Working Paper #1

Metrics for Transportation Investments that Support Economic Competitiveness, Social Equity, Environmental Stewardship, Public Health, and Livability

The Economics of Land Use

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1. *READERS GUIDE*

This working paper provides a new framework for evaluating transportation projects in Minnesota based on established and emerging practices in the field of public sector Return on Investment (ROI). The Working Paper is organized around the following Chapters:

Chapter 2: Project Purpose and Scope. This Chapter describes the context and purpose for Transportation ROI including its relationship to previous and on-going Minnesota Department of Transportation (MnDOT) work. Ultimately this study may provide direction for implementing a broad based ROI process that helps inform MnDOT's policy and budget decision-making.

Chapter 3: Transportation ROI Categories and Metrics. This chapter provides an overview of well-established and emerging approaches to measuring ROI for transportation projects and programs that go beyond safety and system performance. The general categories addressed include:

- Economic Competitiveness
- Social Equity
- Environmental Stewardship
- Public Health
- Livability

Chapter 4: Project/Program Selection and Analysis. This chapter considers various options for selecting an appropriate and manageable subset of MnDOT projects and programs that can best serve as a template to test the utility of ROI analysis going forward. It includes a preliminary description of candidate projects/programs followed by a discussion of various options for narrowing the analysis.

Chapter 5: Next Steps: This Chapter solicits input from the Project Stakeholder Group (PSG) related to the overall purpose, content, and application of the ROI framework for MnDOT. It also provides a summary of the next steps in this study effort in terms of future meetings and related research and deliverables.

2. PROJECT PURPOSE AND SCOPE

Introduction

This Working Paper provides a potential new framework for evaluating transportation project "return-on-investment" (ROI) in Minnesota as part of a broader effort to inform transportation programming and funding. "Return-on-investment" is a term borrowed from financial analysis that has been expanded in this context to include the monetization of transportation impacts on economic competitiveness, environmental stewardship, social equity, public health, and livability. In this instance, these transportation investment "returns" focus on outcomes likely to be of high concern to a broad set of interest groups and the general public.

This framework complements an earlier ROI analysis prepared for the Minnesota State Highway Investment Plan (MnSHIP) by Smart Growth America (SGA), MnDOT, Gresham Smith and Partners. Ultimately this study may provide direction for implementing a broad based ROI process that helps inform MnDOT's policy and budget decision-making. Specific examples of how ROI can be used in these contexts include project design (i.e. including features that respond to desired ROI outcomes), project prioritization and programming (given limited financial resources), and disclosing the ROI performance of particular projects or entire programs, such as the State Transportation Improvement Program.

It is widely recognized that transportation infrastructure can have wide ranging impacts on society and the environment. Indeed, the economic history of the United States is often linked to new transportation technologies and major transportation investments from canals and river transportation to railroads to the interstate highway system and air travel. Surprisingly, however, systematic efforts to quantify and compare economic, environmental, public health, and other broader societal impacts of transportation investments are relatively recent. While transportation ROI analysis is a rapidly growing practice that continues to gain acceptance at both academic and professional levels, its actual application in the policy arena remains relatively limited.

Most transportation investment decision-making addresses user needs measured in terms such as improved safety and reduced travel delay. In order to achieve greater gains with limited dollars, transportation agencies have begun using decision-making criteria that consider the full spectrum of strategic goals, such as safety, economic development, transportation choice, community character, and resource conservation[1] This approach to evaluating performance ensures that states get more than successful individual projects—they get a transportation system that supports the economy and helps to address other state priorities. The approach also demonstrates the results of transportation investments to stakeholders and constituents, which can ultimately play a critical role in building public support for transportation funding increases.

