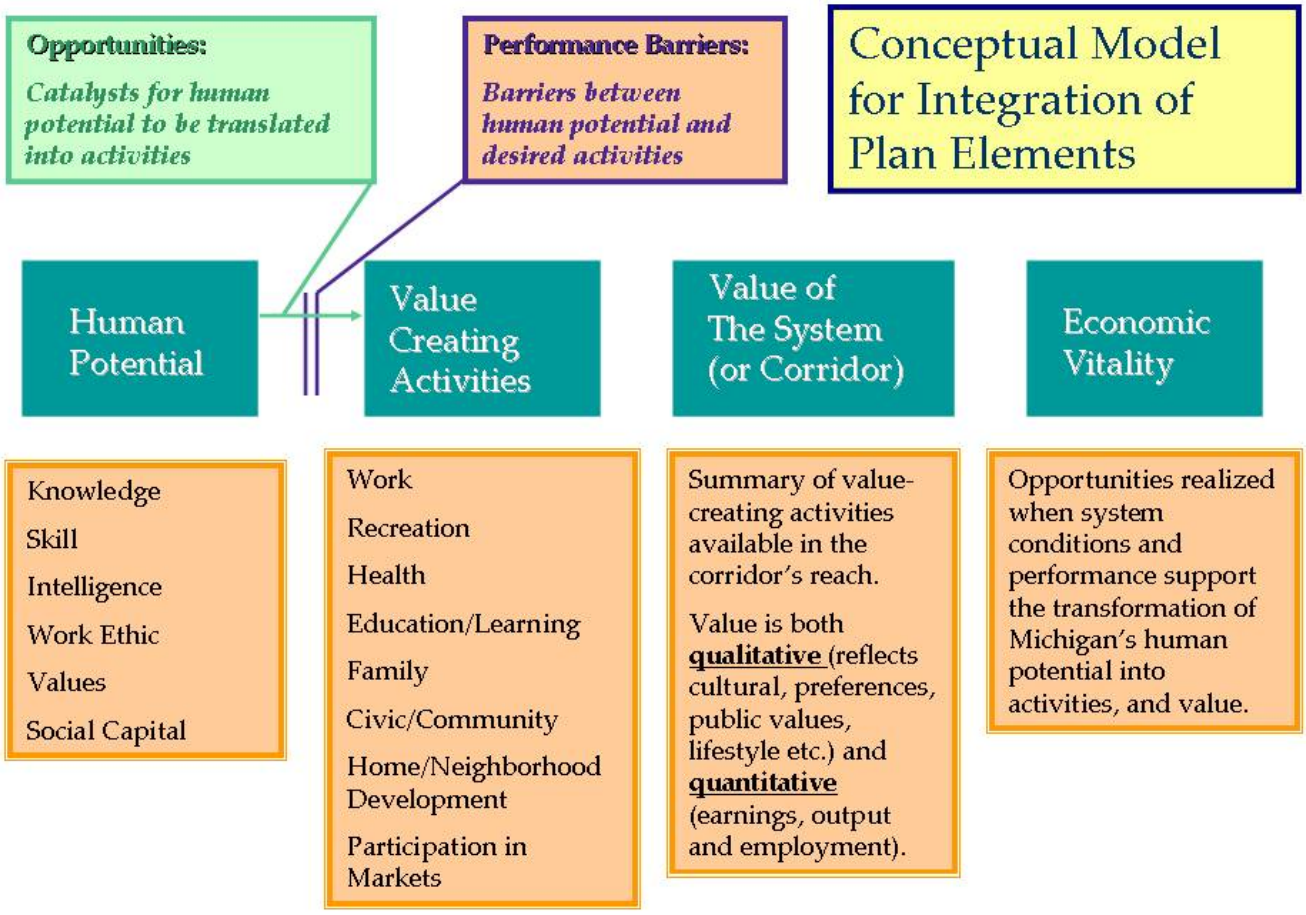
The overall role of the transportation system is to connect system users to activities in the safest, most efficient, and sustainable ways possible. This is achieved by:

(1) Identifying, preventing, and removing performance barriers that may prevent or inhibit Michigan's system users from engaging in economic activities and

(2) Identifying and supporting opportunities on the transportation system that may encourage or stimulate economic activities.

Figure 4 illustrates how transportation system barriers may stand between Michigan's economic potential and the value-creating activities that transform potential into economic vitality. Achieving the performance goals of the transportation system requires removing these barriers and realizing opportunities. Barriers, opportunities, and performance objectives are further explored in **Chapter 8, System Performance as a Barrier and an Opportunity for Economic Vitality,** of this report.

Figure 4: Transportation System Barriers



Chapter 5. Transportation System Users and Michigan's Economic Potential

Michigan's people and businesses are the ultimate source of potential for the creation of value, jobs, and vitality in Michigan's economy. They are also the ultimate beneficiaries of decisions pertaining to the transportation system. The function of the integrated system is to connect users with activities, consumers with markets, businesses with the resources they need for production. Each of the modal technical reports of *MI Transportation Plan* identifies segments of system users sensitive to the performance of that mode or system component.

Throughout the technical reports, user segments are associated with each component of the transportation system. In many cases, the same user segment depends on a number of different components. For example, inner city residents are identified in the *Transit Technical Report* as likely users of transit, and also in the *Non-Motorized Technical Report* as users of bicycle and pedestrian infrastructure. This means that some types of users require more coordination of different modes and components than others. Understanding how different user segments can depend on multiple modes or components provides insight for planning the integrated system. The relative complexity of planning for a user segment depends on how many potential modes and other programs that may be involved in meeting their needs.

This section examines Michigan's transportation system user segments from a statewide, multi-modal perspective. Understanding user segments means recognizing how many different combinations and arrangements of modal and system components may be needed for the system effectively serve a group of users.

Throughout the technical reports, 27 different user segments are identified. Their dependence, sensitivity, and needs with respect to different aspects of the transportation system are discussed in the integration section of each report. Segments are identified in each technical report by associating the issues facing system components (or modes) within the context of the *Travel Characteristics* and *Socioeconomic Technical Reports.*

It is helpful to realize how the components of the transportation system serve many of the same users. **Figure 5** provides a full listing of user segments identified in the technical reports. User segments specifically identified in the integration sections of technical reports are illustrated by black squares with a white letter "T." Because the identification of segments in the technical reports is subjective, it is understood that segments identified with respect to one aspect of the transportation system may also be relevant in other aspects as well, even if not explicitly mentioned in a technical report.

The shading in **Figure 5** recognizes in black squares without the letter "T" those segments that may be dependent on a particular aspect of system performance, even though it is not explicitly addressed in a technical report.

