Quantifying the Value of Multimodal Freight Investments

MID-AMERICA FREIGHT COALITION

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About the Mid-America Freight Coalition (MAFC)

The industries and farms of the Mid-America region can compete in the marketplace only if their products can move reliably, safely and at reasonable cost to market.

State Departments of Transportation play an important role in providing the infrastructure that facilitates movement of the growing amount of freight. The Mid-America Freight Coalition was created to support the ten states of the Mid America Association of State Transportation Officials (MAASTO) region in their freight planning, freight research needs and in support of multi-state collaboration across the region.

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This report presents: (1) a brief description of the two most common analysis formats: benefit-cost analysis and economic impact analysis, highlighting the differences between the two in focus and approach; (2) a discussion on the various components of such an analysis process, specifically highlighting various benefit/impact categories that should be considered when evaluating the merits of a project; (3) the standard processes and methodologies for evaluating these benefits and impacts along with potential data sources; (4) a survey of the evaluation practices followed by the Mid America Association of State Transportation Officials (MAASTO) states; (5) three case studies evaluating impacts from three transportation modes and a discussion on the comparison between the analyses; and (6) a summary of findings along with discussion on applicability of the analysis techniques and comparing analysis across modes.</td></tr>
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EXECUTIVE SUMMARY

Quantifying the impact of infrastructure investments is key to understanding, communicating, and justifying the value of these investments, as well as comparing the merits of multiple potential projects against each other. Evaluating and comparing impacts for freight projects is not a trivial task given the variety of methodologies and data sources available to practitioners and analysts. Evaluating benefits derived from multimodal projects or comparing benefits between projects across modes is an even more challenging task.

This document has been prepared to identify the best approaches available for comparing investments across modal projects while also identifying appropriate tools and data sources to complement or aid the analysis process. The document is aimed at informing practitioners of available methodologies, tools and data sources, and the benefits of using one technique vs. the other or in conjunction with, depending on the need, as well as providing a glimpse of the practices the various Mid America Association of State Transportation Officials (MAASTO) states are currently following. The report outlines the key differences between Economic Impact Analysis (EIA) studies and Benefit-Cost Analysis (BCA) studies, the two most common frameworks to quantify the impacts of a proposed transportation project, explaining in brief how each is conducted. Further, various benefits attributed to freight projects are discussed along with any standard methodologies or processes associated with quantifying such impacts and benefits. While not all impact categories may apply to all modes and all types of projects, the intent is to provide a full spectrum of impacts for a practitioner to choose from that are relevant to their needs. The key benefits/impacts considered in this document are listed in the table below.

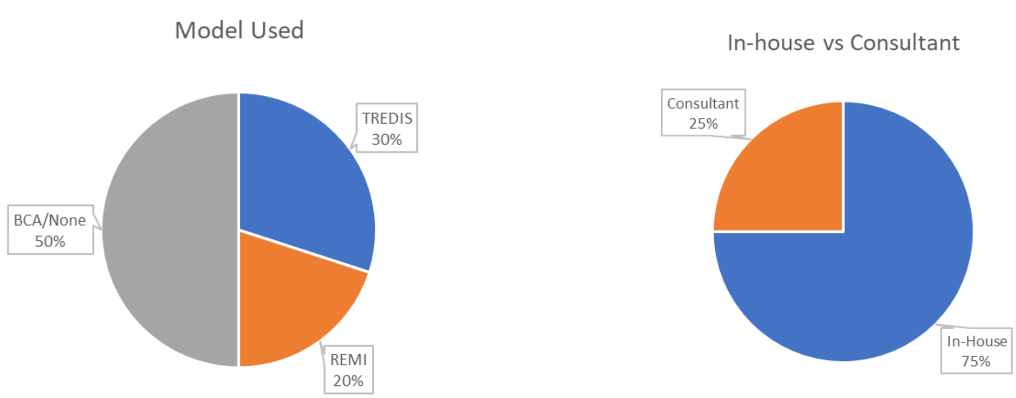
Table 0-1: Benefits/Impacts Applicable to Freight Transportation Projects.

Long-Term Outcome	Societal Benefit / Impact
Livability/Quality of Life	Accessibility
	Land use changes that reduce VMT
	Property value increases
	Accessibility to employment
Economic Competitiveness	Travel time savings
	Operating cost savings
	Energy security benefits
	Travel time reliability
	Employment rate changes
	Throughput/capacity
Safety	Value of prevented accidents
	Perception of safety
State of Good Repair	Long-term replacements
	Maintenance and repair savings
	Reduced VMT
Environmental Sustainability	Reduced emissions
Secondary Criteria	Innovation

	Public-private partnership
Miscellaneous	Demographic changes
	Tax revenue changes
	Logistical efficiency
	Perception of comfort
KEY: The colors indicate whether the category is typically applicable to BCA exclusively (green), EIA exclusively (red), or both (orange). Note that these might be loose boundaries as the inclusion of a benefit in either type of study is scope and audience dependent. A darker shade of orange indicates a benefit that was included in BUILD guidelines but did not exist in TIGER documentation.	

The report further lists various tools and resources that may aid the analysis process, based on what modes are supported by the tools, and introduce the most commonly used tools along with their strengths and weaknesses.

A short survey was conducted to gather information about the processes used by the ten MAASTO state DOTs in performing economic analysis. The questionnaire asked the DOTs about what tools and methods they use, whether they employ consultants or perform in-house analysis, and which of several aspects of economic analysis they pursue. Half the states responded saying they do not have a traditional economic analysis framework and use variations of Benefit-Cost Analysis or a merit-based ranking comparison between projects, where projects are scored based on predetermined thresholds of impacts. Of the states that use traditional Economic Impact Analysis, Transportation Economic Development Impact System (TREDIS) was the more popular tool used, with the Regional Economic Models Inc (REMI) PI+ model (or PI+ with TranSight extension) being slightly less popular. Some states shared that the choice of using the former over the latter was highly motivated by cost considerations. Figure 0-1 shows the share of states that use TREDIS vs. REMI (PI+ and/or TranSight) vs. other alternatives, as well as the share of states that conduct their analysis through consultants vs. in-house.



(a) (b)

Figure 0-1: Pie Charts Showing Fraction of States (a) Using REMI-(PI+ and/or TranSight) and TREDIS, and (b) Using Consultant vs. In-House Analysis

Finally, the report uses three case studies of quantitative evaluation of freight infrastructure from across three different modes to compare and contrast the differences in approaches and intent.

The three studies considered include a Benefit-Cost Analysis for a proposed railroad equipment upgrade project, a statewide Economic Impact Analysis of existing ports, and a statewide Economic Impact Analysis of existing airports. The comparison shows that while the BCA focuses on benefits accrued in targeted categories of impacts (such as fuel costs and emissions), the EIAs focus on the overall economic impacts in dollars generated. The state-wide EIAs concentrate heavily on job creation, associated income from wages, and the overall economy generated. Further, since the focus of the EIAs is to illustrate the reach of the projects, they can often aggregate all revenues / employment for impacted businesses as indirect impacts for the project being studied, even when these revenues may not be completely attributed to the subject project alone. Thus, the quantitative value of the impacts (more specifically the indirect impacts) is not a true representation of the increase in economic value due to the subject project as compared against a scenario where the project did not exist. These aspects of the BCA and EIA highlight how the objective and the audience for such studies can differ making a comparison between them futile. In turn, this further highlights the need to develop consistent frameworks for comparison of values associated with various multimodal projects. In addition, as multimodal projects become increasingly important to our economy and society, we should continue moving in a direction to assign project-specific funding for multimodal projects, rather than using highway funds. This would facilitate both better cross-mode analysis and planning, as well as be beneficial to program stability.

1. INTRODUCTION

Quantifying the economic impact of infrastructure investments is key to understanding, communicating, and justifying the value of these investments. It has proven difficult for the transportation industry to come to agreement on a unified approach to understanding the benefits of transportation investments in a single mode, for example, comparing similar project types with different levels of investment. It has proven more difficult to understand the value of transportation investments compared across modes. The difficulty in understanding and comparing the value of model investment reflects the range of variables that each of the modes introduce that may not be consistent across the projects. In addition, data fidelity across modes, as well as general data availability, is often a problem. Intervening factors that complicate comparison of impacts across the modes include differences in commodity values of cargos, differences in transit time of goods, ownership and division of the benefits in the case of public-private partnerships, differences in funding regulations that may skew investments and size of investments, and the anticipated rate of growth due to the investment. As an example, landside port investments may require a decade or more to fully realize the impacts, while in the case of highway congestion, once the project is complete, there is an immediate benefit in travel times and freight efficiency that can be captured in most economic analyses. Additionally, project comparisons do not always consider the secondary or tertiary economic impacts of a given investment, which are usually hard to quantify and monetize. Further, modeling tools available and guidelines and frameworks followed for the analysis are not always consistent across modes. In fact, the processes available for economic modeling of projects involving freeways only, are typically much more detailed than those available for projects involving air or water freight transportation, leading to inconsistent comparisons across modes.

As the federal government is challenged to maintain investments across transportation, education, military, health, and social services, and as the transportation industry continues to fall behind in investments, the ability to present evidence of investments that provide a solid return will be imperative. A similar review process goes with state reviews and investment decisions, as well as more local decisions. All levels of decision-makers are asking, “If we are making transportation investments, where are our dollars best invested and what can local residents, state economies, and federal investors expect to see in terms of economic benefits?” Economic Impact Analysis and Benefit-Cost Analysis have long been used to try to quantify the merits of a project, but the choice of what framework to use, and what benefits or impacts to consider in the analysis has often been somewhat ambiguous, prompting a need for some standardization of process for evaluating projects across the board.

Additionally, federal freight programs are rapidly recognizing investments in marine, aviation, and rail freight projects as viable and needed to fully connect the multimodal freight transportation network. With a national freight policy being defined as one of the key provisions of the Moving Ahead for Progress in the 21st Century Act (MAP-21, 2012), the interest in investments for freight transportation projects has grown further. The Fixing America’s Surface Transportation Act (FAST Act, 2015) further allocated new funding resources for coordinate federal, state, and local investments on the freight network over the next decade, more specifically for the first time providing federal funds intended to be used for freight-specific projects. The FAST Act also established the National Multimodal Freight Policy (NMFP) and the National Highway Freight Program (NHFP), with over $6 billion allocated to be used over five years for the purpose of improving freight movement on the National Highway Freight Network (NHFN) and the National Multimodal Freight Network (NMFN). Through the FAST Act, states are now able to invest in freight modes beyond highways. These investments, teamed with state programs that support all modes of freight movement, will require states to justify, formally or informally, the value of these investments. Importantly, dedicated freight funding could eliminate the backflow of dollars from multimodal projects to highway projects, allowing states to pursue economic development across all modes.