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[1] The use of ROI for transportation planning and financing is a common practice at many levels of government in the US and abroad. For an overview of the practice, see Analysis of Return-on-Investment (ROI) in the United State", EPS Memorandum, January 17th, 2014. http://www.epsys.com/wp-content/uploads/2014/08/ROImm0117214.pdf

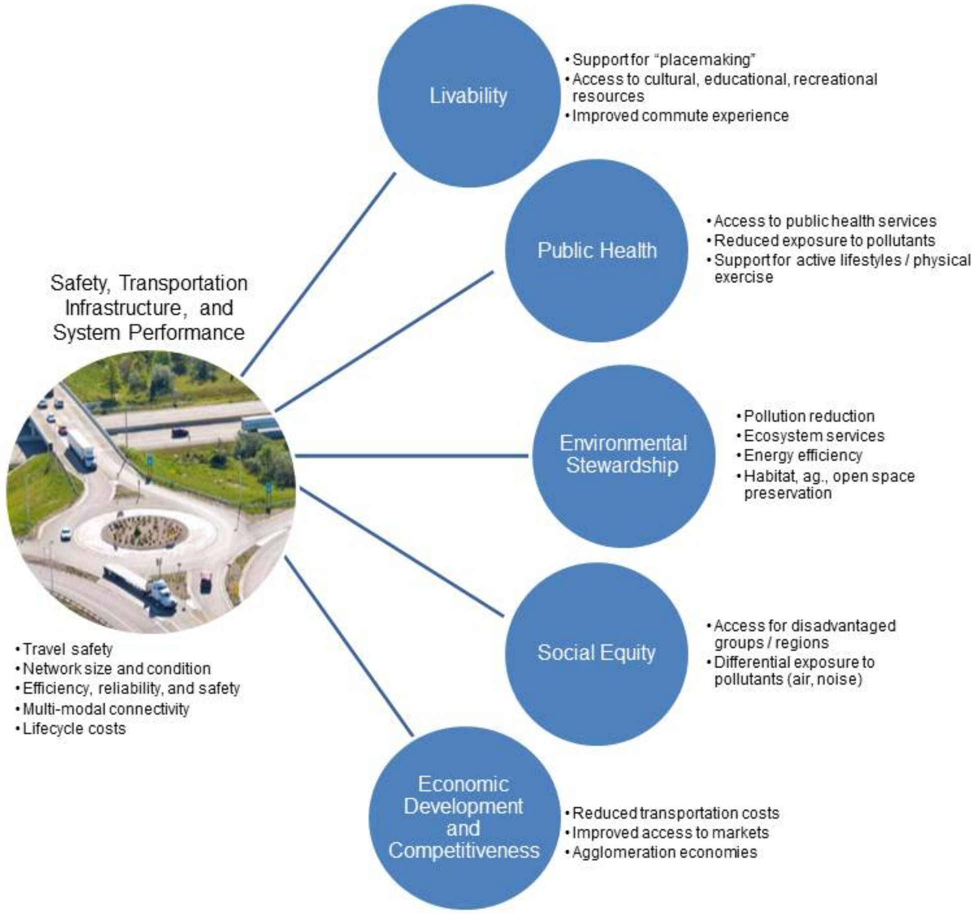
The November, 2013 MnDOT/SGA study "Assessing Return on Investment in Minnesota's State Highway Program" relied on well-established, transportation-specific ROI performance metrics to evaluate MnDOT programs by comparing total costs (both one-time and life-cycle) against outcomes that are important to users of transportation infrastructure (e.g., drivers, passengers, bicyclists). These outcomes included changes in travel time and reliability, vehicle operating costs, safety, and some environmental impacts (e.g., reduced emissions). The study found that there is a sound business case for transportation investment based upon transportation specific ROI criteria.

This current study effort will complement the analysis from this early report, as well as related MnDOT work on system performance (e.g., the Annual Transportation Performance Report), but also consider additional metrics that offer a wider perspective on transportation impacts and incorporate outcomes important to the public at large. This Working Paper provides an overall framework and rationale for evaluating transportation investments based on a broad range of ROI impact categories and introduces an initial set of ROI metrics and methodologies to accomplish this goal. Subsequent Working Papers will incorporate input from the Project Stakeholder Group (PSG) and culminate in an analysis of selected MnDOT projects/programs to test if and how such metrics might be applied more broadly going forward.

Study Framework and Methodological Overview

As noted at the outset, major transportation investments have deep and wide ranging impacts on society that can be both positive (e.g., economic growth) and negative (e.g., air pollution). **Figure 1** illustrates the range of transportation system performance and direct user impacts that serve as the foundation for consideration for the broader set of ROI categories proposed for this study. While economic competitiveness, social equity, environmental stewardship, public health and livability are represented as discrete and progressive ROI categories, it is recognized that in reality they are highly interdependent and affected by a variety of overlapping metrics, as described further in this Working Paper.