Figure 5: Complexity of User Segments Identified in Technical Reports

User Segment (Group)	Segments	Focus Area (Technical Reports)								
		Aviation	*Transit*	*Highway and Bridge*	*Non-Motorized*	*Inter-City*	*Environmentally Sensitive*	*Freight*	*Land Use*	*Safety*
Travelers	Urban/City Residents		T	T	T		T		T	
	Transit Dependent People		T	T	T				T	T
	Elderly Travelers		T		T		T		T	T
	Children and Young People		T	T	T		T		T	T
	Tourist and Recreational Travelers	T					T		T	
	Low Income People		T		T	T			T	
	Ex-Urban and Regional Commuters		T						T	
	Health Walkers and Cyclists			T	T				T	T
	Blue Collar/Industrial Workforce		T	T						
	Students (High School/College)		T							T
	Business Travelers	T		T						
	Distance Travellers (100 Miles or More)	T		T						
	Disabled Travelers		T							
	Service/White Collar Workforce	T		T			T			
	Charter Travellers (Bus)			T						
	Immigrant and Non-English Speaking Populations						T		T	
	Charter Travelers (Air)	T		T						
Operators	Freight Carriers	T					T	T	T	T
	Mail and Contract Carriers	T					T	T		T
	Charter Shippers	T					T	T		
	Passenger Carriers (Inter-City)			T						
	Charter Carriers	T					T	T		
Other Stakeholders	Tourism Businesses						T	T	T	
	Retail Vendors							T	T	
	Real Estate Developers/Private Land Interests						T		T	
	Service Businesses							T	T	
	Just in Time Manufacturers							T		
	Agri-Business (Including Farms and Nurseries)						T			

T	Relationship Identified in Technical Report
	Potential Relationship
	Possible Indirect Relationship

By looking at **Figure 5** it becomes apparent that some groups of transportation system users are related to more than one transportation program or service. For example, city residents as a group have the potential to be affected by more linkages between components than air charter travelers. Consequently, the planning for travelers in urban areas is likely to involve more decisions about integrating programs than planning an air charter facility.

It should be noted that individuals can belong to more than one user segment. Segmentation is a tool for understanding the complexity of transportation planning decisions regarding system performance, not as a way of directly managing trade-offs between different user groups.

The segments can be broadly categorized as:

- Traveler Segments;
- Carrier and Operator Segments; and
- Other Stakeholder Segments.

5.1 Traveler Segments

Traveler segments are comprised of individuals using the transportation system for personal travel. **Figure 5** shows that the technical reports identified 17 specific segments of personal travelers, many of which appeared in multiple technical reports with linkages to different modes and other system conditions. System performance is especially challenging for those who depend on a broad range of modes. Failure of any given mode, or component, or any inappropriate arrangement of system components, can create a system performance barrier for these users.

Identifying general traveler segments helps the planner understand when different transportation programs and components may need to be integrated in corridor or project plans. In this analysis, traveler segments are described with reference to the breadth of different transportation components and programs they may use.

5.1.1 Travelers Potentially Using Many Transportation Programs

The traveler segments who rely on the most complex combination of transportation components and programs include:

- Urban/city residents;
- Transit dependent people;
- Elderly travelers;
- Children and young people; and
- Tourists and recreational travelers.

Decisions about infrastructure and services for these users may are likely to involve coordinated planning for different state and local transportation programs. All of these user segments have potential linkages described in the technical reports on highway and bridge, non-motorized, and transit systems. All of these groups are also highly sensitive to the land use and environmental decisions made on the transportation system. All are potential users of the intercity system and most are potential users of the aviation system. Full system performance for these groups cannot be achieved by ensuring the performance of just one component. Meeting the needs of these segments is likely to require harmonious performance of multiple system components. Investment packages and implementation strategies that provide for a balance of system components are likely to best meet the needs of these users.

There are other traveler segments that are also likely to depend planning involving multiple programs. While not involving as many potential program areas as described above, the following eight groups of users are also likely to require coordinated planning of at least two or more transportation programs:

- Low-income people;
- Ex-urban and regional commuters;
- Health walkers and cyclists;
- Industrial commuters;
- Students;
- Business travelers;
- Distance travelers; and
- Disabled travelers.

Decisions about infrastructure and services for these groups will clearly involve ensuring performance of multiple modal components. Decisions for these groups is also likely to involve the careful arrangement of transportation programs to ensure connectivity between modes. The number of modes involved may be less than for the most highly complex segments. Decisions for most of these travelers can involve both transit and highway and bridge systems. Decisions for these groups are also likely to require integrated decisions with land use planning and special safety considerations. Linkages between aviation systems and roadway systems are likely to add to the complexity of decisions involving the business traveler and distance traveler groups.

5.1.2 Travelers Involving Fewer Transportation Programs

The traveler segments that rely on less complex combinations of system components include:

- White-collar commuters;
- Charter bus travelers; and

- Air travelers.

While decisions for these groups may involve more than one transportation component or program, these groups tend to primarily utilize one or two modes, usually connected with a primary mode. Another set of travelers included in this segment are immigrants and non-English speaking populations. The immigrant and non-English speaking populations are expected to be highly sensitive to how services and infrastructure are delivered (cultural and language considerations). They do not necessarily rely on a complex mix of modal components in and of themselves. In decisions all of these groups of travelers, the performance of a particular system component, such as a primary mode of travel, may provide a reasonable indicator of overall system performance.

5.2 Carrier or Operator Segments

Carrier or operator segments are comprised of firms providing personal or freight transportation services using Michigan's transportation infrastructure. **Figure 5,** on page 22**,** shows that the technical reports identified four specific segments of carriers and operators. Some of these groups of transportation system users appeared in multiple technical reports with linkages to different modes and other system components.

They include firms whose day-to-day operations depend on deliveries made on the system (shippers). They also include firms operating transportation services. Examples of users operating transportation services are carriers of passengers such as airlines and intercity bus operators as well as freight carriers such as trucking companies, and mail and contract carriers. These firms may also include third party logistics providers, offering their own multi-modal service to clients for timely, safe, and reliable delivery of goods.

System performance is especially challenging for carriers and operators who depend on a broad range of modes. When a carrier or operator depends on more than one mode or program, a barrier can be created by failure of any given component. For example a failure at a port can upset the carrier's entire schedule and operation for the highway or rail portions of the shipment. Any disconnected arrangement of system components can also create a barrier for these operators and carriers. For example, even if a shipment arrives at a port on time, if the truck delivery schedule is not synchronized with the port delivery schedule there is a delay. The following is a brief discussion of the carrier and operator segments, and the system performance challenges associated with meeting their needs.