The growing interest in freight investments requires the states to look for models and processes that allow demonstration of benefits derived from investing in various modes, as well as comparison of benefits between investments in one mode versus another. Efficient and useful comparison of investments across modes is not trivial and would likely require the processes to venture beyond traditional economic analysis models. Thus, the report will evaluate additional measures and variables to increase the robustness of the analysis.

Project Objective

The objective of this project is to identify the best approach for comparing investments across modal projects. The best approach must not only reflect accuracy and validity in the analysis and results, but also must include consideration of the time, technical, and data-intensiveness of the model, and monetary costs associated with the analysis process.

This project starts by reviewing the existing literature on analysis frameworks available for assessing the value of transportation projects in general, and freight projects in particular, across the various transportation modes. Following the review of analysis frameworks and benefits or impacts to consider in an analysis, we review some of the most popular available economic models and BCA tools that are used by practitioners to perform or aid in the analysis. The review is followed by an analysis of the strengths and weaknesses of each tool or framework available, along with a matrix-based comparison of scope and aspects considered by each tool. A brief review of the processes followed by each of the ten Mid America Association of State Transportation Officials (MAASTO) states for evaluating the benefits and impacts of transportation projects is covered next, illustrating the spectrum of tools used across the states.

We present a guidebook to evaluate project investments across the modes based on our review of models and practices while offering an agency a spectrum of available choices in tool selection along with their strengths and weaknesses. We further use sample projects selected by the state technical and planning representatives to showcase how the analysis approach may impact the ability to compare benefits across multimodal projects.

2. LITERATURE

Economic Impact Analysis vs. Benefit-Cost Analysis

Economic Impact Analysis (EIA) and Benefit-Cost Analysis (BCA), while typically used for similar purposes in critiquing the impacts of a project, both positive and negative, are different. Economic impacts are the impacts or effects that the project has on the economy of a predefined geographical project area. This usually takes the form of changes in jobs, tax and revenues, economic activities, businesses and sales, etc. An economic analysis, as the name suggests, focuses on such impacts of the project. The geographical area considered for the impact is always well-defined, catering to the city, county, or state for larger projects, and focusing on the economic activity changes to the local businesses and households. Economic analysis does not cater to computing social welfare affects (such as pollution or congestion). In a general sense, EIA is focused on addressing how a project affects the local economy (such as by creating jobs, increasing revenues, or raising wages for some).

Benefit-Cost Analysis on the other hand, as the name suggests, involves estimating the overall costs and benefits of a project including financial and social welfare benefits derived. BCA typically is not localized to the immediate geographical region impacted directly by the project and instead considers a wider range of costs and benefits (for example, energy security for the country). BCA would consider those that are impacted both directly as well as indirectly by the project. Due to the wider scope, BCA considers environmental effects, noise pollution, safety, etc. as direct benefits or costs, though these are typically not of concern in EIA. BCA however, by concentrating on direct impacts, often leaves out transferred (revenue transferred from the region studied to an out-of-study region, for example) and follow-on effects (secondary or tertiary impacts), such as changes to demographics, that are included in EIA. In other words, BCA is focused on answering whether society as a whole is better (benefits outweigh costs) or worse off (costs outweigh benefits) due to the project being evaluated as compared to a no-build scenario.

EIA has a broader scope than traditional BCA with respect to considering overall economic impacts to area residents (such as job access, not usually a part of BCA), but a narrower scope in only considering impacts that directly affect the flow of money in the region and not considering social welfare impacts.

Multimodal BCA

Large freight projects, especially those that might involve corridors spanning across the length of a state, or involve multiple states, often involve more than one mode of transportation. Multimodal projects may involve the movement of freight through a combination of roadways (trucks), rail, air, or ports and inland waterways (ships). Analysis, whether EIA or BCA, for such projects, typically involves impact analysis from all modes involved. Similarly, alternate analysis for such projects requires a framework that can address impacts on each of the involved modes. In addition to the modes directly, inter-modal transfers may play an important role.

For example, intermodal container movement may involve transport by ship from one port to another, offloading into the shipyard, loading onto connector trucks that transport it to an intermodal railyard, loading onto and transport through a railcar to a destination railyard, and finally transportation to the local warehouse or distribution facility through trucks using the roadways network.

Multimodal BCA would thus need to consider the impacts of project alternatives on all modes involved in a framework that allows for direct assessment and comparison of costs and benefits across modes. For the example corridor mentioned earlier, this might involve assessing the delays, costs, environmental and safety impacts, etc. corresponding to the ship transport, loading or unloading at the port, rail transport, truck transport, and any wait times. There is thus a need to identify a general BCA framework that can assess the impacts across all modes through a common perspective.

This report draws chiefly from three sources while also borrowing from various others. First, the guidelines presented in Better Utilizing Investments to Leverage Development (BUILD) BCA guidance documentation [1] (formerly Transportation Investment Generating Economic Recovery [TIGER] BCA guidelines [2]) are used as the basis for developing the BCA framework with BUILD requirements in mind. A 2012 National Center for Freight and Infrastructure Research and Education (CFIRE) report titled “Using Benefit-Cost Analysis for Evaluating Discretionary Transportation Infrastructure Investment” [3] is used as an interpretive tool for understanding the, then known as, TIGER grant guidelines from the perspective of freight projects, specifically. Finally, the National Cooperative Freight Research Program’s (NCFRP) research report 38 titled “Guide for Conducting Benefit-Cost Analyses of Multimodal Multijurisdictional Freight Corridor Investments” [4] offers the baseline for much of the literature on available methodologies and data sources required for performing multimodal freight project BCAs.

In addition to the above, other sources referred to often throughout this report include: FHWA’s BCA guidelines, FHWA’s TOPS BC User Manual [5] and Desk Reference [6], FRA’s BCA for Rail documentation [7], AASHTO’s Redbook [8], USACE’s Principles and Guidelines, FAA’s BCA guidelines [9], REMI’s TranSight Model documentation [10], IMPLAN Help Book, and TREDIS’s online documentation [11].

3. FREIGHT BCA: PROCESS

Benefit-Cost Analysis is one of the most common means of weighing the benefits (typically monetary) derived from a project against the costs (again monetary) incurred by the project. BCA can be a tool for decision-makers in deciding what projects to undertake, for stakeholders in assessing the profitability and desirability of projects, and for practitioners in presenting the merits of proposed projects to decision makers.

Applied to freight, BCA is an analytical framework that may be used to evaluate investment decisions related to transportation projects that benefit freight movement across various modes. The motivation behind having such a framework is to provide a standardized metric against which multiple competing projects and alternative designs may be evaluated and compared against each other. Since BCA is an analysis framework, it typically needs to be complemented with a multitude of models that can quantify various impacts of the project (such as a traffic model to ascertain impacts on travel times on roadways). Freight movement is usually associated with long corridors when considering end-to-end movement, with the goods possibly being moved over multiple modes of transportation and across multiple jurisdictions and terrains. The need for a framework to assess the merits of multimodal freight transportation becomes apparent for this reason.

The diversity of modes involved in multimodal freight transportation projects also translate to a diverse range of data sources that need to be exploited, diverse measures and conversion factors that might be associated with each mode, as well as a diverse range of specialized processes and tools (such as FHWA's HERS-ST [12] for highway, RAILSIM [13] for railway, and SIMMOD for air transportation) specific to the modes. Identifying such sources and tools while also providing a comparison between their abilities and results produced isn't trivial. This reaffirms the need for a guidebook for evaluating freight project investments across the various modes that brings together the diverse knowledge and practices associated with each mode.

The National Cooperative Freight Research Program's (NCFRP) report 38 provided a "Guideline for Benefit-Cost Analysis of multimodal multijurisdictional freight corridor investments" [4]. The guideline employs 11 "guiding principles" for multimodal freight BCAs based on works by Griffin [14], and Farrow and Zerbe [15]. These 11 principles that analysts should try to invoke when performing an analysis are listed below.

1. Focus on aggregate benefits and net aggregate costs.
2. Use an incremental approach.
3. Choose consistent discount rates.
4. Benefit types evaluated should reflect analysis perspective.
5. Future benefits and costs should always be discounted.
6. Disclosure of secondary and non-quantifiable benefits.
7. Do not include zero-sum transfers of benefits.
8. BCA should be treated as an objective framework for discussion with decision-makers.
9. Respect transparency.
10. Focus on context-sensitive and useful analysis.
11. Use the proportionality principle for determining the depth of BCA.

Summary of BCA steps

The following is a summary of recommended processes involved in a BCA (with more details provided in the subsequent subsections):

1. Project and Players
    a. Define the project
    b. Determine the scope of analysis
    c. Determine the players
2. Costs
    a. Account for project costs
3. Benefits and Monetization of Benefits
    a. Identify benefit triggers and metrics
    b. Develop forecasts
    c. Quantify/monetize applicable first-order benefits
4. Secondary/Tertiary and Indirect Benefits
    a. Analyze externalities and higher-order benefits
5. BCA, Alternate analysis and Uncertainty
    a. Perform BCA/Alternate analysis
    b. Define decision criteria
    c. Evaluate risk and uncertainty

In the following subsections, we further describe some of the important steps involved in the BCA, concentrating specifically on understanding and quantifying benefits.

While the following material concentrates on BCA, which typically outweighs the usefulness of EIA with respect to competing for federal project funds, we consider benefits and impacts as loose classifications with certain components being meaningful both as benefits in BCA and impacts in EIA, and others having relevance only as either a benefit or an impact. In most situations, what components are to be considered depends not only on the type of analysis being performed but also on the scope and players involved. The analyst should decide on what aspects to consider within the analysis and how each is treated on a case-by-case basis.

Project and Players

A first step to performing a rigorous BCA or economic analysis is formally defining the project and determining the scope of analysis. This involves first defining the locations, modes, and facilities to include in the project analysis. The next component is to list alternatives to be considered and the BCA impact areas to be considered. The choice of modes analyzed might need to be updated based on the alternatives being considered, with the possibility of expanding the list of modes beyond those that the original project was expected to impact. Another important step here is identifying the various players and stakeholders based on the project undertaken. This sets the foundation for the objective of the BCA, and for deciding what aspects are important to the BCA.