Figure 1 Building Blocks for a Comprehensive Transportation ROI Analysis



Given the multidimensional nature of transportation networks, measuring impacts presents a variety of methodological challenges including confusing cause and effect, double counting, selecting an inappropriate geographic unit of analysis, and distinguishing between distributional and net-new effects.

Data availability for given metrics can present additional challenges, especially given limited empirical work related to long-term impacts of certain types of investment in particular settings as well as the inherent uncertainty associated with projecting future behavior given potential changes in preferences, market conditions (e.g., demographics, economic competition), technology, and other independent or external variables.

As the state of the art advances, additional metrics and methodologies, as described further in this Working Paper, are becoming available that enable analysts to better estimate transportation ROI more comprehensively. Nevertheless, given the complexities stated above, it remains difficult to derive a unifying ROI measure that sums all the transportation impact measures being considered (e.g., economic competitiveness, social equity, environmental stewardship, public health, and livability). For example, monetary values are not available or well developed for certain types benefits (e.g., improved livability). Even in cases where such estimates can be made, care must be taken not to double count given the cross cutting nature of various impacts and associated metrics (e.g., environmental and public health issues impacts).

In general, the appropriate ROI measurement technique will depend on the particular policy objective or goal associated with the effort itself. Potential goals and applications include:

- Providing a public case for transportation investments and related public funding and financing measures
- Guiding long-range transportation planning efforts
- Setting investment priorities and benchmarks based upon rational set of policy-based criteria and technical metrics
- Engaging stakeholders in transportation investment decision-making by analysis and disclosure of ROI results
- Allocating given funding source(s) to the best performing (given the ROI criteria) transportation projects

Depending on the context, monetary estimates may be necessary, with care taken to exclude benefits that double count multiple categories. However, in other cases, an ordinal ranking (e.g., A is preferable to B) may be more appropriate, with various weights given to certain impact categories based on policy priorities through a combination of quantitative scoring and qualitative evaluation. Finally, a combination of monetary estimates, ordinal ranking, and qualitative discussion of non-monetized impacts and other factors (e.g., policy considerations related to equity or support for emerging sectors, the role of discount rates and other key assumptions, uncertainties and caveats) may be preferable.

3. TRANSPORTATION ROI CATEGORIES AND METRICS

This chapter provides an overview of well-established and emerging approaches to measuring ROI for transportation projects and programs that go beyond safety and system performance. The general categories addressed include:

- Economic Competitiveness
- Social Equity
- Environmental Stewardship
- Public Health
- Livability

Economic Development and Competitiveness

Transportation infrastructure and services provide direct economic benefits to users (motorists, passengers, bicyclists) as well as more indirect benefits to entire regions or sectors. **Figure 2** summarizes various methodologies, metrics, and data sources frequently used to evaluate economic competitiveness impacts associated with transportation infrastructure and services.

Figure 2 ROI Metrics for Economic Development and Competitiveness

Description of Potential Transportation Impacts*	Types of Metrics	Types of Data
Transportation investments can influence economic growth and restructuring : • Increase transport system efficiency (e.g. time, operating cost savings) and reliability (reduced non-re-occurring delay), • Improve access to markets for both consumers and suppliers (e.g, new / expanded inter-modal connectivity) • Create agglomeration economies that facilitate information exchange and more efficient matching of specialized business needs and worker skills	• Job creation and job shifts, capital investment, personal income (direct, indirect, induced) • Improved multi-modal connectivity • Value Capture / creation and enhaced property values • Increased accessibility for people and freight •New(re-) development encouraged by improvement • Implementation of regional development policies • Fiscal Impacts	• Local, regional, state-wide travel demand model outputs (e.g., VMT and Travel Time by mode and purpose --work, personal, tourism) • Congestion (hours of delay) • Number / density of intermodal connections (Change in intermodal connectivity index) • Change in effective market scale or density • Change in freight tonnage • Level or Change in economic activity associated with project (jobs, sales, property value, etc.) • % of regional destinations served • Change in property, income, & sale tax $s

*For a thorough review of analytical methodologies see "Development of Tools for Assessing Wider Economic Benefits of Transportation," Transportation Research Board, SHRP2. July, 2013

As noted in **Chapter 1**, direct user benefits generally serve as the key inputs for the most common and well-documented form of transportation ROI analysis. These metrics generally focus on travel time saving and reliability as well as lower direct travel costs from improved commute efficiencies (e.g., less energy consumption, vehicle wear and tear), or shift to lower cost modes. These benefits can accrue to both individuals as part of work or personal travel and businesses through their transport of goods and services.

