Understanding How to Develop and Apply Economic Analyses: Guidance for Transportation Planners

Final Guidebook

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1.1 Approach Taken in Developing the Guidebook

Chapter 1 Summary

This orientation chapter explains the:

- Goal of the Guidebook
- How it is organized
- How to use it.

Transportation planning historically has incorporated economic considerations into the feasibility, economic impact, return on investment, and benefit cost studies used to develop, evaluate individual candidate projects and programs of investments. Of the eight current planning factors included in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) of 2005the Transportation Equity Act for the 21st Century (TEA-21) of 1998, two are directly related to economic considerations:

1) Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency
2) "Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns."

As applications warranted, economic considerations also have played a supporting role in the assessment of the other five planning factors. For example, security planning assessments often consider the economic costs associated with a disruption at key nodes in the nation's transportation network. Asset management is at the heart of the planning for the preservation of the existing transportation system, another of the planning factors. Safety, too, has an economic component in the value of lives saved and human capital protected.

This growing emphasis on economic considerations in transportation planning and its inclusion at multiple points in the overall process (e.g. project development, evaluation, and programming) mean that transportation planners and professionals, many of whom have no formal training in economics, are increasingly asked to:

- Manage economic studies as part of their routine planning responsibilities
- Make project recommendations to decision makers based on a range of criteria that increasingly incorporate economic methodologies and outcomes.

By improving the ability of transportation planners and professionals to apply economic analysis as a decision support tool, scarce funding and limited space can be stretched further, and more sustainable and responsive projects can be delivered to our nation's communities.

1.2 Objectives

The goal of this Guidebook is to provide comprehensive guidance on the types of economic analyses that are appropriate to transportation planning, programming, and project evaluation. It focuses on the questions that need to be answered, how an analysis should be designed, and how to evaluate and communicate the results of an economic analysis. It is not designed to serve as a manual that provides step-by-step instructions on how to conduct economic analyses, but rather it is intended to assist planners and other transportation professionals in becoming informed managers and consumers of economic analyses. In other words, the Guidebook is designed to help the reader reach a practical level of economic understanding and skill. For those who want or need to go further, the text and appendices make reference to resources that will allow for reaching a deeper understanding.

1.3 Using the Guidebook

The Guidebook is focused primarily on the long-term impacts associated with transportation investments, programs, and policies—in other words, the recurring benefits that result from the construction and operation of these investments and/or policies. However, over the past few years, there has been a heavy emphasis on short-term impacts, particularly jobs and wages generated by the construction of a transportation facility. These short-term impacts are addressed in the Guidebook, particularly in the discussion of measures for economic impact analyses in Chapter 11. However, these short-term impacts are not the primary focus of the Guidebook.

The Guidebook's chapters provide information on various steps in the economic analysis development process—ranging from describing how economic analysis fits within the broader transportation planning effort and the process for conducting an economic study to evaluating which measures to report and track over time. As a result, it is not necessary to read the entire Guidebook at once (or in a particular order) for it to be of use.

Depending on the reader's familiarity with economic analysis, the Guidebook can be used in one of two ways. For those who have little to no experience with economic analysis of transportation investments, it might be most useful to read the Guidebook chapter-by-chapter in order to gain a better understanding of economic analysis and how it relates to transportation planning. Those who are already familiar with different aspects of economic analysis may prefer to use the Guidebook as a reference manual, focusing on specific areas of interest and moving around the Guidebook more freely. As a result, the Guidebook is organized in such a way that it will accommodate both types of readers. A summary of the Guidebook's organization by chapter, as well as the typography conventions applied in the Guidebook to assist the user, are described in the sections that follow.

1.3.1 Organization of the Guidebook

Chapter 2 discusses how economics is applied in the entire continuum of transportation planning activities—from project development and selection to program development and policy support. It focuses on how the questions and choices to be made vary throughout these activities and how different agencies or participants apply economics as a decision support tool in the transportation planning process.

Chapter 3 looks at how economics is involved in the various transportation planning stages for both project and programming investments, as well as long-range planning. It provides an introduction to the transportation planning process and emphasizes the importance of incorporating goals, data, and stakeholder participation in the economic considerations of the planning process.

Chapter 4 provides a summary of the various types of economic analyses performed in transportation planning, including benefit cost analysis, economic impact analysis, return on investment analysis, and other analyses. It highlights the differences among these analyses and provides guidance on selecting the appropriate analysis for project level and program level planning.