Benefits/Monetization of Benefits

One of the most critical aspects of performing a BCA is first identifying and then quantifying and monetizing appropriate benefits derived from the project (or impacts of the project if performing an EIA). The TIGER BCA guide suggests classifying benefits or impacts under one of the five long-term outcomes specified by the USDOT. While the classification style is not carried over explicitly in the BUILD guidelines, the structured format of treating benefits and impacts within one of the five long-term outcomes can be very helpful. The table below (Table 3-1) lists various benefits/impacts to be considered under each of the long-term outcomes. Benefits/impacts mentioned in the TIGER BCA guide [2] or in the CFIRE BCA report [3] are highlighted in light orange, additions covered by the BUILD BCA guide [1] are highlighted in a darker shade of orange, and those that are only relevant to an EIA perspective and might be considered transferred benefits are highlighted in light red. Some of the more commonly evaluated benefits are described in more detail in following subsections.

Table 3-1: Benefits/Impacts Applicable to Freight Transportation Projects.

Long-Term Outcome	Societal Benefit / Impact
Livability/Quality of Life	Accessibility
	Land use changes that reduce VMT
	Property value increases
	Accessibility to employment
Economic Competitiveness	Travel time savings
	Operating cost savings
	Energy security benefits
	Travel time reliability
	Employment rate changes
	Throughput/capacity
Safety	Value of prevented accidents
	Perception of safety
State of Good Repair	Long-term replacements
	Maintenance and repair savings
	Reduced VMT
Environmental Sustainability	Reduced emissions
Secondary Criteria	Innovation
	Public-private partnership
Miscellaneous	Demographic changes
	Tax revenue changes
	Logistical efficiency
	Perception of comfort
KEY: The colors indicate whether the category is typically applicable to BCA exclusively (green), EIA exclusively (red), or both (orange). Note that these might be loose boundaries as the inclusion of a benefit in either type of study is scope and audience dependent. A darker shade of orange indicates a benefit that was included in BUILD guidelines but did not exist in TIGER documentation.	

Livability

The TIGER NOFA listed four main aspects of the livability long-term outcome: accessibility or user mobility, modal connectivity, aiding in the mobility of disadvantaged groups, and effect of project on land use. The former two outcomes may usually be quantified through measures of change in travel times and congestion levels. If a project has an expected impact on these categories, the analysis should qualitatively assess such impacts, and attempt to quantify any relevant metrics possible, while paying attention that benefits are not double counted. The third long-term outcome is typically not impacted by freight projects but should again be qualitatively discussed if relevant.

Accessibility and Property Value

A transportation project may also have an impact on property value and land use. Increases in property value due to a project may be counted as a benefit if the value of land is increased due to the project. Once again, the analyst must be careful that benefits are not double counted. For example, change in travel times or noise pollution levels may positively or adversely affect property value in nearby neighborhoods, but the benefit may not be counted both as a travel time or noise pollution impact as well as a property value impact. Similarly, transfers in property value where one region's property value increases but another's is depreciated, should not be counted. Benefits not counted elsewhere, however, such as property value increase due to land improvements (such as the creation of new green space) as part of the project, may be accounted for as property value benefits.

Economic Competitiveness

Economic competitiveness is a key long-term outcome identified by most transportation BCA, with travel time savings being a critical component of any transportation project.

Travel time savings

The chief economic competitiveness benefit associated with most transportation projects is travel time savings for passengers or freight. The travel time savings may be realized either directly on the mode impacted, or sometimes on other participating modes as well. Examples for the former would be improving capacity or free-flow speeds on freight freeway corridors directly resulting in travel time savings for the freight operators using the corridor. Examples for the latter would include situations where improvement to a facility may result in mode shifts with indirect travel time impacts, and technological improvements to railways affecting grade-crossing operations and thus impacting travel times on the affected roadway.

It is important to note that freight projects may affect the travel times for both the freight movement itself, as well as passenger movements of directly or indirectly impacted modes. It is important to correctly identify what benefits are important and need to be covered by the BCA. While quantifying travel time impacts is typically straight-forward for passenger movements using the statistical value of time for average commuters, assessment of the impacts as they apply to freight is often not as obvious. Travel time impacts on freight might be realized in the form of:

- affected wages for drivers
- vehicle and equipment usage/rental costs
- fuel costs
- delivery time sensitivity for freight being transported (e.g. items with short shelf life, items with high cost of transportation, economic cost of opportunity for items not delivered on schedule, and cost associated with managing delivery earlier than destination is prepared to receive them)

The US Bureau of Economic Analysis (BEA) and the US Bureau of Transportation Statistics (BTS) jointly maintain the Transportation Satellite Accounts (TSA) [16]. The TSA maintains value of transportation activities by industry and commodity, which may a valuable tool for assessing travel time impacts on freight commodity movement.

Congestion, while related closely to travel time, is an impact measure that should sometimes be considered and treated as a second-order impact, separate from the travel time impacts. Usually not easily quantified, a BCA where congestion as an outcome (often social and environmental), should qualitatively assess the impact due to the project being considered.

Table 3-2: Recommended Hourly Values of Travel Time Savings

Category	Surface Modes (Except High Speed Rail)	Air and High Speed Rail
Local Travel		
Personal	$9.50 - $16.30 / ($13.60)	
Business	$20.30 - $30.50 / ($25.40)	
All Purpose*	$10.00 - $17.00 / ($14.10)	
Intercity Travel		
Personal	$16.30 - $24.50 / ($19.00)	$31.00 - $46.50 / ($36.10)
Business	$20.30 - $30.50 / ($25.40)	$50.60 - $75.80 / ($63.20)
All Purpose*	$17.20 - $25.80 / ($20.40)	$38.90 - $58.30 / ($47.10)
Savings are given in 2015 USD per person-hour and listed as: Low – High / (Average) * Weighted averages based on the distribution of travel by purpose on various modes *Source: USDOT Value of Travel Time Savings (US DOT VTTS) – 2016 Revision*		

Table 3-3: Recommended Hourly Values of Travel Time Savings for Drivers/Operators of Transportation

Profession	Hourly Earnings Rates (2015 USD)
Truck Drivers	$21.80 - $32.70 / ($27.20)
Bus Drivers	$22.70 - $34.00 / ($28.30)
Transit Rail Operators	$36.90 - $55.30 / ($46.10)
Locomotive Engineers	$33.30 - $49.90 / ($41.60)
Airline Pilots and Engineers	$69.40 - $104.10 / ($86.70)
Source: USDOT Value of Travel Time Savings (US DOT VTTS) – 2016 Revision	

The original USDOT VTTS document, created in 2012, lists recommended hourly values of travel time by trip purpose and mode in 2009 USD per person-hour. The document was updated through revision 2 in 2016 [17] where the values were updated to reflect 2015 USD per person-hour. The revision also set up an upper and lower range for value of travel time for each category in addition to the average recommended value to be used.

Additional Comments

For roadways freight transportation, the typically measured benefit relates to travel time change across alternatives. The impacts are usually quantified using travel time savings per unit of distance. ([18], [8]).

For rail freight projects, the benefit comes in the way of travel time saved or optimized route distance across alternatives, with the impacts typically quantified either as travel time savings per unit of distance, or over the entire route for through cargo.

The impact for shallow or deep-draft navigation projects usually comes in the form of improvement to port dwell times and trip times, while impact for terminal projects come in the form of terminal dwell time of cargo and time to move a unit of cargo into or out of terminal. Metrics typically used to quantify the impact are transport cost change due to trip time, average dwell time at port or terminal, and load and discharge rates for terminals across all alternatives.

For air freight projects, the travel time impacts are typically measured through changes to freight ton delay hours by air side, terminals, and landside, as well as through landside access delays, and units of express cargo missing guaranteed delivery times [9].

In addition to the above, for multimodal transportation projects, intermodal transfer times for freight and any associated loading/unloading times are also relevant and should be assessed where relevant.

Operation Cost Savings

Operation costs are typically treated as negative benefits for a project. A reduction in operational costs thus translates to a positive net benefit. Typically for freight movement, operation costs may include vehicle fuel costs, vehicle rental and maintenance costs, and any possible taxes, fees, or tolls involved. Driver wages are typically not included here as they are internalized under travel time savings (see Table 3-3 for value of travel time savings for truck drivers, for example).

Since these costs tend to vary considerably based on the region of operation, local data, where available should be used from surveys and historical records for estimating the operation costs, with all sources properly documented in the BCA. When such data is not available, standard national level vehicle operating costs per mile derived from the American Automobile Association and American Transportation Research Institute as mentioned in the BUILD BCA may be used (Table 3-4). The values listed below include, where applicable, vehicle fuel costs, vehicle repair and maintenance costs, depreciation, damage to tires, truck/trailer lease or rentals, insurance premiums, and permit and license costs.

Table 3-4: Operation Cost Averages for Light Duty Vehicles and Commercial Trucks

Vehicle Type	Recommended Value per Mile (2017 USD)
Light Duty Vehicles	$0.39
Commercial Trucks	$0.90
Source: AAATRI and BUILD	

Travel Time Reliability

While a reduction in expected mean travel times for trips is an obvious benefit as discussed above, improvement in travel time reliability may also be a substantial benefit. Travel time reliability is a measure of the probability that the travel times for a corridor or infrastructure fall within a pre-determined range. Higher reliability allows for better planning of freight for on-time arrival. This can be a significant aspect for certain goods whose value or desirability decreases considerably if they do not reach their intended destinations within certain time windows. For logistics to work smoothly, a freight company would usually rather have a shipment be delivered as scheduled with higher precision in managing timeliness, than be delivered early when the destination is unprepared to accept and manage the delivery.

While there have been multiple efforts (see SHRP2 L08 Project [19]) to standardize metrics used to measure time reliability, there is still a lack of standardized processes or methodologies to quantify and monetize reliability benefits in BCA. Since reliability can be a critical impact for certain projects, the BUILD BCA recommends that the agency include reliability benefits where deemed important, with careful documentation of methodology and tools used, as well as clearly listed parameters and factors used for calculations.

Safety

Safety impacts, considered first-order impacts, are typically measured in the form of number of accidents and crashes, and damage (to property and life) associated with the accidents. Investment projects are expected to improve safety benefits by reducing the frequency and severity of accidents. There could be multiple dimensions to safety, including safety from accidents, safety of cargo, and perception of safety associated with the mode of transportation and the corresponding facilities. Various projects, including those related to operational changes, control design, and technology, may influence the safety of the system substantially.

Value of Prevented Accidents

Safety from accidents is a widely recognized first-order impact that the BCA must study. This covers accidents that result in bodily harm as well as damage to property.

Estimating the cost of accidents across alternatives typically involves first estimating the rate of accidents (under various categories as described further below), and monetizing the cost based on the type of accident.