More indirect is the set of transportation-related economic impacts that have the potential to improve market access and inter-relationships. Specifically, transportation investments can create new or improved physical connectivity between customers and suppliers, expanding the depth of existing markets and in some cases enabling the growth of entirely new markets and/or economic interactions. While clearly related to the direct user benefits described above (e.g., improved travel time and efficiency), these impacts differentially effect certain industries or economic sectors , but are harder to quantify because they involve changes to existing travel patterns and fundamental shifts in economic activity and relationships (as opposed to proportional shifts in baseline trends).

In any case, these more indirect economic effects are often represented by changes in the effective size, density, and/or level of interaction associated with the customer, labor, and/or supplier markets available to particular sectors, locations, or region. This increased market reach can improve productivity, competitiveness, and overall economic activity (e.g., jobs, sales, and value added). Specifically, the following economic effects are most pertinent:

- **Increased market capture and/or trade**: Transportation services and infrastructure can expand the market reach and thus demand for the goods and services of a particular sector and/or region, providing new or improved access to a larger customer base (for either attracting customers or delivering products). While in some cases these impacts are distributional (e.g., location X becomes more or less competitive relative to location y) in other cases they generate an overall increase in economic productivity through competition and comparative advantage.

- **Agglomeration economies**: Agglomeration economies refers to the improved productivity that results from physical connectivity that facilitates a more efficient matching of specialized business needs and worker skills. This can often lead to or increase the speed of innovation through improved interaction, information sharing, technology diffusion, and other economic synergies. While agglomeration economies is most often associated with co-location or geographic proximity, the effect can occur at various geographic scales and is often fostered by transportation improvements that facilitate mobility within or between regions, sub-markets, or districts.

While improved market access has historically been associated with major capacity expansion, increasingly other types of transportation investments are providing equal or greater market access benefits. This is in part due to the relationship between project costs (capacity improvements tend to be expensive) and the law of diminishing returns. Specifically, the primary components of both the state and nation’s transportation network that connect major regions to one another are already in place, and we no longer need to create an interstate highway, rail, or aviation network, for example. Consequently, many of the transformative economic impacts associated with creating these initial connections between major population and employment centers, vital natural resources, regional cultural and recreation amenities, and other significant economic generators have already come to pass.

Increasingly, smaller scale and less costly upgrades, linkages, and efficiencies to these existing transportation networks, such as expanded multi-modal connections, traffic management, and carefully targeted local capacity improvements can provide significant mobility benefits at a much lower cost. Of course, by the same logic investments that ensure that the heavily utilized elements of the existing transportation network remain in a state of good repair also generate a relatively high ROI.

On the development side, there is a growing body of research documenting the relationship between different development patterns and the costs associated with constructing and maintaining transportation infrastructure to support those development patterns, indicating that more compact development tends to result in lower infrastructure costs. As a result, transportation improvements to support more spread out development patterns may have a lower ROI because the costs of the improvements are larger relative to the positive impacts.

Of course, an analysis of potential economic impacts of transportation must consider the underlying economic conditions and trends relevant to the location of a particular investment. This is because transportation facilities are often a necessary but rarely a sufficient basis for economic growth. In the worst cases, new capacity or access points have not led to new growth because the underlying pre-conditions for economic development are not present (e.g., necessary capital and labor inputs, market support etc.).