Chapter 5 explores the issues associated with answering the questions necessary to establish the framework for an economic analysis. By addressing these components of the analysis first, the Planning Project Manager and economics team members will be able to determine what type of economic analysis is necessary, the appropriate scale of the analysis, and the appropriate methodology and tools to apply in the analysis.

Chapter 6 provides practical advice for managing an economic study and determining how the economic analysis can best support the overall purpose of the transportation project or program. It discusses the general steps in an economic analysis, the importance of distinguishing short-term from long-term impacts, things to consider when selecting a methodology or modeling approach, as well as best practices.

Chapter 7 addresses user benefits, such as travel time, travel cost, and accidents avoided savings, that may be included in economic impact analyses or benefit cost analyses. It provides an overview of user benefits, what to consider when selecting a methodology, influence of other parts of the planning study on the user benefits estimation, when the user benefit analysis should be performed, and methods available to estimate these benefits.

Chapter 8 focuses on the non-user benefits, such as travel time, travel cost, and accidents avoided savings, that may be included in economic impact analyses or benefit cost analyses. It provides an overview of non-user benefits, what to consider when selecting a methodology, influence of other parts of the planning study on the non-user benefits estimation, when the non-user benefits analysis should be performed, and methods available to estimate these benefits. The key consideration in this chapter is the differences between user (Chapter 7) and non-user benefits.

Chapter 9 discusses the analysis of community benefits that may be included in economic impact analyses or benefit cost analyses. It provides an overview of community benefit types, what to consider when selecting a methodology, influence of other parts of the planning study on the community benefits estimation, when the community benefit analysis should be performed, and methods available to estimate these benefits.

Chapter 10 describes the introduction of wider economic benefits into the assessment of transportation projects or programs. It identifies the types of benefits that typically fall under the umbrella-term "wider economic benefits," provides an overview of each type of benefit, discusses what types of projects might have these benefits, describes connections to other parts of the planning study, and provides an overview of the methods available to estimate these benefits.

Chapter 11 focuses on identifying appropriate measures for the impacts that may be included in economic impact analyses. It addresses specific measures, what they mean, what data are needed to quantify these measures, and how the measures relate to other parts of the transportation planning process.

Chapter 12 focuses on identifying appropriate measures for the benefits that may be included in benefit cost analyses. It addresses specific measures, what they mean, what data are needed to quantify these measures, and how the measures relate to other parts of the transportation planning process.

Chapter 13 discusses the key considerations in selecting and managing an economic consultant and the economic analysis process. It is designed to assist transportation planners and professionals by highlighting the types of questions to ask during an economic analysis, ways to assess the reasonableness of economic analysis results, and how to identify common mistakes made during an economic analysis.

Chapter 14 offers suggestions on how to effectively communicate economic findings to non-technical audiences using general strategies and graphics.

Lastly, the four appendices include a List of Acronyms, Glossary of basic economic terms grouped by topic area, a Glossary of basic terms listed alphabetically, and References used in the development of the Guidebook.

1.3.2 Typographic Conventions Applied in the Guidebook

Several typographic conventions are applied in the Guidebook to help the reader more easily navigate the material and to find specific items of interest more quickly. The following conventions are used throughout the Guidebook:

- ***Bold, italicized text*** is used in chapter subheadings, as well as to highlight critical information about the economic analysis process or helpful tips for using the Guidebook.

- Text boxes contain real-life examples, summaries of major steps in the economic analysis process, as well as critical information about the economic analysis process. These boxes may be simple text boxes as shown here or colored boxes.

- Blue underlined text indicates hyperlinks to more detailed information about the term or terms in other sections of the Guidebook. When your mouse is placed over one of these terms, a text box with a brief definition of the term and a link to click on for a more detailed discussion are provided. ***To return quickly to the previous location (where hyperlink was clicked), press ALT-Left Arrow (ALT + ←).***

- References are indicated by bold, italic numbers in parentheses ***(1)***. Additionally, these references are hyperlinked to the appropriate reference in Appendix D of the Guidebook.

1.4 Chapter Conclusion

This chapter introduced the Guidebook's intention to support the ability of transportation planners and professionals to develop, implement, evaluate, and communicate an economic analysis of transportation investment at either a project level or program level. It is designed to assist planners and other transportation professionals in becoming informed managers and consumers of economic analyses, rather than provide detailed instructions on how to calculate economic impacts and benefits. A summary of each chapter and typographical conventions are provided to help the reader navigate the material efficiently.