The data for the accident rates may be either modeled through simulation models or computed using modifiers to average historic accident rates related to the region and mode of transportation. For highways, typical sources include State DOT and MPO models and statistics, Bureau of Transportation Statistics, National Transportation Statistics, or independent research. For rail freight, information could be derived from FRA, Office of Safety Analysis, BTS, NTS or independent studies. GradeDec, a tool to estimate accidents at grade crossings, is often used when railway grade crossings are impacted by the project. The USACE, American Association of Port Authorities, and US Coast Guard provide additional sources from the ones listed above for inland waterways and ports, and FAA for air freight. In addition, specific railroad, airway, and port associations may also prove to be a good source for relevant information related to accident rates.

Monetization of costs once the accident rates are known, is typically done using USDOT TIGER guidance, which uses the “Treatment of the economic value of a statistical life in US DOT departmental analyses,” (orig. 2008, updated 2011). The Value of a Statistical Life (VSL) is estimated to be $9,400,000 per fatality measured in 2013 dollars, and injuries from accident are classified under six categories based on the severity (Minor, Moderate, Serious, Severe, Critical, and Non-survivable), assigning a fraction of VSL to each injury (see Table 3-5). Injuries are typically either reported on the Abbreviated Injury Scale (AIS), or on the KABCO scale which is then converted to AIS scale before assigning a monetized value.

Table 3-5: AIS Severity Levels and Fraction of VSL Assigned to Each Accident Severity

AIS Level	AIS 1	AIS 2	AIS 3	AIS 4	AIS 5	AIS 6
Severity	Minor	Moderate	Serious	Severe	Critical	Unsurvivable
Fraction of VSL	0.003	0.047	0.105	0.266	0.593	1.000

In addition, property damage only (PDO) crashes are assigned a basis value equivalent of $3,862 (2010 dollars) per vehicle based on The Economic and Societal Impact of Motor Vehicle Crashes (2010, revised 2015) [20]. For freight, an appropriate value of property damage to vehicle should be assigned based on the vehicle cost and is specific to the mode being analyzed.

Additional Comments

There are other components to the cost of accidents that are harder to quantify using currently available tools. Larger accidents may result in damage to the infrastructure as well as negative benefits due to congestion, increased travel time, lower travel time reliability, and increased discomfort and or risk to other users of the facility or infrastructure. For example, accidents involving freight trucks carrying hazardous materials could potentially block a major corridor for multiple hours as the spill and debris are carefully cleared. This could result in a substantially large societal cost due to the delays experienced by vehicles blocked from movement on the corridor. Debris from an accident might similarly cause severe damage to the pavement or potentially to the infrastructure such as bridges, culverts, and toll plazas. Similarly, ships carrying resources such as oil may lead to spills due to accidents. Such accidents, though rare, have historically had a remarkably large cost associated with the plethora of damage it does to marine life and local geology. While such accidents are very rare, they can be highly relevant for certain projects due to the magnitude of damage associated. For example, projects that involve technological or logistical improvements leading to decreased risks of such large-scale accidents should consider valuing the benefits accordingly. Specific to freight, the analyst should also attempt to quantify damage to the freight being carried due to accidents.

Perception of Safety

While the physical safety impacts of a project are usually quantifiable, various improvements, such as technological improvements, might also have an impact on the perceived safety for the mode beyond the physical or real impacts. For example, Positive Train Control (PTC) and Electronically Controlled Pneumatic (ECP) brakes on trains might result in a stronger sense of safety for property and freight goods carried, potentially leading to a mode shift from other modes. From an economic impact point of view, the mode shift could lead to a change in revenues for specific modes and regions which might be relevant to the study. The societal benefits derived from a stronger perception of safety is difficult to quantify.

State of Good Repair

The state of good repair long-term outcome addresses the conditions and performance of the infrastructure system. The project analysis should try to quantify the metrics to value the current and projected future conditions of the system as well as any improvements that might be derived due to the project considered.

Project analysis is typically expected to address the following pertinent aspects: how the project addresses the current conditions, how it ensures future efficiency, and how the asset is expected to be managed through the projected analysis period. Together, these aspects involve looking at how symbiotically the project fits into the current infrastructure, whether it complements the existing system or improves weaknesses, sustainability of the system with and without the proposed project, funding for future maintenance and repair costs, plans for managing the system and changes to VMT or capacity due to the project.

State of good repair measures may also encompass secondary impacts such as changes to congestion levels on the system, or changes to the serviceable capacity of the system.

Environmental Sustainability

Emissions

Emissions are another impact regularly associated with transportation projects and the most common measure of impact on the environment. The monetized values of emissions directly are typically computed from knowing the emission rates, transportation activity measures (volumes, loads, and speeds) to determine total emissions, and monetization for each unit of pollutant released into the environment. While some transportation projects tend to reduce emissions (such as through improved speeds and mode migration towards lower emission modes), others might increase emissions by inducing higher traffic demand.

The most commonly considered emissions categories are:

- Carbon Monoxide (CO)
- Nitrous Oxides (NO_x)
- Carbon Dioxide (CO_2)
- Sulfur Oxides (SO_x)
- Particulate Matter (PM)
- Hydrocarbons/Volatile Organic Compounds (VOCs)

USDOT’s TIGER BCA Resource Guide recommends using monetized value of emission costs as reported by the “Corporate average fuel economy for MY2012-MY2016 passenger cars and light trucks” (CAFÉ) report [21] for CO_2, VOCs, NO_x, PM and SO_x (Table 3-6), and using values reported in “Social cost of carbon for regulatory impact analysis under executive order 12866” (page 39, table A-1 of report) [21, 22] for the social cost of carbon.

Table 3-6: Value of avoided emission.

Emissions Type	$ per Short Ton (2015 USD)
CO_2	Varies by year
SO_x	$42,947
NO_x	$7,266
VOCs	$1,844
PM 2.5	$332,405
Source: BUILD [1], originally NHTSA [21]	

BUILD BCA guidance documentation recognizes that the approach for quantifying benefits from reduced CO_2 and Green House Gases (GHG) emissions referred to in the previous TIGER BCA guidance iteration were later rescinded. Thus, USDOT does not currently identify a recommended valuation process for CO_2 and GHG emissions reductions.

Emission rate estimations are typically decided based on the mode studied and sources available. Emissions for trucks are typically estimated using regional MPO and state models. Rail emissions may be estimated either through EPA provided guidance on emission factors for freight locomotives or from railroad and terminal provided information and models. EPA's Motor Vehicle Emission Simulator (MOVES), PART5 and MOBILE6b models, Argonne National Lab's GREET model, and California Air Resources Board (CARB)'s EMFAC model are other commonly used sources for estimating emission factors.

Where warranted, a more detailed analysis might consider using a combination of air dispersion models and population demographics to assess secondary costs of pollutants inhaled by the population both while in the vehicle and at home.

It is important to note that emission rates are sensitive to numerous factors, many that can't be measured accurately and thus the estimates are not always precise. Some such factors include the precise mix of fuel being used, weather conditions, fleet age, etc.

Noise Pollution

In addition to emissions, a proposed or planned project could also impact noise pollution levels by increasing or decreasing it. Noise pollution may be measured at a location from recording the intensity of noise in decibels due to the source. This is then used to measure exposure to noise for individuals working or residing in the neighborhood. The National Institute for Occupational Safety and Health (NIOSH) defines recommended maximum exposures to noise for workers over an extended period of time. There are currently no standard techniques available to either quantify noise pollution due to transportation projects or to monetize benefits from reduced noise pollutions. However, this may be considered an impact/benefit of a studied project.

Secondary Criteria

In addition to the traditional impact categories, there are numerous potential impacts derived from a project that may be much harder to quantify. The following are some such impacts:

- Innovation (Technological or Operational)
- Public-Private Partnerships

- Perception of Comfort and Safety

Such impacts may be considered in the BCA, typically unquantified as an additional benefit, but with care that no impact is double counted. For example, there may be benefits of upgrading the hardware of a transportation infrastructure that goes beyond the improvements derived in travel times or costs as it may allow for easier standardization across larger networks. Similarly, projects that involve public-private cost sharing and partnerships have an unquantifiable benefit of setting up future collaborations with components of such future projects assigned more efficiently by each industry's expertise and forte.

Costs

Once the benefits or impacts have been accounted for, the costs associated with the project need to be identified. Project costs include a sum total of all resource costs associated with completing the project and maintaining the new or improved transportation facility over its lifecycle. The costs include costs for all resources needed, including capital costs, land costs, equipment and material costs, and labor costs. Depending on whether a BCA or an EIA is being performed, either all costs, regardless of the bearer, or only pertinent costs reflecting the EIA region, may be studied, respectively.

Costs associated with the project are typically classified as capital costs (all initial expenditures) or operating and maintenance expenditures for running the system over its lifecycle.

Capital Cost

In addition to the obvious construction costs (land, labor, materials, and equipment costs), capital costs may also include costs of soft services required for the project, such as project planning, review processes, land acquisition, utility relocation, and transaction costs related to financing.

When the capital cost is incurred over multiple years, they should be recorded accordingly in the year in which they were or are expected to be incurred. Both the TIGER and BUILD BCA require that the costs be provided in three distinct forms: nominal dollars, real dollars, and discounted real dollars. Nominal dollars reflect the actual dollars spent in year-of-expenditure dollars for prior as well as future costs. There are then required to be converted to a common base year dollar value (USDOT recommends using 2017 as the base year) using known and predicted inflation values to convert dollars across years.

Operating and Maintenance Costs

While the capital costs consist of initial costs required for completing the project infrastructure, the infrastructure needs to be maintained through its lifecycle. Operating and Maintenance (O&M) costs reflect the continuing costs associated with running the system and supporting and maintaining the health of the system through the analysis period.

O&M costs must be computed and reported for all alternatives under consideration including the baseline no-build alternative. O&M costs for the project can potentially be higher (such as with projects involving the creation of new infrastructure), or lower (such as with projects involving replacing existing infrastructure) than the no-build status quo. As with capital costs, O&M are typically reported in year-of-expenditure or nominal dollars, as well as in adjusted base year dollars.

An important aspect to note here is that O&M costs are also listed as a potential impact or benefit of the project. As such, while the O&M costs are typically explained under the costs section of a

BCA, they are typically to be counted as a net charge with respect to the base scenario, as a benefit (either positive or negative as the case may be).