5.2.1 Carrier and Operator Segments Use Many Modes

All of the carrier and operator segments rely on complex relationships between different modes and components. All can involve aviation, highways, rail and bridges and have implications for the physical environment. Because they all involve trucking and heavy vehicles, the special safety considerations associated with heavy vehicles apply to all. System planning decisions involving carriers and operators potentially involve aviation, rail and highway modes as well as

ports, which are addressed in the *Freight Profile Technical Report*. When considering investment packages and corridor implementation strategies from the shipper and carrier perspective, it is likely that the balance and arrangement of highway, rail, and port investments will need to be considered. Strategies for carriers and operators also involve the potential need to address the environmental, land use, and safety implications of improvements for these users.

5.3 Other Stakeholder Segments

Other segments of system users include stakeholders who, while not physically moving on the system, use it to manage their operations, create value at their locations, and engage in markets. **Figure 5,** on page 22, shows that the technical reports identified five specific segments of stakeholders. Many of these groups were cited in multiple technical reports with linkages to different modes and transportation programs. Most of these stakeholders rely on a broad range of modes, where a system performance barrier can be created by a failure of any given component. These stakeholders can also be affected by any disconnected arrangement of system components.

The following is a brief discussion of the stakeholder segments, and the system performance challenges associated with meeting their needs.

5.3.1 Stakeholder Segments Depend on Many Modes and Issues

Special stakeholder groups identified in the technical reports include:

- Tourism businesses;
- Retail vendors;
- Real estate developers and land interests;
- Ecologically sensitive segments such as agricultural nurseries;
- Manufacturers (especially time-sensitive just-in-time operations); and
- Service businesses.

Decisions about infrastructure and services for these stakeholders are likely to involve ensuring the performance of multiple modal components. Decisions involving these stakeholders also require careful attention to the connectivity of modal programs and components. To meet the needs of these stakeholders, decisions must be sensitive to the environmental and land use implications of transportation investments, all are dependent on freight shipments and deliveries, including issues at locations on supply chains sometimes nearby but more likely at some distance from where the user is located.

Each of the above stakeholder groups depends on Michigan's highways, bridges, rail and transit systems to make nearby workers and far-off markets accessible. Some rely on non-motorized transportation or accessibility to airports or air freight. To support the vitality of

these groups, investment packages and corridor implementation strategies must provide for a balance of system components.

5.4 Users and System Performance

The above analysis has examined how Michigan's transportation system users rely on both the performance and arrangement of transportation system components and programs. An integrated approach to planning and investment decisions must take into account the needs of these groups to access activities through different combinations of programs and services.

For the most part, users are unaware of the complexity of system components associated with accessing activities. They simply understand their need to participate in an activity and find the best way to get themselves or their required goods to the activity. The preferred vision of *MI Transportation Plan* calls for such a seamless transportation system. Transportation components in a seamless system are arranged to remove barriers that may inhibit complex multi-modal travel patterns.

The complexity of user needs and activities is especially important in the implementation of corridor strategies. Implementing an integrated plan for activity centers and corridors requires MDOT to make decisions involving multiple program and service areas. This means that corridor improvement strategies must be based on an understanding of:

- Which groups utilize each corridor?
- On which combinations of modes and programs do these groups depend?

For example, a corridor that is heavily traveled by tourists with complex activity patterns may require a complex arrangement of modal components and programs. Integration for the tourist corridor is expected to be more challenging than for a corridor that is used primarily for the commuting of workers owning their own vehicles.

An activity center with a large concentration of transit-dependent households provides another example. The implementation strategy for a high concentration of transit-dependent households will involve structuring more modal programs and services than a corridor where users are known to be almost exclusively single-occupancy vehicle drivers.

The meaning of system performance and the application of performance objectives may be different based on the nature of system users.

Chapter 6. Activities and the Integrated System

The purpose of the integrated transportation system is to enable diverse users to engage in activities. Each of the technical reports identifies activities dependent on the various modal components of Michigan's transportation system. By engaging in activities, system users participate in markets, achieve educational goals, perform labor, provide services, access quality

of life, and realize Michigan's economic potential. The economic activities mentioned in the technical reports can be categorized into five broad groupings:

- Activities Supporting Community and Individual Quality of Life;
- Production of Goods and Services;
- Workforce Participation;
- Participation in Markets; and
- Sales.

Each of these groupings includes specific activities described in the technical reports. **Figure 6** provides a full listing of activities identified in the technical reports. It summarizes activities mentioned in each technical report as sensitive to particular modes or aspects related to system performance (illustrated as black squares with the white letter "T"). It is understood that activities identified in relation to one aspect of the transportation system may also be relevant in other aspects, even if not explicitly mentioned in the report.

The shading in **Figure 6** recognizes in black squares (without the letter "T") those activities that may be dependent on a particular mode or aspect of system performance, though not explicitly addressed in a technical report.

Some activities are more dependent on linkages between modes and system components than others. The complexity of an activity for the integrated system is gauged by how many different transportation modes or programs may be associated with the activity. For example, pleasure and recreational activities are accessed by all of the modes, and can directly involve almost all aspects of system performance except for freight. In comparison, health care activities have little linkage to the non-motorized and intercity components of the system. Health care activities are less likely to have special environmental sensitivities or represent special safety needs. Pleasure and recreational activities involve more coordination among potential transportation programs and components health care activities. The following is a brief discussion of an integrated approach to transportation planning decisions for different types of activities.

Figure 6: Complexity of Activities Identified in Technical Reports

Activity Types	Activities	Focus Area (Technical Reports)								
		Aviation	*Transit*	*Highway and Bridge*	*Non-Motorized*	*Inter-City*	*Environmentally Sensitive*	*Freight*	*Land Use*	*Safety*
Community Quality of Life	Pleasure/Recreation	T	T	T	T	T	T		T	T
	Social Activities								T	T
	Family Obligations								T	
	Civic Activities								T	
Production of Goods & Services	Manufacturing	T		T			T	T	T	
	Provision of Services	T		T				T		
	Inter-Modal Transfers			T			T	T		
	Warehousing			T			T	T		
	Mining (Nonmetallic Minerals)							T		
	Farming/Agriculture			T			T		T	
Workforce Participation	Building/Land Development						T		T	
	Working in Government		T	T					T	
	Working in Service Sector	T	T	T					T	
	Working in Industry		T	T					T	
Participation in Markets (Final Demand)	Consumption (Shopping)		T	T					T	
	Consumption of Services		T	T					T	
Sales	Retail Sales	T						T	T	
	Wholesale Sales	T		T				T	T	
Individual Quality of Life	Exercise/Health Walking or Cycling				T		T		T	T
	School and Educational Activities		T						T	T
	Health Care		T							

T	**Relationship Identified in Technical Report**
	Potential Relationship
	Possible Indirect Relationship

6.1 Activities Supporting Community Quality of Life

Activities supporting community quality of life involve individuals traveling for the purposes of:

- Pleasure;
- Recreation;
- Family obligations;
- Civic involvement;
- Family Obligations; and
- Civic Activities.