Social Equity

Transportation services and infrastructure often have differential impacts on various population groups and/or locations with important implications on social equity. **Figure 3** summarizes various methodologies, metrics, and data sources that can be used to evaluate social equity impacts associated with transportation investments. It is important to note that since social equity impacts frequently capture the economic incidence or distributional effects associated with many of the other ROI categories considered in this study, care must be taken not to double count these impacts. In many cases, it is more appropriate to evaluate social equity separately as a stand-alone measure rather than as an additive metric

Figure 3 ROI Metrics for Social Equity

Description of Potential Transportation Impacts	Types of Metrics	Types of Data
This category focuses on the distributional impacts or economic incidence of transportation investments given their potential to have differential impacts on various population groups and/or locations.	• % low income groups served including service level changes of various modes • Improved access for economically depressed neighborhoods or rural locations • Induced development from improved access • Proximity or exposure to air and noise impacts • Accessibility for handicapped populations (e.g. Americans with Disabilities Act (ADA) compliant facilities), or other disadvantages groups (e.g. seniors)	• Change in travel time to key origins / destinations for economically distressed or rural areas • Change in number of person trips to key activity centers (i.e. shopping, jobs, recreation, institutional) • Change in local air or noise levels by income of exposed population • Demographic profile of affected communities • % of income spent on transportation • Change in number of ADA facilities

The social equity impacts of transportation investments can be both positive and negative. On the positive side, for example, transportation investments can improve access to and from economically depressed neighborhoods or regions, providing residents greater access (or lower travel costs in the case of mass transit) to jobs and services or improving the competitive position of local properties (e.g., urban/main street improvements or a new on/off ramp). On the negative side, poorly planned transportation infrastructure can isolate communities by creating physical barriers as well as increase exposure to air and noise pollutants.

While many social equity impacts support or are consistent with the other ROI impact categories considered in this study, others are not. On the supportive side, for example, investments that expand connectivity to poor neighborhoods can also have public health benefits by improving access to healthy food sources. Likewise efforts to create more walkable neighborhoods often disproportionately benefit lower income groups since they are less likely to be able to afford an automobile.

Conversely, programs designed to increase automobile ownership among low income households have been shown to have employment benefits but may run counter to efforts to reduce congestion and the health effects of auto pollution. In addition, the negative impacts associated with transportation capacity expansion infrastructure (e.g., new highway by-pass, track alignments, airports), often disproportionately affect poor neighborhoods. Whether positive or negative, it is important to include these externalities in an ROI analysis as well as discuss potential implications on social equity.

Environmental Stewardship

Transportation investments and resulting travel and land use patterns have a range of positive and negative impacts on natural systems that can be assessed using a variety of metrics (see **Figure 4**). While environmental stewardship has inherent value, for the purposes of transportation ROI analysis these impacts are most often estimated based on changes in economic productivity and/or property or resource value (e.g., resulting from degradation of ecosystem services, reduced physical condition of property, loss in recreation use, etc.), as well as public health impacts, as discussed below.[2] Thus, as always, care must be taken not to double count environmental stewardship impacts with ROI estimates included under other ROI impact categories.

Figure 4 ROI Metrics for Environmental Stewardship

Description of Potential Transportation Impacts	Types of Metrics	Types of Data
Transportation patterns and investment can have a variety of positive or negative impacts on natural systems (e.g. air, water, habitat, open space).	• Energy efficiency • Change in air pollution or water / stormwater discharge levels • Land consumption (including ag.) • Habitat preservation	• Change in emissions by mode & type (e.g. GHG, CO2, NOX) • Total ROW land used (e.g. ag., habitat, open space) • Change in impervious square feet or stormwater discharge • Number of endangered species "takings"

Probably the most common environmental impact calculated in transportation ROI analysis is change in aggregate emission levels, often segregated into GHG and non-GHG pollutants. The EPA and other sources typically publish estimates of social cost per ton of emissions, calculated based on estimates of vehicle miles traveled (VMT) and Average Vehicle Speed (AVS) which vary by vehicle type. These values change through time because (1) of emission rate reductions associated with regulatory requirements and technological innovation (e.g., fuel efficiency and electric/hybrid vehicles), and (2) per unit emissions producing larger incremental damages as physical and economic systems become more stressed in response to climate change. Again, since the EPA social cost estimates generally account for a variety of factors, including public health and reduced economic productivity, ROI calculations should only count these impacts once (e.g., under public health ***or*** environmental stewardship).