Alternative Analysis/Sensitivity Analysis

The benefits and costs associated with each alternative considered, including the no-build baseline, are compared in the BCA component. Typical metrics used to reflect the viability of the benefits vs. costs analysis are:

Net Present Value (NPV), where all costs discounted to the base year are subtracted from all benefits also discounted to the base year to yield an NPV. When the NPV is positive (benefits exceed costs), the project may be deemed economically justifiable.

Benefit-Cost Ratio (BCR), where the ratio of the present value of benefits (including negative benefits) to the present value of costs is computed. The BCR allows for a more realistic comparison across projects and alternatives compared to NPV as it attempts to normalize the returns by dollars spent. The higher the BCR, the better the returns from the project. It is important to stress here that all negative benefits are included under benefits as opposed to costs in a typical BCA.

It is important to further note, that the NPV or the BCR alone cannot be used blindly to compare across alternatives. A major reason for this is that many benefits cannot be quantified or monetized. Thus, the selection process becomes somewhat subjective in choosing which alternative provides the most societal benefits.

A complete BCA further involves addressing the uncertainties associated with the BCA values (predictions for BCA inputs such as travel times and demand, estimates of costs, lack of data or use of incomplete data, etc.). Such uncertainties should be properly identified in the analysis, elaborating specifically on the aspects that might largely affect the BCA. Further, sensitivity analysis, where possible, is recommended to illustrate how some of the uncertainties might change the NPV or the BCR of the alternatives, possibly providing a range of expected BCRs.

4. BCA/EIA TOOLS AND RESOURCES

In this chapter, we discuss some of the prominently used tools and resources for multimodal freight Benefit-Cost Analysis. In Table 4-1, we list numerous tools specific to the various modes of transportation that may be used by an analyst to aid their analysis. A number of these tools are private enterprise tools that need to be purchased to be used, while others are freely available for use. Tools that require purchase are highlighted in red in the table below. Note that a few tools are no longer actively supported by their creators or could not be traced to their origins.

Table 4-1: List of Various Tools and Resources by Mode of Transportation.

Highway				
HERS / HERS-ST [12]	FHWA STEAM	AASHTO Redbook [8]	STRATBencost	MicroBencost
Cal-B/C Corridor, Network (Caltrans)	FHWA BCA / BCA.Net (Defunct)	TREDIS [11]	TREDIS – MBCA [11]	GradeDec.Net
TOPS BC [5,6]	REMI [10]			
Railway				
RailSim (Systra) [13]	Rail Traffic Controller (RTC)	FRA's GTMS	FRA GradeDec.Net	Surface Transportation Board Report R-1
Raileval	Owens et. al. [23]	TREDIS	URCS	REMI - Transight
Inland Waterways / Marine				
ORNIM (Ohio River Nav. Invest. Model)	USACE – Nav. Economic Tech. Program [26]	HarborSym (Institute of Water Resources)	USACE Principles and Guidelines Economic guidance docs.	TREDIS
USACE – General	REMI - Transight			
Air				
SIMMOD (FAA Airport Airspace Sim. Model)	FAA Runway Delay Sim. Model	MIT's LMI Runway Capacity Model	Total Airport and Airspace Modeler (TAAM)	FAA Airport Capacity Model
FAA Economic Values Guide	FAA Airport Delay Model	TREDIS	REMI - Transight	
Misc				
IMPLAN	*Ohio SPR 662*			
KEY: Orange highlight indicates resources that need to be purchased before use.				

IMPLAN

IMPLAN (IMpact analysis for PLANning), is a system of county-level data input-output models originally developed by the USDA forest service. IMPLAN was created as a product of the Rural Development Act of 1972 using public funding. It was eventually privatized due to ever-growing demand and is now owned and operated by the IMPLAN Group, LLC (formerly the Minnesota IMPACT Group) who actively update the databases and the software. The software still retains an open access philosophy, allowing maximum access to users of the structure of data and the model. IMPLAN is currently one of the most widely used economic impact modeling systems in the US. IMPLAN offers one of the simplest and most economical complete solutions to performing BCA or EIA for projects.

IMPLAN's greatest strength over other modeling systems like TREDIS and REMI, is that the modeling is fully visible (as opposed to black box modeling aspects in REMI) and the results are easier to interpret and explain. IMPLAN allows flexibility for users, offering the possibility to modify production functions and trade flow assumptions to suit the study needs, while also allowing for an unhindered choice of study geography (states, counties, or zip-code regions). Similarly, users may choose what industries (NAIC codes) to study based on their requirement. Impacts are presented broken down and categorized by industry and classified as direct, indirect, or induced impacts.

IMPLAN is, however, a static model (unlike REMI and arguably TREDIS, explained later) with the multipliers used reflecting industry linkages and flows at a given instant of time. Being a static model, IMPLAN cannot be readily used for forecasting purposes or to capture price elasticities and changes in consumer or industry behavior from direct impacts. Due to the same reason, impacts presented by IMPLAN are aggregate impacts over the entire lifecycle, and time needed to realize impacts may not be evident. IMPLAN can however be used to obtain impacts over time if set up to run iteratively building on each previous run.

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TREDIS

The Transportation Economic Development Impact System (TREDIS) Suite provides Benefit-Cost Analysis, Economic Impact Analysis, and Financial Impact Analysis solutions for transportation projects through its multitude of products. TREDIS was designed as a web-based tool to enable researchers, consultants, and transportation agency staff to collaborate. The tool is offered through a flexible subscription service where customers can choose the duration and geographic coverage areas.

TREDIS highlights the following as its main strengths:

- A ***complete solution*** across all modes of transportation.
- Incorporates ***wider economic benefits*** for a variety of players and perspectives.
- An ***internet cloud-based solution*** allowing simultaneous use by multiple agencies and staff.
- Employs a ***dynamic economic simulation*** to estimate long-term and short-term impacts. The element of dynamic modeling is attributed to the fact that results are generated over long periods of time even though at its core it uses a static IMPLAN model. TREDIS however (unlike REMI) does not use an equilibrium model where factors and multipliers are computed iteratively.

The economic and financial analysis models used in TREDIS build on economic models from various popular tools, incorporating the full industry structure of IMPLAN and adding dynamic forecasting of long-term changes in the economy, labor force, industry cost responses, and transportation effects. In addition to the main TREDIS suite, TREDIS – Freight, TREDPLAN, TREDAir, TREDTransit are other tools offered by the company for specialized solutions to complement the main economic suite.

The Benefit-Cost Analysis module in TREDIS covers all modes of transportation (road, rail, air, marine, pedestrian, and bicycle), offering a basic version that covers traditional BCA including travel time, costs, safety and emission benefits, with an expanded version that adds wider economic benefits such as logistics and supply chain reliability, and intermodal connectivity. The Economic Impact Analysis module of TREDIS is used to compare economic impacts across projects, sensitive to changes in metrics related to travel time, costs, reliability, etc. TREDIS is one of the most widely used economic impact tools for transportation impact assessment.

TREDIS – Freight consists of the freight and trade analysis module, an optional add on to TREDIS. The module is used to estimate the change in volume and type of commodities moving into and out of an analysis region due to the transportation project's impact. The module leverages the business growth analysis from EIA to predict expected changes in freight volumes.

TREDIS also provides the Multimodal Benefit-Cost Analysis (MBCA) web-based tool for free to users. This tool allows a user to compare costs and user benefits for multimodal transportation projects, or across projects.

TREDIS normally comes delivered with a variety of built-in tools including:

- Economic Impact Analysis in the form of multi-regional IMPLAN trade flow model
- Information on regional connectivity from Oak Ridge National Labs and Geographic Information System (GIS) market data from Environmental Systems Research Institute (ESRI)
- Freight flow data from the USDOT Freight Analysis Framework
- The Local Economic Assessment Package (LEAP) model for economic development growth assessment

However, TREDIS is a modular framework that can also be provided with other options including:

- The REMI economic model or localized input-output economic models
- Commercial baseline forecasts from sources such as Moody's Analytics (www.economy.com)
- More detailed freight flow data from Global Insight's TranSearch freight database

In addition to the free MBCA version and a subscription of the complete suite, TREDIS also offers a free university version that includes everything other than inbuild freight database and ability to define user-specified study regions (Table 4-2).

The US TREDIS model is a dynamic, multi-regional economic impact simulation model. It incorporates economic geography relationships and econometrically derived response factors for cost and access changes, as well as labor market and income factors. Employing a multi-regional economic modeling framework, TREDIS can be used to study inter-regional supply and demand changes. The tool incorporates wider economic benefits that can include the positive effects of public transportation on the economy via changes in increases in job access and decreases in traffic congestion growth. TREDIS also incorporates wider measures of BCA that can include social and environmental benefits.

Table 4-2: TREDIS Software Tiers

	TREDIS Product Version			
Capabilities	**Free Trial**	**Free MBCA**	**Free University**	**Full Subscription**
User BCA	Y	Y	Y	Y
EIA (wider benefits)	Y	N	Y	Y
Public-Private Cash Flow Analysis	Y	N	Y	Y
Fiscal Impact Analysis	Y	N	Y	Y
Freight Data	Y	N	N	Y
Area Economic Profiles and Forecasts	Y	N	Y	Y
User-specified Study Region(s)	N	N	N	Y
Importing / Exporting Projects	Y	N	Y	Y
Support	Knowledge Base	Knowledge Base	Knowledge Base	Full Support
Reports	All	BCA Reports	All	All

REMI

The REMI model, owned and produced by Regional Economic Models, Inc., is a dynamic economic modeling framework. The model was originally created in 1980 as a hybrid of input-output models (like IMPLAN) and econometric modeling where equilibrium solutions are obtained through multiple iterations. Being a dynamic model, REMI is able to estimate the time path of impacts and forecast growth and benefits. The input-output component of the model uses national coefficients from the Bureau of Labor Statistics, regionalized using the RPC technique. The econometric component is based on economic general equilibrium models, thus allowing for reliable forecasting abilities.

REMI offers a collection of multiple model extensions in addition to the central economic model (traditionally called REMI, now PI+), including Tax-PI for evaluating fiscal, economic and demographic effects of tax policy changes, E3+ focusing on modeling energy and environmental policies, and TransSight specializing in modeling the impacts of transportation projects.

TransSight integrates travel demand and transportation forecast modeling into the REMI economic model, to dynamically forecast impacts of transportation projects. Models integrated to various degrees include TranPlan, TransCAD, TP Plus, EMME, EMME2, and HERS. Incorporating the multiple models, TransSight can generate a complete perspective with a full spectrum of impacts from a project. In addition to the transportation models, TransSight also incorporates extensive transportation relevant data such as emissions data and safety valuation factors.