These activities realize economic potential by retaining and attracting residents and workers in Michigan. Such activities also support Michigan's social capital and institutions. This is recognized by MDOT's mission statement "To provide the highest quality integrated transportation services for economic benefit and improved quality of life."

6.1.1 Community Quality of Life Depends on Many Aspects of Transportation

Activities supporting community quality of life can depend on many possible combinations of transportation modes and programs. These activities may involve virtually any mode or combination of modes, and are highly sensitive to land use and the natural environment. Transportation investment decisions aimed at supporting these tourism activities (and centers where these activities occur) may require complementary investments in modal components and a strategic arrangement of modal assets.

Investment packages and corridor implementation strategies in centers where these activities are concentrated are likely to require a mix and strategic arrangement of modal components.

6.2 Activities Contributing to Individual Quality of Life

Activities contributing to individual quality of life involve individuals traveling to support their overall health and well being. Examples of these activities include:

- Exercise;
- Walking, or cycling for health purposes;
- School and educational activities; and
- Seeking health care.

These activities realize economic potential by helping retain and attract residents and workers in Michigan. This is recognized by MDOT's mission statement "To provide the highest quality integrated transportation services for economic benefit and improved quality of life."

The above activities contributing to individual quality of life may involve different combinations of transit, roadways, and non-motorized systems. These activities are unlikely to involve freight systems, aviation, or intercity components of the system. Exercise and recreational biking/walking are also sensitive to the natural environment and involve special safety considerations for recreational cyclists and walkers. Decisions and investment packages aimed to support the above activities are likely to involve a balance of investments in modal assets and a strategic arrangement of transportation system components.

6.2.1 Health Care Often Depends on a Primary Mode

Unlike many activities supporting individual quality of life, health care is often especially dependent on one mode or program. Access to health care often depends on transit or roadways, in some cases, aviation and only involves intercity transportation for non-drivers in need of more sophisticated care than is offered locally. Access to health care generally does not entail the use of non-motorized transportation, does not have complicated interactions with the natural environment, involve freight, or pose special safety needs. For these reasons, decisions and investment packages aimed at centers of health care activity may require more focus on a primary mode than on a complex arrangement of programs.

6.3 Production of Goods and Services

The production of goods and services consists of activities undertaken by businesses. These could include manufacturing products or providing government or private services. These activities realize economic potential by adding value to the worker's time, or to raw materials through the manufacturing process. The intermodal transfers and warehousing of products in the supply chain are also activities associated with the production of goods.

6.3.1 Production and Services Often Depend on Multiple Transportation Programs and Components

Manufacturing, the provision of services, intermodal transfers, and warehousing all rely on the performance of a combination of transportation programs and components. These activities may involve many modes simultaneously. They may also require a strategic arrangement of modes to be effective. In Michigan, only the non-motorized component of the system is unlikely to be involved with these activities. Because they may involve multiple and interdependent modes, investment packages and corridor implementation strategies for centers of manufacturing and service activity must invest in complementary transportation programs.

6.3.2 Some Production Activities Depend on a Primary Mode

Mining, farming, timbering, and agricultural activities involve less inter-modal complexity than other types of production. This is for two reasons. First, these activities involve the production (or extraction) of heavy commodities, for which complex transportation operations would be costly and impractical. Second, mining, timbering, and agricultural production often occur in

rural and other remote areas, where highways often the only mode available for workers. Many agricultural, forest, and mining commodities depend heavily on barge and rail systems. The primary integration issue for these systems pertains to adequate pavement and bridge condition for heavy trucking on farm-to-market roads, as well as efficient operations at rail and seaport operations. Some high-value Michigan agricultural products have a time-sensitive shelf life. Time sensitive commodities rely heavily on access to air freight as well. Any given mining, farming, or timbering activity is likely to depend heavily on one primary and one secondary mode for goods movement.

The relatively lower level of modal complexity for these activities makes these activities more sensitive to one particular mode of transportation. Because less complex production activities entail less potential for modal diversion, these activities are often especially sensitive to the condition and performance of one primary mode. For example, a major performance barrier inhibiting the mobility and accessibility of waterways would have a very concentrated impact on timbering activities. A waterway problem for the timbering industry could not be significantly mitigated by improving other modes or system components.

It should be noted the agri-business industry includes nurseries and laboratories with activities that can be more complex than traditional farms in their dependence on system components. Because these are not characterized by farming as an activity, these businesses are addressed as a complex user segment in **Section 5.3.1, Stakeholder Segments Depend on Many Modes and Issues**.

6.4 Workforce Participation

Participation in the workforce consists of activities undertaken by individuals in exchange for wages and earnings. These activities realize economic potential by enabling valuable goods and services to be produced. These activities also provide employment for workers who can then participate in markets as consumers.

6.4.1 Workforce Participation Depends Highly on Primary Modes

Workforce participation is depends heavily on a few key modes and combinations of transportation programs. It is less environmentally-sensitive and poses fewer special safety needs than other activities. It does not directly involve freight systems. The integration issues associated with workforce participation arise when because jobs may are accessed by mixes of roadways, transit, non-motorized systems. Certain types of jobs may also depend on commercial aviation. Investment packages and corridor implementation strategies supporting workforce participation are likely to involve a balance of investments between primary and secondary modes to achieve reliability. Workforce participation is expected to depend on a strategic arrangement of transportation system components to ensure the mobility of labor and seamless access to jobs.

6.5 Participation in Markets (as Consumers)

Participation in final demand markets consists of the consumption of goods and services. These activities realize economic potential by making choices, goods, and services available for consumers to sustain their households and businesses.

6.5.1 Consumers Rely On Multiple Modes and Transportation Programs

Participation in consumer markets requires the integration of many different modes and programs. Access to consumer markets may involve different combinations of roadways, transit, or non-motorized systems, and is closely tied to land use planning. Shoppers participating in retail markets may also be sensitive to environmental amenities. These activities seldom are associated with intercity services and do not directly involve freight or present special safety needs. Investment packages and corridor implementation strategies supporting retail and consumer centers are likely to involve a balance of investments in modal assets. Integrated approaches for these activities also require a strategic arrangement of transportation system components to ensure access to locations where consumer activities are concentrated.

6.6 Sales (Participation in Markets as Vendors)

Sales activities consist of wholesalers and retailers placing goods on the market. These activities realize economic potential by placing competitive goods on the market and providing profits for wholesalers and retailers.

6.6.1 Sales Activities Rely on Multiple Modes and Transportation Programs

Like participation in retail markets, all sales activities (wholesale and retail) can require the integration of many modes and transportation programs. Sales activities do not pose special safety needs or involve intercity passenger services. Sales activities are highly dependent on freight components and aviation to ensure adequate stocks of inventory. They may also be affected by access and reliability of transit, roadways, and non-motorized systems to ensure the availability of workers and consumers. While shoppers participating in retail markets may be sensitive to environmental amenities, sales and management staff selling retail goods are less likely to be so sensitive.