In some cases the benefits of preserving or cost of degrading a natural resource or amenity stemming from transportation projects/programs can be captured using hedonic pricing or contingent valuation methods. Both methodologies are commonly used to place a value on environmental amenities or resources that are not typically traded in the market and thus do not

[2] In some cases, ROI impacts can be assessed based on clean-up and/or mitigation costs. However, these expenses can also be included on the project/program cost side of the ledger as part of the land acquisition, site preparation, and entitlement requirements for transportation projects (e.g., wetland mitigation or erosion control measures).

have a readily observable price (this method is also often used to value recreational and cultural resources as described further under the "livability" ROI category).[3] While both hedonic pricing and contingent valuation are widely accepted techniques, they can require significant research, and in some case primary analysis, to derive estimates that fit the unique circumstances associated with a particular transportation project/program.

Public Health

Transportation infrastructure influences public health both directly by altering travel safety (i.e. accident rates) and providing direct access for public health and safety services (e.g., emergency medical response, hospitals, police and fire) and indirectly through environmental quality and support of physical activity. **Figure 5** summarizes the various methodologies, metrics, and data sources that can be used to evaluate public health impacts associated with transportation investments.

Figure 5 ROI Metrics for Public Health

Description of Potential Transportation Impacts	Types of Metrics	Types of Data
Transportation improvements can impact public health by: • Supporting active transportation choices (e.g. multi-modal) • Improving access to health care, healthy food options, and recreation amenities • Affecting environmental quality and exposure levels (e.g. air quality) • Improving travel safety (e.g. accident rates)	• Improved bike / ped accessibility • Improved access to recreation opportunities • Air quality improvements • Reduced injuries / fatalities	• Miles of interconnected bike / ped lanes • Change in bike / ped participation rates • Fitness related health indicators (e.g. obesity) • Air quality related health factors (e.g. asthma rates) • Emergency response & travel time to health facilities • Safe Routes to Schools data

[3] Hedonic models rely on actual market transactions, such as property sales, to decompose the item being researched into its constituent characteristics, and obtain estimates of the contributory market value of each characteristic. For example, in a housing market a hedonic model assumes the price of a property is determined by the characteristics of the house (size, appearance, features, condition) as well as a variety of external factors, including environmental factors such as views, noise levels, proximity to recreational amenities, etc. Multi-variable regression models are used to isolate the value of the particular characteristic of interest (i.e. house X is exactly like house Y in all respects except it has a view. If house X sells for $10,000 more than house Y the value of the view is worth this amount). Contingent valuation is based on a similar concept but it is based on public surveys rather than multi-variable regression analysis.

Probably the most commonly monetized ROI public health metric relates to transportation safety. Methodological approaches and corresponding data needed to monetize the benefits of transportation investments that reduce the probability of certain types of crashes are well established. Similar estimates have been reported in previous MnDOT reports. In addition, changes in response times for emergency services can also be monetized based on improved public safety.

Transportation facilities also play a key role in facilitating physical exercise, although these impacts can be difficult to measure with precision given the range of variables involved. A wide variety of studies have shown that access to “complete streets” type facilities such as bicycle lanes, good sidewalks, safe and well-lit streets, and Safe-Routes-to-Schools (SRTS) can promote more active living, including biking and walking. In addition, transportation facilities that provide convenient access to recreation areas (e.g., parks and trails) can also promote physical exercise. Physical exercise and other forms of active living can, in turn, reduce health care costs and help older adults remain independent longer.[4]

A variety of studies have quantified the potential health effects resulting from increased bicycling and walking. By way of example, **Figure 6** shows the monetized values per bicycle or pedestrian mile that were reported in the MnDOT PRISM methodology documentation based on a literature review. Of course, the difficulty is estimating the actual change in bicycling or pedestrian activity that can be attributed to a particular transportation investment.

Figure 6 Value of Bicycle and Pedestrian Health Effects by Mode (2011 $ per Person Mile Traveled)

	Health Benefits by Mode / Person Mile Traveled		
Mode	Low	Likely	High
Bicyclists	$0.0043	$0.0500	$0.0575
Pedestrian	$0.0017	$0.0200	$0.0230

Source: MnDOT PRISM

Livability

In many ways livability can be viewed as the culmination or combined by-product of all of the ROI impact categories described above. It can also serve as a “catch-all” for a range of transportation impacts that cannot be neatly categorized but are nevertheless clearly relevant to the quality of life in a particular region or the state as a whole. The distinct livability metrics identified and proposed for this study focus on the role of transportation investments in

[4] See “Transportation Final Report,” prepared by Altarum Institute for the American Public Health Association, October, 2012. Pages 18 – 23, 36, 39, and 42.

supporting "place-making" efforts, expanding access to cultural, educational, and recreational resources/assets, and improving the quality of the commute experience, whether for work or personal (as distinguished from time savings or safety), as shown in **Figure 7**.