While offering a complex economic model, the time costs (due to higher complexity), and the financial costs (more expensive than the alternatives discussed above) are aspects that may nudge a customer in a different direction.

HERS and HERS-ST

The Highway Economic Requirements System (HERS) was developed as an optimization framework for FHWA to allocate resources while maximizing derived economic benefits. The "State Version" (HERS-ST) was the equivalent tool for state and regional authorities. The tool is closely linked with the Highway Performance Monitoring System (HPMS), FHWA's system used to monitor the performance of the national highway system. Developed by FHWA, HERS offers tools for assessing roadway-centric projects.

HERS, at its root, is a model that allows agencies to simulate and compare benefits and costs for multiple highway projects, focusing mainly on impacts to pavement, travel times, crashes, VMT, fuel consumption, emissions, and vehicle operating costs.

The impacts of a project are computed independently based on existing models, such as the delays through appropriate HCM procedures, crash rates using Highway Safety Manual (HSM) procedures, emissions and fuel consumption from EPA's MOVES model, and vehicle operating costs from a combination of various factors such as fuel and oil consumption, maintenance and repair costs, and depreciation, all based on default national average values.

HERS offers a quick and simple tool for evaluating highway projects, without getting into the details of economic impacts or even travel demand estimations. While not a complete economic modeling tool like the others discussed earlier, HERS finds relevance in often being used as a building block for more complex tools.

FHWA–TOPS-BC

The Tool for Operations Benefit/Cost (TOPS-BC) [5] is a decision support tool created by FHWA to complement the Operations Benefit/Cost Analysis Desk Reference [6]. The TOPS-BC tool effectively replaces the BCA.NET tool earlier endorsed and managed by FHWA for performing BCA.

The tool uses a spreadsheet-based design to assist transportation engineers in conducting BCA by providing four key capabilities: investigating impacts (investigate expected range of impacts), researching methods (identifying various appropriate tools and methodologies for conducting BCA), estimating costs (framework and default values for life-cycle costs for various strategies), and estimating benefits (framework and impact factors for conducting simple BCA).

TOPS-BC considers various traditional Measures Of Effectiveness (MOEs) including travel time savings, vehicle operating costs, crashes, and emissions, as well as some emerging MOEs such as travel time reliability and induced travel/consumer surplus. Further, it suggests consideration for additional harder-to-quantify MOEs such as livability, customer satisfaction, and perception of safety and security based on the type of project being considered.

Since TOPS-BC caters to engineers who are evaluating transportation system management and operations (TSM&O) projects, the tool identifies a variety of potential projects including signal design and coordination, capacity enhancement, ramp metering, and incident management projects. The inputs required by the tool as well as the benefits and impacts considered, thus depend largely on the type of project being evaluated.

5. MAASTO DOTS

As part of the project, we conducted surveys with the Mid America Association of State Transportation Officials (MAASTO) to collect information on the processes used to conduct economic analysis at the states. MAASTO represents one of four geographical regions within the country as defined by the American Association of State Highway and Transportation Officials (AASHTO). MAASTO consists of ten member states primarily in the Midwest, including Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.

States were sent a short questionnaire (Figure 5-1) asking questions on the economic models used (if any) to assess projects, whether the analysis was done in-house or contracted to private consultants, and factors considered for the analysis. Table 5-1 summarizes the type of model used and whether consultants are hired for the analysis for each state surveyed. A dark red colored cell indicates the type of model/characteristic employed by the state for their economic evaluations, while light red indicates that the model has, in the past, been used but is no longer used by the state. Figure 5-2 shows a pie chart summarizing the popularity of the most common economic models used by the states.

Economic Analysis Questionnaire

Contact Name:

Do you use an Economic Model to value and evaluate your state's highway and/or multimodal investments?

Is the work completed in-house or by a consultant?

Which models do you use?

Do you feel the economic modeling used in your agency is accurate?

Does the model provide information you can use?

What do you use the results of the modeling for?

What factors do you consider when analyzing multimodal freight investments?

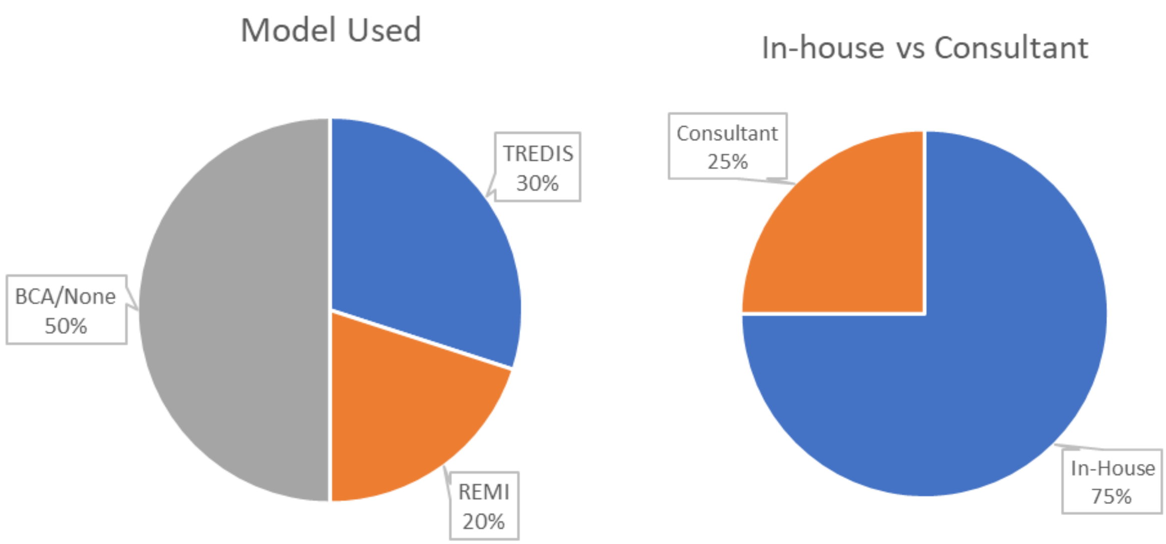
Factor	Y/N
Economic impacts	
Demographic changes	
Changes in travel time	
Creation of jobs	
Changes in GNP for the state	
Customer satisfaction	
Safety	
Industry support and development	
Modal support and development	
Others?	

Do you have any additional comments or suggestions regarding economic modeling for multimodal freight analysis?

Figure 5-1: Questionnaire Sent to MAASTO DOTs

Table 5-1: Choice of Economic Modeling Framework Used by States

State	Economic Model Used					In-House / Consultant	
	TREDIS	REMI	Other	Merit-Based Comparative	BCA	In-House	Consultant
Minnesota							
Michigan							
Missouri							
Iowa							
Wisconsin							
Illinois							
Kentucky							
Kansas							
Ohio							
Indiana							



(a) (b)

Figure 5-2: Pie Charts Showing Fraction of States (a) Using REMI and TREDIS, and (b) Using Consultant vs. In-House Analysis

In addition to the model used, states were asked what factors they considered in their economic modeling. Table 5-2 shows factors considered by the state in their analysis. A dark red color indicates that the factor is considered within the model used by the state, light red indicates that the factor is considered only in part, and orange indicates that the factor is investigated, but outside of the main modeling process. Of the states that do conduct an economic analysis (5 of the 10 states), travel time was the only factor consistently considered by each state, with economic impact, demographic changes, creation of jobs, and industry support and development being used by 4 of the 5 states. Based on the responses received, Kansas seems to have the most well-rounded analysis with respect to factors considered (with all listed factors directly modeled through TREDIS apart from customer satisfaction, which is modeled in part).

Table 5-2: Aspects of Modeling Considered by States in their Processes.

Factors Considered	IL	IN	IA	KS	KY	MI	MN	MO	OH	WI
Economic Impact										
Demographic Changes										
Changes in Travel Time										
Creation of Jobs										
Changes in State GNP										
Customer Satisfaction										
Safety										
Industry Support and Development										
Modal Support and Development										
KEY: Dark red indicates components considered in full, light red indicates components only partially considered, and orange highlight represents components that are investigated, but outside of the main modeling process.										

In speaking to the DOTs, we realized that, while some states have distinctly defined procedures for evaluating projects, some are still in the process of developing the complete framework, be it in deciding what set of tools to use, or what specific impacts to consider in the analysis. The choice of the tool (or software package) used for project evaluation analysis is driven both by cost and by the end objectives desired. The larger models, namely REMI and TREDIS, offer wholistic options for performing the analysis, offering coverage for most of the listed impact categories. States using such models do so either using in-house analysis or through consultant services. States that do not subscribe to either TREDIS or REMI, tend to perform in-house analysis that employs either their own BCA framework or a system devised around comparing performance measures or warrants to compare between the viability of competing projects. Finally, there are a few states that do not currently have a complete economic evaluation process set up and are in the process of developing such a framework to streamline the evaluation of projects.

A common theme noticed in the responses was the sensitivity of the analysis to the quality of data entered, and the lack of data in general associated with multiple modes and multiple impact categories. Thus, multiple states treat their analysis results as a subjective comparison of projects by impact categories and not definitive for choosing projects when performing BCA.

6. CASE STUDIES - SAMPLE PROJECTS

In this chapter, we consider three economic studies and compare how the studies were conducted. The three projects include a Benefit-Cost Analysis for a recent railroad equipment upgrade project from Kansas, a statewide Economic Impact Analysis study for Missouri's public ports, and a statewide Economic Impact Analysis study for Missouri's airports. The comparisons will illustrate the inherent differences in the objectives of a BCA and an EIA study, the differences due to the scale of project/activity considered, and to a lesser extent, the differences due to the modes considered.

Project 1: Kansas State DOT – Railway Equipment Project BCA

Our first case study refers to a Benefit-Cost Analysis performed for a railway equipment upgrade project from Kansas. The proposed project looks at replacing 10 locomotives currently being used, with 7 new purchases. The BCA was performed for a 10-year study period starting with 2018 as the base fiscal year. The project development is expected to start in 2019, and benefits are expected to start accruing in 2021. The new fleet to be purchased is expected to have a 50-year lifecycle. The table below shows the summary of benefits and costs between existing conditions and with the project implemented.

Table 6-1: Costs and Benefits Comparison Between Build and No-Build Scenarios for Railway Equipment Upgrade Project, Case Study #1.

	Existing Conditions	Build Scenario
Capital Cost ($)	0	2,000,000
Operations and Maintenance Costs ($ per year)	120,000	70,000
Fuel Costs ($ over 10 years)	8,776,836	6,103,587
VMT (miles per year)	113,082,000	82,571,454
Cost of Train Delays ($ per day)	150	200
Availability Rate of Fleet	54%	85%
Reliability Costs ($ over 10 years)	2,518,500	766,500

Table 6-2: Emissions Savings for Railroad Equipment Upgrade Project, Case Study #1.