Investment packages and corridor implementation strategies supporting wholesale and retail trade centers are likely to involve a balance of investments in modal assets. Sales activities are also likely to require a strategic arrangement of freight and personal transportation system components to ensure reliable access to these activities.

6.7 Activities and System Performance

When system performance (or a performance barrier) reduces the value or participation in the above activities, the system as a whole falls short of its ultimate performance goal. This is true even if individual modal components meet mode-specific performance targets. The more complex the activity, the more system components must be considered to ensure system performance.

The activities and user segments described above are often concentrated in specific locations or activity centers. The integrated system supports these centers by a system of corridors. The scope of modal assets and system components is related to user segments and activity types.

Chapter 7. Activity Centers, Corridors, and Border Crossings

Identifying activity centers in Michigan is a useful to understand where and how transportation system components may be best integrated to connect users with activities. Understanding the location and relationships between activity centers supports the identification of key corridors and system connections. Once these are identified, strategies to integrate the system more fully can be developed and implemented. The *Corridors and Borders Report* of *MI Transportation Plan* identifies Michigan's major activity centers and organizes the integrated system into multi-modal corridors. The activity centers and corridors provide a tool for selecting and implementing strategies to improve and integrate the systems.

7.1 Activity Centers

As part of the process to identify Michigan's corridors of highest significance, the *MI Transportation Plan* team identified 51 activity centers or clusters within Michigan, and six centers outside Michigan. This quantitative analysis began by plotting the location of:

- Major business and industry concentration and centers – based on number of employees and employment per square mile;
- Population concentrations and centers – based on population and population per square mile;
- Retail centers – based on retail employment;
- Higher education centers – based on student enrollment;
- Military bases – based on number of service members and employees;
- Health centers - based on number of trauma facilities/beds and hospital employment;
- Tourist centers – based on hotel capacity, number of visitors (person days), length of stay, taxes collected; and

- Transportation infrastructure – all modes and intermodal connectors and international border crossings.

These individual facilities and characteristics are combined and defined as activity centers. Activity centers serve hubs for a variety of activities. The integration of system elements within each center must be appropriate to the needs of users and activities concentrated within the center. The most complex activity centers are those rich in user groups and activities involving multiple transportation modes and programs as indicated in **Chapter 5, Transportation System Users and Michigan's Economic Potential,** and **Chapter 6, Activities and the Integrated System,** of this report. These include centers with high concentrations of tourism, retail activity, manufacturing, business, and education. For example, the economic potential of centers rich in retail trade, higher education, and industrial activity is likely to require more decisions regarding the integration of transportation programs the economic potential of less complex centers.

7.2 Corridors

The integration of the statewide transportation system goes beyond providing modal balance and the arrangement of system components within individual centers. The activity centers are connected to each other to determine which corridors people and goods may utilize in transport between the centers. The *Corridors and Borders Report* includes an analysis evaluating the availability, accessibility, safety, connectivity, and mobility of the multi-modal transportation infrastructure along each corridor. Based on this analysis, strategies appropriate to support statewide connections between centers are provided. The strategies reflect the need for modal balance on corridors serving activity centers and users dependent on combinations of multiple transportation modes and programs.

Chapter 8. System Performance as a Barrier and an Opportunity for Economic Vitality

The performance of Michigan's integrated transportation system can provide both barriers and opportunities for the state's economic vitality. Barriers arise when conditions on the transportation system make it more difficult, more expensive, or impossible for an activity to take place. Barriers inhibit users from engaging in economic activities.

The likelihood of performance barriers increases where users and activities require more strategic combinations of transportation programs. This is because:

(1) User groups and activity centers with complex transportation needs are dependent on more system components. The failure of any single component may interfere with an economic activity.

(2) Even if each individual component is sufficient, it is possible for the broad range of components to be arranged in a way that fails to connect users with activities.

Opportunities are created by conditions on the transportation system that make it easier, less expensive, or possible for an activity to take place that may not otherwise occur. Opportunities can be created by improving only one mode, or by improving an integrated combination of programs. However, in highly complex activity centers and corridors, the innovative combination of modal assets may create new opportunities by connecting users with activities in new ways. Removing barriers and realizing opportunities for users are practical ways to improve integrated system performance.

MI Transportation Plan has identified four goals and 28 performance objectives for the system. These are listed in the *Goals, Objectives and Performance Measures Report* of *MI Transportation Plan*. Achievement of these goals and objectives involves the removal of performance barriers described in this report and the realization of opportunities for users to engage in activities. Of the 28 performance objectives, eight are explicitly associated with system integration. These objectives are:

- Preserve the quality and condition of all transportation system elements;
- Reduce fatality, injury, and crash/incident rates on all modes;
- Reduce the vulnerability of transportation facilities to terrorist attacks, natural disasters, and other unexpected events;
- Expand intermodal connectivity and the number of modal options for freight and passengers;
- Address system bottlenecks and weaknesses to reduce congestion, enhance continuity, and improve modal connections;
- Improve existing system capacity through the application of new technologies and strategies;
- Coordinate transportation services supplied by both public and private sector providers; and
- Address institutional barriers to interjurisdictional cooperation.

Two other objectives, while not explicitly associated with the integration performance area, have been consistently identified in the technical reports and the preferred vision as critical to the integrated system. These are:

- Improve coordination between transportation decision-making and land use planning; and
- Minimize negative externalities and maximize the positive impacts that transportation has on the physical and human environment.

Figure 7 organizes the barriers and opportunities from the focus areas of the technical reports into performance objectives associated with the integrated system. The figure illustrates how removal of barriers and realization of opportunities can help achieve the performance objectives of *MI Transportation Plan*. The figure also illustrates the different system components that may be enhanced by removal of each barrier or the realization of each opportunity. In the figure, the black squares indicate the modal components that may be involved in removing a barrier or realizing an opportunity. A "T" indicates that a barrier or opportunity was explicitly identified in the technical report addressing a system component. When removal of a single barrier or realization of a single opportunity affects many different system components, the system can become more integrated. In **Table 7**, the "T" indicates a relationship identified in the technical report; a black-filled box indicates a potential relationship; a gray-filled box indicates a possible indirect relationship.