CHAPTER 2 How Economics is Applied in Transportation Planning in General

Economics is about making choices—and making the right choices plays an important role in the transportation planning process. This chapter discusses how economics is applied in the entire continuum of transportation planning activities—from project development and selection to program development and policy support. It focuses on how the questions and choices to be made vary throughout these planning activities and how different agencies or participants apply economics as a decision support tool in the transportation planning process.

Chapter 2 Summary

Chapter 2 explains and illustrates the variety of ways that economics can be applied to support decision making throughout the transportation planning process.

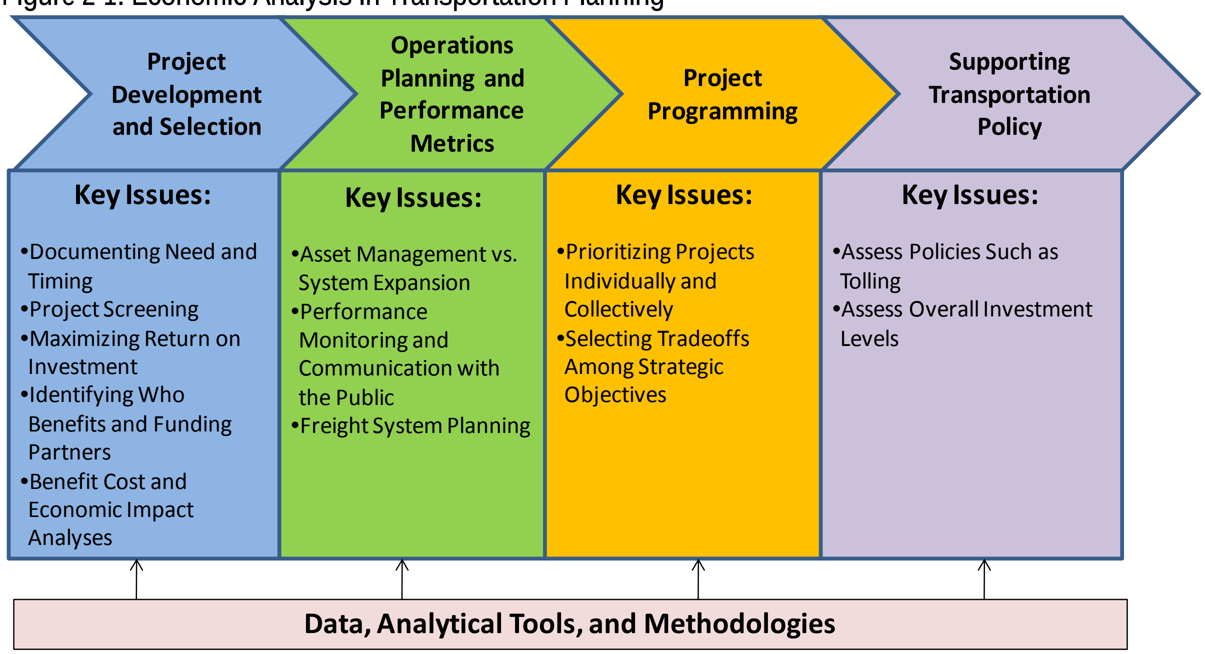
2.1 Role of Economic Analysis

Economic analysis can be applied to support decision making along the entire continuum of transportation planning activities—spanning the development of individual projects to the construction and justification of a full transportation program. Although economic *methodology* does not change with the transportation planning phase, the structure of the economic analysis does vary. The structure varies due to differences in:

- Types of questions asked at various stages in the planning process
- Audience needs for information
- Amount and detail of information available to construct the analysis.

Figure 2-1 summarizes the different uses of economic analyses in the transportation planning process as well as the key issues addressed in each phase.

Figure 2-1: Economic Analysis in Transportation Planning



Source: AECOM

At a ***project level***, economic analysis informs the project assessment by screening alternatives to identify which offers the most cost effective solution to a transportation problem. In the design and engineering phase, it offers feedback on a design's return on investment, inclusive of its life cycle cost, and helps to assess the risks associated with project delivery. Identifying beneficiaries can inform how to pay for the investments.

At a ***program level***, economic analysis can be applied to performance data, informing the development of program budgets and areas of program emphasis to meet strategic goals. It highlights the tradeoffs when allocating departmental budget resources among programs (e.g. asset management vs. congestion relief vs. safety).