Figure 7 ROI Metrics for Livability

Description of Potential Transportation Impacts	Types of Metrics	Types of Data
Transportation investments can improve a location's overall livability by: • Supporting "place-making" efforts • Improving access to various cultural, education, recreation assets / resources • Improving the commute experience	• Supporting local planning efforts • Mode flexibility / choice • Walkability, Pedestrian Friendliness • Trip quality (experience, level of effort / stress, views) • Preservation of historic / cultural resources • The jobs–housing balance	• Commuter preference surveys • Census based Journey-to-Work data, Avg. Commute Times • Increased O/D to cultural, educational, recreational amenities • Change in travel time to essential daily needs / activities • Walk-Scores

Because of the more qualitative and in some cases subjective nature of many livability metrics, measuring ROI can often be more of an art than a science. Probably the most widely used methods involve hedonic pricing and contingent evaluation, as referenced above. For example, analysts can compare differences in the average sale prices of similar homes that differ with respect to livability metrics such as access to cultural, education, and recreational assets or "placemaking" measures such as walkability.

By way of example, walkability is often seen as a value in its own right, beyond the health benefits described above. For example, an increasing body of research is showing that consumers (e.g., homebuyers, tenants, and certain types of businesses) place a value on walkability, as evidenced by differential real estate prices. Indeed, Walk Score indices[5] are becoming a standard attribute in many real estate listings in certain communities.[6]

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[5] Walk Score is a privately-held company that provides information on location-specific walkability. Walk Score measures the walkability of any address using a patented system. For each address, Walk Score analyzes hundreds of walking routes to nearby amenities. Points are awarded based on the distance to amenities in each category. Amenities within a 5 minute walk (.25 miles) are given maximum points. A decay function is used to give points to more distant amenities, with no points given after a 30 minute walk. Walk Score also measures pedestrian friendliness by analyzing population density and road metrics such as block length and intersection density. Data sources include Google, Education.com, Open Street Map, the U.S. Census, Localeze, and places added by the Walk Score user community.

[6] For a detailed analysis of the economic benefits of walkability, see "Foot Traffic Ahead, Ranking Walkable Urbanism in America's Largest Metros," by Christopher B Leinberger and Patrick Lynch, of the George Washington University School of Business.

4. PROJECT/PROGRAM SELECTION AND ANALYSIS

This chapter considers various options for selecting an appropriate and manageable subset of MnDOT projects and programs that can best serve as template to test the utility of this type of analysis going forward. The first section provides a preliminary list and description of candidate projects/programs followed by a discussion of various options for narrowing the analysis.

Proposed Universe of Candidate Projects/Programs

This study effort is designed as a follow up to the 2013 MnDOT/SGA ROI study on MnSHIP funding. The projects and programs included in the earlier analysis will be the starting point. Overall more than 90 projects, with a total cost range of $632 million to $1.5 billion, are included on this list. These projects were categorized into one of the following ROI Categories summarized in **Figure 8** below.

In addition to these MnSHIP projects, MnDOT staff has submitted additional projects for consideration that have been evaluated as part of the Corridor Investment Management Strategy (CIMS) and Corridors of Commerce processes. These projects are included because the level of detail and data associated with this evaluation process makes them particularly good candidates for ROI. In this respect, it is worth noting that, like most states, MnDOT does not have a statewide transportation demand model that can be deployed to generate estimates related to changes in trip counts, VMT, or other factors that generally serve as important inputs to ROI analysis. In some cases, such estimates are available from local or regional transportation agencies and were included as part of the CIMS evaluation process.