Figure 7: Integration Performance Objectives, Barriers and Opportunities

Opportunities										Objectives	Barriers								
	Technical Report Focus Areas											Technical Report Focus Areas							
Performance Opportunities Identified in Technical Reports	*Aviation*	*Transit*	*Highway and Bridges*	*Non-Motorized*	*Inter-City*	*Environmental*	*Freight Oriented*	*Land Use*	*Safety*	*Performance Objectives Associated with Integration*	*Performance Barriers Identified in Technical Reports*	*Aviation*	*Transit*	*Highway and Bridges*	*Non-Motorized*	*Inter-City*	*Environmental*	*Freight Oriented*	*Land Use*	*Safety*
Information systems to track non-motorized assets				T						**Preserve the quality and condition of all transportation system elements**	Inadequate Pavement Condition			T						
											Deteriorating Bridges			T						
	Opportunities Entail Removal of Crash Risk as a Barrier									**Reduce fatality, injury and crash/incident rates on all modes**	Special Safety Needs of Older Drivers									T
											Incident Induced Delay Affects Reliability							T		
											Risk of Highway Crashes			T						
	Opportunities Entail Removal of Barriers Created by Terrorist Incidents/Natural Disasters									**Reduce the vulnerability of transportation facilities to terrorist attacks and natural disasters**	Long Recovery Time for Damaged Infrastructure							T		
Involve civic groups in transit planning		T								**Expand the breath and depth of modal options for freight and passengers**	Freight Vs. Passenger Rail Trade-Offs					T				
Collaborative planning for bicycle and pedestrian infrastructure				T							Inadequate Airport Capacity	T								
Collaboration between inter-city and transit providers					T						Remote Airports Vulnerable to Loss of Commuter Routes	T								
Intermodal Freight Terminal							T				Limited Transit Schedules		T							
Driver Training and Safety							T				Limited Inter-City Schedules					T				
											Long Transit Transfer Times		T							
											Affordability of Inter-City Services					T				
											Disconnected or Incontiguous Bicycle/Pedestrian Routes				T					
	Opportunities Entail Removal of Bottlenecks as a Barrier									**Address system bottlenecks and weaknesses to reduce congestion, enhance continuity and improve modal connections**	Congestion/Bottlenecks			T						
Private Sector Involvement in ITS Architectures		T								**Improve existing system capacity through the application of new technologies and strategies**	Unknown									
Business involvement in providing transit					T					**Coordinate transportation services supplied by both public and private sector.**	Disconnect Between Bicycle/Pedestrian Infrastructure and other modes							T		
Involve businesses in intercity transportation	T										Shortage of Drivers/Mechanics for Trucks and Busses		T							
Airline Recruitment and Retention	T																			
	Opportunities Entail Removal of Institutional Barriers									**Address institutional barriers to inter-jurisdictional cooperation**	Jurisdictional Boundaries Between Transit Providers				T					
Colocation of Air Cargo with Other Facilities						T				**Improve coordination between transportation decision-making and land use planning**	Land uses incompatible with Bicycle/Pedestrian needs						T			
Context-Sensitive Solutions						T				**Minimize negative externalities and maximize the positive impacts that transportation has on the physical and human environment**	Declining Quality of Life Due to Natural Environments						T			
Aesthetic and Scenic Amenities on Highways and other Infrastructure						T					Destruction of Natural Habitats						T			

Chapter 9. The Challenge of Financing the Integrated System

Previous sections have demonstrated that achieving system performance for complex users and activities entails balancing investment on system components. However, the financial resources available to support the integrated system are often organized to support particular components of the system. The investment packages in the *Revenue Gap and Investment Packages Analysis* will address different possible statewide balances of modal investments for the integrated system. There are challenges associated with combining statewide revenue sources to provide an integrated transportation system for Michigan's activity centers and users.

An integrated system requires investing in specific programs that provide leverage for improving the system as a whole. The *Revenue Gap and Investment Packages Analysis* of *MI Transportation Plan* deals with the reality that financial resources do not permit the full investment level that would be required to remove all barriers on each system component individually. Therefore, integrated system performance depends on achieving leverage by strategically supporting different funding categories in ways that support system integration.

Leverage can be defined as the potential to improve system performance through multiple modes by investing resources into one funding category. For example, when the scope of a roadway modernization project includes crosswalks and improves access to transit or park-and-ride commuter lots, the project achieves leverage for the system beyond simply addressing the roadway need itself.

There are two types of leverage that are relevant for comparing and assessing statewide investment packages.

9.1 Direct Leverage

Direct leverage is achieved by investing in one program to save money in another program. For example, investment in the modernization of an intersection may include investment in a bicycle and pedestrian crossing and signal. The investment roadway modernization can directly improve Michigan's non-motorized system by making improvements on bicycle/pedestrian connections that would be very expensive or infeasible otherwise. The investment of roadway modernization dollars can effectively function as an investment in both roadway modernization and non-motorized transportation. This is true even though it is the need for roadway modernization that initiates the investment. In another example, resurfacing of a principal arterial can extend pavement life and improve road condition, but the pavement improvement will also reduce vehicle maintenance costs for transit agencies.

These are examples of direct leverage. Direct leverage is important because it provides a mechanism to efficiently address resource gaps for individual system components by improving the integrated system. The concept of direct leverage is fundamental to the design of

investment packages considered in the *Revenue Gap and Investment Packages Analysis* of *MI Transportation Plan*.

9.2 Indirect Leverage

Indirect leverage is the opportunity to improve system performance through multiple system components while directly spending or saving money on only one physical component of the system. While indirect leverage may result in some savings, to different components, the primary benefit of indirect leverage is improved performance for the integrated system. For example, investment in rehabilitation of bridges improves the mobility of transit vehicles (fewer weight-restricted bridges) and enhances safety for customers in transit vehicles. While investment in bridge rehabilitation does not directly save or provide transit capital and operating funds, the investment has the potential to enhance the safety and mobility performance of transit.

Investment in one physical system component or specific service can realize indirect leverage by:

A. *Improving access to other components*
   Leverage on accessibility is achieved when investment in one type of project makes other system components more accessible. This increases the value of each component to system users without making direct physical investment. For example, investment in bicycle/pedestrian infrastructure has the potential to make transit more accessible to users, though not explicitly improving transit service or infrastructure.

B. *Improving mobility of other components*
   Leverage on mobility is achieved when investment in one type of project has the potential to address mobility barriers in other investment categories. For example, investment in urban transit can support modal diversion, reducing traffic volumes, and enhancing the mobility of roadways that have capacity expansion needs due to traffic volumes. However, this addresses the capacity need in a way that does not explicitly fund expansion of the roadway.

   In another example, investing in the roadway-resurfacing category supports the mobility needs of urban and rural transit operations by ensuring roadways are suitable for transit routes. However, this investment supports transit routes without explicitly adding to the transit funding category.

C. *Improving safety of other components*
   Leverage on safety is achieved when investment in one type of project has the potential to address safety barriers on other types of facilities. For example, adding lanes to a deficient roadway allows for improvement to an at-grade railroad crossing. This creates the possibility to remove barriers to safety for rail while not explicitly investing in the rail funding category.