Key Quantifiable Statistics		
Fuel Consumption Avoided	861,063	gallons
Avoided CO_2 Emissions	9,698	tons
Avoided NO_X Emissions	124.38	tons
Avoided PM 2.5 Emissions	3.35	tons
Avoided VOC Emissions	5.46	tons
Avoided SO_2 Emissions	1.78	tons

Table 6-3: Monetized Value of Benefits and Costs Before and After Discounting to Base Year and Overall Benefit/Cost Metrics for Railroad Equipment Upgrade Project, Case Study #1.

	Undiscounted	Discounted
Benefits		
Fuel Cost Savings	$2,673,249	$1,624,934
Incremental O&M Savings	$500,000	$306,733
Residual Value	$666,780	$296,058
Reliability Cost Savings	$1,752,000	$1,074,794
Avoided Emissions Costs	$2,213,517	$1,357,920
Total Benefits	**$7,805,547**	**$4,660,439**
Costs		
Costs	**$1,808,018**	**$2,000,000**
Key Financial Metrics		
Net Present Value	5,997,529	2,660,439
Benefit-Cost Ratio	4.32	2.33
Discounted Payback Period	4.89	5.34
Internal Rate of Return	29%	

Reliability savings are computed from expected change to the availability rate of existing fleet and the average cost of train delay.

Emissions cost savings are computed based on estimated reductions in CO_2, NO_x, PM 2.5, VOC, and SO_2 emissions. The emission reduction is expected to be constant over each of the 10 years (emissions are not expected to increase with age of the fleet, though the older fleet in the base scenario is expected to have higher emission rates). While CO_2 emissions are both computed and reported, no monetary value is assigned to benefits from reduced CO_2 emissions in keeping with the changes in the BUILD BCA guidelines.

As with emissions, fuel consumption of the fleet is not expected to change over the course of the 10 years. The older fleet, in the base scenario, is estimated to provide 400 miles per gallon of fuel efficiency, with the newer fleet having a slightly improved 420 miles per gallon. The main savings in fuel consumption can be attributed to the reduced VMT at 82,571,454 miles per year compared to 113,082,000 miles per year in the base scenario, nearly a 27% reduction in VMT.

Project 2: Missouri State DOT – Public Ports Economic Analysis

Missouri's DOT commissioned Cambridge Systematics to prepare a public ports economic analysis report in 2018 [24]. Missouri's 12 public ports and over 1000 miles of inland waterways connect the state to the entire Mississippi River system, including the Ohio, Tennessee, and

Illinois rivers. The study was performed to assess the economic impact of the public ports and inland waterways. The study found that Missouri public ports handled nearly 4 million tons of freight in 2016 (a 78% increase since 2011), valued at over $12 billion. The ports are essential to local crop production, mining, nonmetallic mineral product manufacturing, transportation equipment manufacturing, chemical manufacturing, and primary metal manufacturing industries. The ports further support nearly 290,000 jobs annually (1 out of every 10 jobs in the state), with an estimated $15.7 billion labor income and over $100.6 million annual economic activity. The port system collectively generates over $2.4 billion in state and local tax revenues annually. The system accounts for 4.1% share of the state's total freight production tonnage by marine mode (vs. 3.9% national average), and 2.4% share of total freight attraction tonnage by marine mode (vs. 3.9% national average).

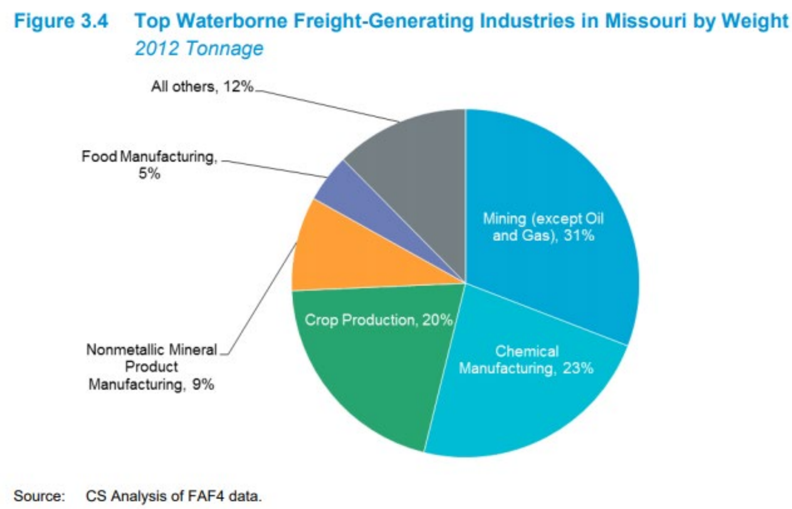


Figure 6-1: Top Freight Generating Industries by Weight that Use Missouri's ports, Case Study #2 [24]

The study assessed direct impacts of the port system (employment, added value, market growth, reduced costs, etc. associated with both port-dependent and port-benefitted industries and companies), as well as indirect and multiplier impacts (local purchases by port dependent companies and their employees) on the economy. The study was done relying chiefly on the IMPLAN model. The results from the statewide Economic Impact Analysis are summarized in Table 6-4.

Table 6-4: Summary of Overall Statewide Impacts of Missouri's Ports, Case Study #2 [24]

Total Statewide Impacts	
Employment	290,000
Income (in billions USD 2016)	$15.7
Gross State Product (in billions USD 2016)	$100.6
State and Local Tax Revenue (in billions USD 2016)	$2.4

Table 6-5: Summary of Employment Impact from Missouri's Ports, Case Study #2 [24].

	Total Employment	Avg. Annual Income Impact
Direct Employment	1,070	$69.4 million
Employment at Port-Dependent Businesses	106,810	$4.694 billion
Employment at Port-Benefitted Businesses	97,510	$4.963 billion
Induced Jobs (from IMPLAN) (from direct and port-dependent)	80,991	
Total Jobs supported	**288,981**	

Project 3: Missouri State DOT – Statewide Airports Economic Impact Study

Missouri's DOT commissioned Landrum and Brown, Inc. to perform a statewide airports economic impact study in 2012 [25]. The study focused on the economic impacts of the nine commercial service and 99 public use airports in the state.

The EIA study was performed following the Federal Aviation Administration guidelines [9], with impacts categorized as direct, indirect, or induced (multiplier) impacts, and the total impacts reported as a cumulative sum of the three categories.

Data for direct impacts were collected through a comprehensive survey effort catered for airport management and aviation-related businesses and tenants.

Table 6-6: Summary of Impact Analysis Results for Missouri Airports, Case Study #3 [25].

	Jobs	Payroll ($ million)	Output ($ million)
Commercial Service Airports			
Direct Impacts	17,443	976.4	3,551.1
Indirect Impacts	38,350	825.5	2,515.6
Induced Impacts	37,379	1,026.5	4,177.9
Total Impacts	93,172	2,828.5	10,244.6
General Aviation Airports			
Direct Impacts	3,957	193.0	587.2
Indirect Impacts	863	17.3	36.2
Induced Impacts	2,629	89.8	233.8
Total Impacts	7,449	300.1	857.1
Total Statewide			
Direct Impacts	21,400	1,169.4	4,138.2
Indirect Impacts	39,213	842.8	2,551.8
Induced Impacts	40,008	1,116.4	4,411.7
Total Impacts	**100,621**	**3,128.6**	**11,101.7**

In addition to the quantifiable benefits, the economic impact study identifies how Missouri's airports add to the quality of life of its residents through numerous non-quantifiable benefits. These include a variety of recreational flying-related activities, such as soaring, parachuting, and flight training, and providing access to a variety of recreational resources such as hunting and fishing preserves, parks, and resorts. Further, the airports afford access to emergency patient transfers, medical doctor transport, agricultural application, search and rescue operations, disaster relief staging, traffic monitoring, law enforcement, natural resource monitoring, and aerial mapping, among other benefits.

Contrast of Styles Between Case Studies

Having looked at the case studies individually, we next try to compare the techniques used and components of impacts considered by each analysis. The differences in the analyses arise through three main components:

- The first study uses a BCA for a proposed project whereas the latter two studies perform an EIA for existing infrastructure
- The first project is limited in scale to one aspect of the infrastructure (equipment upgrade),) while the latter two consider aggregate statewide impacts of an entire infrastructure system
- The mode considered in each study is different from the others.

Table 6-7 shows the components considered in each study.

Table 6-7: Synopsis of Benefits/Impacts Considered by the Three Case Studies Investigated

Impacts / Benefits Considered	Project, State, and Type of Analysis		
	Rail Equipment Kansas BCA	Statewide Ports Missouri EIA	Statewide Airports Missouri EIA
Fuel Cost Savings			
Operations Cost Savings			
Reliability Cost Savings			
Emissions Savings			
Employment			
Income / Payroll			
Tax Generated			
Total Economic Activity			

As can be seen from the table, there is a stark difference between how the BCA for a specific project and statewide EIAs may differ. While the former focuses on benefits accrued in targeted categories of impacts (such as fuel costs and emissions), the latter focuses on the overall economic impacts in dollars generated. The state-wide EIAs concentrate heavily on job creation, associated income from wages, and the overall economy generated. Further, since the focus of the EIAs is to illustrate the reach of the projects, they can often aggregate all revenues/employment for impacted businesses as indirect impacts for the project being studied, even when these revenues may not be completely attributed to the subject project alone. Thus, the quantitative value of the impacts (more specifically the indirect impacts) is not a true representation of the increase in economic value due to the subject project as compared against a scenario where the project did not exist. These aspects of the BCA and EIA highlight how the objective and the audience for such studies can differ substantially, making a comparison between them futile. In turn, this further highlights the need to develop consistent frameworks for comparison of values associated with various multimodal projects.

7. CONCLUSIONS

This project sought to identify the best approaches available to practitioners for evaluating and comparing benefits derived from freight investments across modal projects. This is achieved by looking at the available frameworks for evaluating the economic impact or viability of projects, various tools, and products that automate the analysis, and data sources and tools that supplement the analysis by providing inputs, estimates, and multipliers needed to perform the analysis.

In this report, we presented first, a brief description of the two most common analysis formats: Benefit-Cost Analysis and Economic Impact Analysis, highlighting the differences between the two in focus and approach. Next, we discussed the various components of such an analysis process, specifically highlighting various benefit/impact categories that should be considered when evaluating the merits of a project. The standard processes and methodologies for evaluating these benefits and impacts along with potential data sources were discussed. We also surveyed the evaluation practices as followed by the MAASTO states and summarized them showing the popular trends among the states.