From a ***policy perspective***, economic analysis can be applied to estimate overall investment levels needed to meet identified needs and to justify and calibrate revenue increases. By helping planners to quantify and value the economic benefits and costs of transportation policies, programs, and projects over a multi-year timeframe, economic analysis allows decision makers to devote resources to their best uses (in terms of maximizing benefits to the public and their customers) and to explain those tradeoffs and decisions to the general public. It supports the application of transportation planning as a decision support process.

2.2 Application of Economic Analysis

As Table 2-1 illustrates, there is considerable diversity in how economics is applied by transportation planning agencies. Very few agencies use economics in all the ways illustrated in the table. Because of federal requirements, most agencies will be familiar with assessing a project's net economic impacts. However, many do not consider the full range of costs and benefits when conducting their analyses because this may involve newer economic considerations (and therefore not as well defined) and/or are too involved in relation to the project or program size. The use of economics in performance monitoring, asset management, and assessment of economic development potential are less prevalent in use, although these are gaining acceptance within the transportation planning community.

Table 2-1 provides examples of how different transportation agencies apply economics in their planning activities. The variety of uses reflects the diversity of roles, the emphasis that these roles receive within individual agencies, the scale of projects undertaken by the agency, and the resources available to the agency.

Table 2-1: Illustrative Examples of the Use of Economic Analysis

Transportation Agency Task	Illustrative Economic Application
Planning a New Infrastructure Project or Developing a New Program	Determining appropriate project alignment and/or alternative selection
Developing a Plan to pay for a Project or Program	Identifying who benefits from the project and assessing the financial sustainability of funding sources, such as sales and fuel taxes
Managing the Transportation System	Using cost analysis to determine whether to invest in maintenance or a new asset
Evaluating Alternative Operating Policies	Assessing the return on investment from congestion relief and Intelligent Transportation Systems (ITS) policies
Evaluating the Regulations that Govern the System's Use	Determining economic costs associated with truck restrictions
Sharing Information	Documenting how investment decisions were made and tradeoffs assessed
Working with Economic Development Partners	Projecting the development impacts associated with a candidate transportation investment

2.3 Chapter Conclusion

This chapter discussed how economic analysis can be applied to support decision making along the entire continuum of transportation planning activities—spanning the development of individual projects to the construction and justification of a full transportation program.

- *Project level*: Economic analyses helps screen alternatives to identify the level of cost-effectiveness and return on investment and to asses risks associated with project delivery.
- *Program level*: Economic analysis helps analyze performance data and tradeoffs when allocating departmental resources among programs.
- *Policy perspective*: Economic analysis helps identify overall investment levels needed to meet transportation needs and allows decision makers to devote resources to their best uses (in terms of maximizing benefits to the public and their customers.)

Although economic *methodology* does not change with the transportation planning phase, the structure of the economic analysis does vary. The structure varies due to differences in:

- Types of questions asked at various stages in the planning process
- Audience needs for information
- Amount and detail of information available to construct the analysis.

CHAPTER 3 Applications of Economics in the Transportation Planning Process

The goal of an economic study (regardless of the type of study or planning stage) is to identify the tradeoffs associated with the construction and implementation of the candidate transportation project or program in comparison to doing nothing—or the "No Build" alternative. These tradeoffs provide decision makers with the information necessary to determine whether to invest in a particular project, a more beneficial alternative project, or a program. While this basic question is the same for all investments, how these tradeoffs are measured and evaluated may differ depending on the type of project(s), the stage in the planning process, or the condition of the rest of the transportation network.

Chapter 3 Summary

Chapter 3 discusses how economic analysis supports specific phases in the transportation planning process, including:

- Long-range planning
- Project and program investments
- Studies of specific aspects of the project or program.

This chapter examines how economics is involved in the various transportation planning stages for both project and programming investments, as well as long-range planning. It provides an introduction to the transportation planning process and emphasizes the importance of incorporating goals, data, and stakeholder participation in the economic considerations of the planning process.

3.1 Transportation Planning Stages

The transportation planning process is a decision support process that identifies the types of benefits or consequences (not always positive) that transportation investments create for their communities. It is a cooperative process that requires the participation of many parties with unique viewpoints, including public users, business organizations, community groups, environmental agencies, freight users, transportation providers, and state and regional planning organizations. As a result, the entire transportation planning process, from developing long-range plans to implementing projects, involves numerous steps that can require the coordination and inclusion of the following key input areas: (*1*)