D. *Improving the reliability of other components*

Leverage on reliability is achieved when investment in one type of project or service has the potential to make another system component more reliable. This enhances the value of all components for system users. For example, an investment in signal timing and traffic operations does not provide direct saving or investment in transit capital or operations. However, the investment in signal timing and operations may represent an indirect investment in transit if the project serves to enable the transit service to perform on time. This creates the possibility to remove or prevent performance barriers associated with transit reliability.

The concept of indirect leverage is fundamental to the design of investment packages considered in the revenue gap and investment packages analysis of *MI Transportation Plan*. The *Revenue Gap and Investment Packages Report* of *MI Transportation Plan* gives a full accounting and description of each program funding category as well.

Figure 8 illustrates the potential for direct and indirect leverage to enhance system performance. It illustrates the potential for leverage between different types of transportation programs. The green cells indicate the possibility of direct leverage in which investment in a funding category (row) may, through leverage, involve a direct investment or resources into an infrastructure or service covered by another funding category (column).

The pink cells indicate the possibility in which investment in a funding category (row) may, through leverage, result in an indirect improvement in the performance and user value of infrastructure covered by another funding category (column). When indirect leverage is possible, the nature of the indirect leverage is indicated in the cell by letter codes. The combinations of funding categories with the highest potential for leverage are located in the upper left hand area of **Figure 8**. The figure is organized by mode and by funding categories that are further considered in the investment and gap analysis of *MI Transportation Plan*.

Figure 8: Potential for Leverage between Transportation Funding Categories

↓ How would it improve performance and/or save money for these components? ↓

If you invested money in each of these categories… ▼	Roadway: Preservation	Roadways: Reconstruction (Includes modernization)***	Roadways: Capacity Improvement (Adding Lanes)	Rehabilitation of Bridges (including Big Bridges)	Bicycle and Pedestrian Improvements	Urban Transit*	Rural Transit**	Intercity Bus	Passenger Rail	Freight Rail	Aviation	Marine Passenger	Marine Freight
Roadways: Resurfacing	X	X	X	X	S				A	A	A	A	A
*Roadways: Reconstruction (Includes modernization)****	X	X	X	X	S,M	M,R, S	M, R, S	M, R, S	A	A	A	A	A
Roadways: Capacity Improvement (Adding Lanes)			X			M,R , S	M, R, S	M, R, S	A	A	A	A	A
Roadways: Preventive Maintenance for Highways and Bridges					S	A, M	A, M	A, M					
Rehabilitation of Bridges (including Big Bridges)	X	X	X	X	M, S, A	M, S	M, S	A, M, S, R	S	S	A		
Bicycle and Pedestrian Improvements					X	A,S	A, S	A	A			A	
*Urban Transit**			M		M	X	A, M	A	A		AM		
*Rural Transit (including demand response)**						A, M	X	A	A		AM		
Intercity Bus						A,R, S	A,R, S	X	A, R, S		A		
Passenger Rail			M, S,		A	A	A	A	X				
Freight Rail	A,M	A,M	A,M	A,M	A,M					X			A
Aviation											X	A,M, R	
Marine Passenger											A,M, R	X	
Marine Freight										A			X
Operational Improvements (signal timing,	X	M	S, M	X	A, S	M, R	M, R	M, R		A	A	A	A
ITS Deployment	X	M	S, M	X									
Carpool /Park and Ride Lots			M, R		A, M	A	A	A	A		A	A	

Leverage Potential	
	Potenial to save money
	Potential to improve performance
	Uncertain potential for leverage

Nature of Leverage Potential	
A	Improves accessibility
M	Improves mobility
R	Improves reliability
S	Improves safety

A funding category is considered high leverage if investment in that category may directly or indirectly improve performance through many other categories. The concept of leverage as illustrated in **Figure 8** can help guide statewide investment decisions for the integrated system.

Chapter 10. An Integrated Approach to Service Packages and Decision Principles

Transportation planning is about choices. Achieving the preferred vision of the *MI Transportation Plan* entails planning decisions which seek to integrate Michigan's transportation programs and services. Decisions must allow for the complexity of modes and linkages needed for full system performance and the leverage to be gained by making strategic multi-modal investments. To support these choices, decision principles based on the complexity of system users, activities, performance goals, and leverage potential may help.

Based on this *Integration Technical Report*, the following decision principles are suggested as a basis for statewide investment packages and corridor improvement strategies.

Decisions in *MI Transportation Plan* must be made at two levels. First, the plan produces the comparative assessment of statewide investment packages, which invest the state's transportation resources into different types of improvements. Second, the plan articulates implementation strategies to deliver transportation resources for system users by Michigan's system of corridors and activity centers. Based on the concepts in this *Integration Technical Report*, the following decision principles are offered for statewide investment and for corridor implementation strategies.

10.1 Statewide Investment Decision Principles

10.1.1 Invest Financial Resources to Preserve Existing System Components.

Preserving existing components is critical to prevent new performance barriers from arising. For example, bus capital funds used to replace an aging bus on an existing line can help ensure continued reliable service. If this capital is not maintained, the access, safety, and mobility of transit, but also roadways, and other modes may be affected.

10.1.2 When Improving a System Component, Consider and Make Allowances for Improvements That May Be Needed in Integrated Components.

For example, expanding transit service and placing a bus stop in a residential area may prompt the need for sidewalks and pedestrian access to the new transit stops.

10.1.3 Seek Investments that Provide Leverage, Remove Barriers, Realize Opportunities, and Improve Integration for Multiple Components.

For example, investment in expanding or paving carpool parking lots may help mitigate some highway expansion needs by reducing the number of single-occupancy vehicles on the road at peak hours. In another example, investment in reconstructing roadways with wider shoulders may also support the provision of bicycle lanes to improve non-motorized performance.

10.1.4 Assess Performance Objectives with Respect to All Modes

For example, reducing fatality, injury, and crash/incident rates is a performance objective. Achieving this objective may entail the provision of other modal alternatives for users with special needs, the provision of bicycle and pedestrian infrastructure on roadways, and ensuring that transit vehicles and drivers are equipped for safe operations.

10.2 Corridor Implementation Decision Principles

10.2.1 Implement Strategies One Project at a Time

Because each project is different, there is no one-size-fits-all approach to delivering an integrated system. Decisions about how to scope projects and which components to improve ultimately depend on the complexity of users and activities served by each project. Implementation approaches can be very different depending on the nature of user needs, activities supported by the system, and the context of improvements. For example, an integrated approach to a rural corridor where grain elevators and farm-to-market roads are critical assets will be different than for a densely populated urban corridor with a large concentration of retail and academic centers where fixed route transit systems, extensive urban pedestrian networks, and local street systems are available.