Figure 8 ROI Categories from State Highway Program

ROI Category	Description	Avg. Investment (millions) Maintain Current Performance a	Economically Competitive b	Total TFAC Recommendations = a + b
Safety-Spot Improvements at High-Risk Locations	Infrastructure improvements to promote safe driving, such as rural intersection conflict warning systems, diverging diamond interchanges, and passing lanes	$662	$578	$1,240
Pavement Preservation - Corridor	Routine work to preserve the condition of the highway or respond to specific conditions, including treatments to prevent pavement deterioration and eliminate surface cracking	$1,377	$1,264	$2,641
Pavement Reconstruction - Corridor	Outside of urban areas, replacement of the entire existing pavement structure by the placement of the equivalent or increased pavement structure	$106	$288	$394
Pavement Reconstruction - Urban/Main Street	Within urban areas, replacement of the entire existing pavement structure by the placement of the equivalent or increased pavement structure as well as improvement of the underground utilities	$275	$408	$683
Bridge - Repair	Repair or ongoing maintenance measures for bridge substructures, superstructures, and/or decks	$171	$451	$622
Bridge - Replacement	Reconstruction of bridge substructures, superstructures, and/or decks	$399	$1,052	$1,451
Congestion Mitigation - General	High return on investment capacity enhancements and spot improvements (e.g. interchange reconstruction, auxiliary lanes, and other improvements)	$553	$798	$1,351
Capacity Development	Enhancements that expand the economic and quality of life access to areas served by the corridor	$1,146	$1,246	$2,392
Active Traffic Management (ATM)	Application of communication technologies to transportation systems to dynamically manage congestion (e.g. Traveler information systems, dynamic signing and re-routing, dynamic shoulder lanes, speed harmonization, and temporary shoulder use)	$79	$114	$193
MnPASS	High-occupancy/toll (HOT) lane network managed lanes	$632	$912	$1,544
Totals		$5,400	$7,111	$12,511

Source: MDOT / SGA

Selecting Candidate Projects/Programs

As noted throughout, a primary goal of this study effort is to evaluate a short-list of MnDOT projects or programs against a broad based set of ROI methodologies and metrics, as described in **Chapter 2**. This evaluation process can serve as a test case for the utility and direction of future ROI application and data collection in Minnesota. To accomplish this goal it will be important to select a representative sample of projects or programs that can provide useful insights on the mechanics, feasibility, and appropriate scope for this type of analysis. Several interrelated considerations and options in this regard include:

- **Scale of Analysis**: ROI analysis can be conducted at different scales, ranging from programmatic to project and/or site level analysis. While more granular analysis (e.g., site or project level) can be more accurate and detailed, allowing for nuanced evaluation of particular ROI metrics, it can also be data intensive and less likely to capture statewide or macro-level considerations.
- **Suitability to ROI Analysis**: For a variety of reasons, certain types of projects/programs are more amenable to ROI analysis than others. This is because they are more likely to demonstrate discernable impacts related to the key ROI categories identified as important to this study effort and material deviations from baseline conditions.
- **Illustrative Qualities**: It will be important to pick projects or programs that run the gamut in terms of the methodological issues and funding categories that are likely to be of interest and applicable to ROI analysis going forward.
- **Level of Interest**: It may be useful to pick projects or programs that are of particular interest to key stakeholders and/or “ripe” given the current policy and funding environment.
- **Data availability**: In general, effective ROI analysis can require significant data and analysis related to project scope and likely impacts. However, as referenced in the previous section, the level and type of data that is available for MnDOT projects/programs varies widely and additional research can be time- and resource-intensive.

Another key goal of this initial Working Paper is to identify the need and likely utility of additional research as well as potential information and resources that may be available to support the overall objectives of this project. Of course, the complexity and requirements of future research will depend on the types of projects/programs being evaluated and the ROI categories of interest.

5. NEXT STEPS

This initial Working Paper has outlined a framework for evaluating transportation ROI for future MnDOT projects and programs based on a broad set of metrics that take into account impacts that are likely to be of concern to the public at large. The primary goal is to describe the rationale and key issues associated with this type of analysis and solicit input from the PSG. Specifically, we seek input on the following:

- ROI impact categories
- ROI methodology and metrics
- Data sources and additional research (if any)
- Specific projects/programs for future analysis

Based in the input received on questions above and additional research by the Project Team, we will prepare Working Paper #2 for presentation at the next PSG meeting. Working Paper #2 will present a more refined list of candidate projects/programs and a “first-cut” evaluation of a number of selected projects/programs as a basis for testing the utility of the various metrics and methodologies identified herein. Finally, the Project Team will present additional discussion on the lessons learned and implications for future application of ROI in Minnesota