Using three case-studies evaluating impacts from three different transportation modes, we provided a discussion on how and why such analyses differ from one another. The case studies consist of a Benefit-Cost Analysis for a railway equipment upgrade project, a statewide ports Economic Impact Analysis, and a statewide airports Economic Impact Analysis study. The variety in the style of analysis and the scale of infrastructure studied provides an opportunity to critique the merits of the different analysis methods. The railroad equipment analysis focuses on pointed benefits accrued in select categories of impacts (such as fuel costs, reliability, and emissions) that are most relevant to the project, finally producing a B/C ratio as a measure of the viability of the project. The two statewide economic impact studies, for ports and airports respectively, on the other hand, are aimed at evaluating the total size of the economy that is directly or indirectly affected by the infrastructure in question. These Economic Impact Analysis studies concentrate heavily on job creation, associated income from wages, and the overall economy generated or impacted. The indirect impacts aggregate all jobs and revenues affected in some way by the infrastructure even if those are fully attributed to the infrastructure alone. This means that the results from an Economic Impact Analysis are not a good measure of the actual impact the infrastructure may have as opposed to a scenario without the infrastructure present, as the indirect impacts are an exaggerated measure. The BCA lends itself best to situations where projects are to be compared for their operational benefits. The BCA, due to focusing on operational benefits such as travel time savings and environmental impacts, is somewhat better suited to comparisons across modes albeit with the understanding that availability of data might hinder a perfect comparison is most situations. The EIA, in turn, is best utilized in situations where the financial benefits to the local economy are to be highlighted. These aspects of the BCA and EIA highlight how the objective and the audience for such studies can differ substantially, making a naïve comparison between a BCA and an EIA from distinct projects futile. In turn, this further highlights the need to develop consistent, standardized frameworks for comparison of values associated with various multimodal projects.

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APPENDIX A – FULL QUESTIONNAIRE RESPONSES FROM MAASTO STATES

NOTE: The following is edited for phrasing, in places.

Minnesota

Contact: Nicole George

Minnesota does not use an economic model for evaluating projects. They have a standard benefit-cost evaluation and use other quantitative criteria for competitive programs, but neither of those could be considered an economic model.

Michigan

Contact: Jesse Gwilliams

Do you use an Economic Model to value and evaluate your state's highway and/or multimodal investments? – Yes

Is the work completed in-house or by a consultant? – Both

Which models do you use? – REMI, and a specialized in-house tool utilizing REMI. (Also, aeronautics bureau has something custom made by EDR using IMPLAN)

Do you feel the economic modeling used in your agency is accurate? – Yes

Does the model provide information you can use? – Yes

What do you use the results of the modeling for? – Evaluation of 5-year plan highway investments, using number of jobs, socio-economic benefits, ROI, etc.

What factors do you consider when analyzing multimodal freight investments?

Economic impacts	Yes
Demographic changes	Yes
Changes in travel time	Yes
Creation of jobs	Yes
Changes in GNP for the state	Yes
Customer satisfaction	Not quite as yet
Safety	No, tried but difficult
Industry support and development	No
Modal support and development	No
Others?	

Do you have any additional comments or suggestions regarding economic modeling for multimodal freight analysis? - Our economic modeling in planning is highway based right now. We have been exploring multimodal options for our analysis package, but as of now the freight analysis in this respect is based on our highway investments.

Missouri

Contact: Eva Voss, Machelle Watkins, Cheryl Ball

Do you use an Economic Model to value and evaluate your state's highway and/or multimodal investments? – Yes

Is the work completed in-house or by a consultant? – Consultant

Which models do you use? – TREDIS economic impact model

Do you feel the economic modeling used in your agency is accurate? – TREDIS provides the most accurate information for economic modeling.

Does the model provide information you can use? – Yes. It can assess transportation-related changes and calculate economic impacts and benefits by industry, study area and year.

What do you use the results of the modeling for? – The results of the modeling are used to update the data in MoDOT's annual Tracker measure, Economic return from transportation investment-7a. They are also used to support federal grant applications.

What factors do you consider when analyzing multimodal freight investments?

Economic impacts	Yes, within TREDIS
Demographic changes	TREDIS incorporates region-specific information on demographic and economic changes over time when evaluating economic impacts.
Changes in travel time	Yes, within TREDIS
Creation of jobs	Yes, within TREDIS
Changes in GNP for the state	Yes, within TREDIS
Customer satisfaction	Assessed independently of the TREDIS analysis
Safety	Safety improvements affect societal benefits (such as within a benefit-cost analysis) but do not directly affect activity within the economy. TREDIS can monetize safety benefits
Industry support and development	Yes, within TREDIS
Modal support and development	Assessed independently of the TREDIS analysis
Others?	

Do you have any additional comments or suggestions regarding economic modeling for multimodal freight analysis? - Past MoDOT federal grant applications have used TREDIS fueled by Transearch to incorporate corridor-specific information on commodity profiles to drive Economic Impact Analysis that is more tailored to specific industry responses to corridor improvements.

Indiana

Our planning group uses a REMI model or in house, ad-hoc analysis to look at economic impact of some projects. It is a consideration in those projects, but does not play a big role in project planning. INDOT is currently focusing on preservation and rehabilitation projects rather than added capacity or other major capital work. We are generally responsive to industry requests and those from local officials.

Ohio

Contact: Mark Locker

The team that handles Ohio's TRAC projects has an economic component they use. It is a way to sort projects and score them on the economic merits of the project. Similar to the USDOT BCA for the BUILD (formerly TIGER) projects.

Kentucky

Contact: Jeremy Edgeworth

Don't use any form of economic modeling/analysis.

Illinois

Contact: Sheng Chen, Michael Vanderhoof, James (Jim) Durako, Holly Ostdick

Do you use an Economic Model to value and evaluate your state's highway and/or multimodal investments? – No, we have not used an economic model in the past

Is the work completed in-house or by a consultant? –

Which models do you use? –

Do you feel the economic modeling used in your agency is accurate? – N/A

Does the model provide information you can use? – N/A

What do you use the results of the modeling for? – N/A

What factors do you consider when analyzing multimodal freight investments?

Economic impacts	No
Demographic changes	No
Changes in travel time	Yes
Creation of jobs	No
Changes in GNP for the state	No
Customer satisfaction	Yes
Safety	Yes

Industry support and development	Yes
Modal support and development	No
Others?	

Do you have any additional comments or suggestions regarding economic modeling for multimodal freight analysis? - IDOT is in the process of adding/strengthening economic analysis in our planning process. The new IL statewide Travel Demand Model will be able to produce future year Vehicle Miles Traveled, and Vehicle Hours Traveled information. The information will be major input into the Regional Economic Model Inc's tool REMI and perform the economic analysis for multimodal freight analysis.

You will notice that we don't have a lot of experience yet with economic modeling.

That said, there have been three recent efforts into quantitative analysis for investment decisions through our asset management program, a new capacity project prioritization tool, and the evaluation of projects for our competitive freight program. There are economic criteria in our "new capacity" project prioritization tool but it falls well short of what you'd consider an economic model. Our competitive freight program criteria were focused on the goal areas of bottleneck reduction, safety, intermodal accessibility and technology deployment and we only indirectly covered economic factors due to that focus and our desire to use readily available data.

We do recognize the potential value of adding these tools and are in the process of building capability to do so through development of a statewide travel demand model.

Iowa

Contact: Garrett Pederson

Iowa DOT does not actively utilize an economic model at this time, but the Project Management Office is currently examining new methods for calculating the value of projects. It's expected that this information will ultimately help inform project selection/prioritization.

Wisconsin

Contact: Dean M. Prestegaard

Do you use an Economic Model to value and evaluate your state's highway and/or multimodal investments? – Yes

Is the work completed in-house or by a consultant? – Both. In the past, consultants have often helped with Benefit-Cost Analyses (BCA) for grant applications which generally included economic modeling. Currently, we (my section) are working towards increasing the use of our capabilities to perform BCA and other economic modeling in lieu of consultants

Which models do you use? – Currently IMPLAN and TREDIS. Previously, REMI was used but it was too costly and complex (which increased staff time devoted to maintaining skills) for the amount of added benefit it provided

Do you feel the economic modeling used in your agency is accurate? – • Generally, yes, however it must be taken in the context of what the modeling is being used for. In most cases we are comparing scenarios and concerned with 'differences' (build/no build). "Accuracy" depends on the context. We are not modeling as a 'predictor'.

Does the model provide information you can use? – Yes, that is why we have them.

What do you use the results of the modeling for? – BCAs in support of grant applications or to aid in decision making.

What factors do you consider when analyzing multimodal freight investments?

Economic impacts	Yes
Demographic changes	Yes
Changes in travel time	Yes
Creation of jobs	Yes
Changes in GNP for the state	No
Customer satisfaction	Yes (subjective/interpretive, not analyzed in models)
Safety	Yes
Industry support and development	Yes
Modal support and development	Yes
Others?	

Do you have any additional comments or suggestions regarding economic modeling for multimodal freight analysis? – *Not answered*

Kansas

Contact: David Schwartz, John Maddox

Do you use an Economic Model to value and evaluate your state's highway and/or multimodal investments? – Yes

Is the work completed in-house or by a consultant? – In-house

Which models do you use? – TREDIS

Do you feel the economic modeling used in your agency is accurate? – It's as accurate as the data we feed into TREDIS. Contingent development is a weakness… any chamber of commerce can claim "but for this project, we won't get X company to come", but the flip side is trickier… if the facility isn't improved, will businesses leave?

Does the model provide information you can use? – Yes, I feel it's a useful tool for comparing projects' benefits, but use a grain of salt if touting predicted benefits at a ribbon-cutting.

What do you use the results of the modeling for? – Good to compare the benefits of one project vs another, or different phases of a large projects. Use with caution if conducting B/C justification studies.

What factors do you consider when analyzing multimodal freight investments?

Economic impacts	Yes, sometimes
Demographic changes	Sometimes
Changes in travel time	Yes
Creation of jobs	Yes
Changes in GNP for the state	Yes
Customer satisfaction	Yes? (David asked John to comment, but John didn't notice)
Safety	Yes
Industry support and development	Yes
Modal support and development	Yes
Others?	

Do you have any additional comments or suggestions regarding economic modeling for multimodal freight analysis? - Truck data is hard to find! Railroads are only slightly easier.

MID-AMERICA FREIGHT COALITION

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