10.2.2 Assess the Complexity of Users and Activities When Conducting Corridor Studies

Corridor studies include an assessment of the relative complexity of users and activities served by the corridor. This involves identifying user segments, their activities, and the potential for leverage among modes.

10.2.3 Allow Greater Flexibility and Innovation in Funding for Needs that Are More Complex

For example, improving pedestrian access in an urban retail center served by transit involves complex decisions about system components. This means that investment in this corridor should involve more flexible funding and require more planning decisions than preserving a farm-to-market road. However, this does not mean that the downtown pedestrian retail center is more important, or warrants more funding, than the farm-to-market road. Integration

pertains more to the flexibility of funds than to the total importance of a project or financial amount of need.

10.2.4 Assess How Connections to and Within Complex Activity Centers Can Be Improved for Overall Corridor Performance.

For example, if a corridor serves a major tourist and recreational center frequented by older tourists, the arrangement of modal components must take into account the connectivity of local modal systems required by these users. Something as simple as the absence of a crosswalk from a hotel to a bus stop, or a turning radius at an intersection inappropriate for older drivers could provide a performance barrier making the entire corridor less accessible to complex users.

10.2.5 Recognize that Investments in One Mode on a Complex Corridor or in an Activity Center are Likely to Generate Needs or Benefits on Other Modes.

For example, modernizing a roadway in a tourist/recreational area is more likely to require scope and funding for bicycle, pedestrian, and transit elements than a similar roadway improvement on a road to a mine. In another example, when an airport is expanded or improved, supporting roadways may require expansion and improvement to realize the full value of the airport investment.

10.2.6 Coordinate with Partners and Stakeholders to Understand Corridor Complexity and Maximize Financial and Performance Leverage for Other Modes or Jurisdictions.

For example, it may be possible to coordinate with county and municipal partners to plan for the improvement of sewer lines or other utilities when state roadways are reconstructed. In another example, it may be possible to plan capacity expansion in conjunction with local growth management policies to manage travel demand and overall expansion needs.

10.2.7 Consider Linkages Between Land Use and Performance of System Components.

For example, it may be possible to work with local planning and public works agencies to manage development pressure for a new interchange, finding ways to support changes in development without affecting freeway system performance. In a similar way, system performance can be enhanced and preserved by collaborating with local planning and zoning officials on strategies like access management for principal arterials. MDOT defines access management as a set of proven techniques that can improve safety and reduce traffic congestion while assuring safe and reasonable access to properties adjacent to a roadway.

Chapter 11. Conclusion

Michigan's people and businesses depend on a seamless, integrated transportation system to transform their economic potential into economic vitality. Achieving an integrated system requires an approach to statewide planning and implementation that takes into account the complexity of system users and activities, and responds to that variety. This means identifying those activity centers where the most complex activities are concentrated. It also entails corridor improvement strategies appropriate to the needs of different user groups to connect them to activity centers along the corridors. An integrated approach to both statewide investment packages and corridor implementation strategies is essential to remove barriers that stand between Michigan's people and their economic potential. Achieving the performance objectives of *MI Transportation Plan* involves removing barriers system users face, and the creation of opportunities for them to participate more fully in the economy.

Different principles apply to achieving system integration at different levels. At the highest level, integration means leveraging resources to make funds available that may improve the connectivity and balance of modes. At the implementation level, integration requires greater attention to modal balance and connectivity in activity centers where users and activities are complex.

Ultimately, Michigan will achieve a seamless, integrated system one project at a time and one decision at a time. *MI Transportation Plan* provides concepts and principles for the decisions needed to realize the vision of a fully integrated system. The ultimate beneficiaries of an integrated system are Michigan's people and businesses, who will use the integrated system to achieve their greatest human and economic potential with greater freedom from the barriers to safety, mobility, and sustainability.

Appendix A: Glossary

Activities – Specific actions undertaken by system users that require movement of people or goods to access a place, people or other resources.

Activity Centers – Geographic locations with concentrations of people, jobs, educational and health facilities, tourist attractions and other similar economic based facilities or services.

Component Performance - The effectiveness with which any given system component connects system users with activities.

Complexity of Activities – Refers to the breadth of transportation system components that may be required to support user access to an activity, and the other considerations, such as safety, land use or environmental quality that may be involved with connecting users to the activity.

Complexity of a User Segment – Refers to the breadth of transportation system components that may be required to support a particular user segment, and the degree to which other considerations, such as safety, land use or environmental quality may be involved with meeting the needs of that segment.

Corridors – Transportation systems that link activity centers, to each other, and to system users.

Decision Principle – A consideration for qualitatively assessing a statewide service package based on the complex relationships affecting integrated system performance.

Direct Leverage – The chance to save money by improving multiple physical system components or specific services within the scope of one project or improvement type.

Economic Potential – Defined as the natural, human, capital, and cultural resources of the state that can generate value, income and improve the quality of life in Michigan's economy.

Funding Category – Describes a way transportation funds can be invested in a specific element of the system. Funding for the transportation system is often organized into these categories to ensure revenues for individual system components.

Indirect Leverage – The chance to improve system performance through multiple system components while investing money into only one physical component of the system or one specific type of transportation service.

Integrated System - The full combination of transportation infrastructure, services, programs and assets in place to connect system users with activities.

Investment Package - An investment scenario that arrays different combinations of transportation improvement types to support varying levels of system performance. An investment package can be described as a "mix of fixes."

Leverage – The potential to improve system performance through multiple modes by investing resources into one funding category.

Operations – The provision of integrated systems and services that make the best use of existing transportation systems in order to preserve and improve customer-related

performance. This is done in anticipation of, or in response to, both recurring and non-recurring conditions. Operations includes a range of activities in both urban and rural environments, including: routine traffic and transit operations, public safety responses, incident management, snow and ice management, network/facility management, planned construction disruptions, and traveler/shipper information.

Operations and Maintenance (O&M) – The range of activities and services provided by the transportation system and the upkeep and preservation of the existing system. Specifically, operations include the range of activities/services provided by transportation system. Maintenance relates to the upkeep and preservation of the existing system.

Opportunities – Conditions on the transportation system that make it easier, less expensive or possible for an activity to take place that may not otherwise occur.

Performance Barriers – Conditions on the transportation system that make it more difficult, more expensive or impossible for an activity to take place.

Performance Objectives – Statements that indicate desired conditions on the statewide transportation system.

System Components – Individual elements of modal infrastructure, services, programs, and assets that help the integrated system connect system users with activities.

System Performance – The effectiveness with which the integrated system enables users to engage in activities.

System Users – Those who depend on the transportation system to engage in activities.

User Segments – Groups of system users who use the transportation system in a similar way, with similar travel characteristics and purposes (as defined in the *Travel Characteristics Report*).

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