- *Data*: Identifying current and future population, employment, and travel characteristics and choices
- *Safety*: Identifying the incidence of accidents, including fatality, injury, and property damage only accidents
- *Non-discrimination*: Working to ensure that transportation services do not impose disproportionate adverse impacts to minority and low-income populations and ensuring that everyone has the opportunity to participate in the transportation planning process
- *Environmental issues*: Ensuring that the transportation strategies and investments consider land use management, natural resources, environmental protection, conservation, and historic preservation
- *Air quality*: Identifying impacts on the emission of pollutants, particularly for regions with nonattainment or maintenance air quality areas
- *Economic development*: Determining how transportation strategies could impact future economic development, whether the transportation system can support any additional growth spurred by the new development, and how transportation funding can support economic growth while balancing other transportation priorities
- *Fiscal constraint*: Analyzing project costs and revenues to make sure that future revenue is sufficient to fund the projects included in a long-range plan or near-term transportation improvement program. This

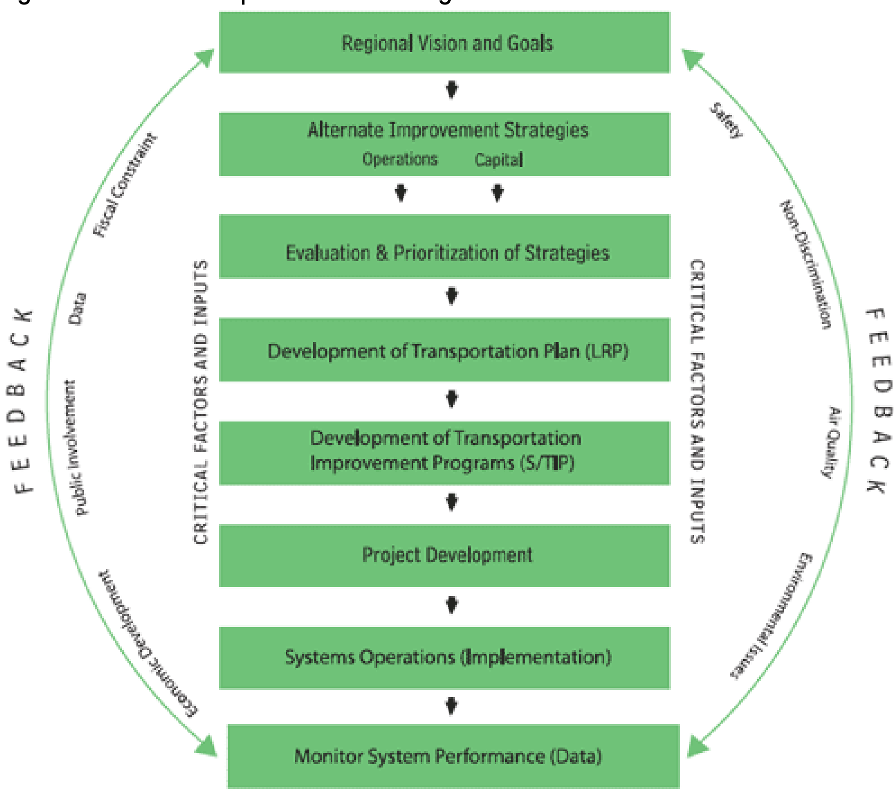
includes developing reasonable forecasts of future project costs (including capital, operations, and maintenance costs) and future federal, state, and local revenues available for the plan or program

- *Public involvement*: Ensuring that everyone with a stake in transportation decisions has a means to voice concerns or issues with conditions, polices, plans, strategies, and projects in their community that are addressed during the transportation planning process.

Economic analyses can support all of these elements and are a key aspect of the following: data collection and describing the Purpose and Need for the project or program; monetizing the value of safety, environmental, air quality and economic development impacts; describing environmental justice issues and relative access to job opportunities and affordable housing; and describing the outlook for the tax revenues that may underpin the funding plan for a project or program. Articulating the economic impacts associated with a candidate investment is a core part of communicating with the public about the merits and costs of the project or program.

Figure 3-1 summarizes the key stages and inputs of the transportation planning process in the US. (2)

Figure 3-1: The Transportation Planning Process



Source: Replicated from Transportation Planning Capacity Building Program, FHWA/FTA, *The Transportation Process: Key Issues*, September 2007.

Broadly, this process moves transportation planning through the establishment of a vision and goals and developing a long-range plan and near-term program of investments to implementing individual projects through construction and operation. Economic considerations primarily are involved in the evaluation of Long Range Transportation Plans (LRTPs), Transportation Improvement Programs (TIPs), and individual project development, which are described in the sections below.

3.1.1 Long Range Transportation Plans

Before an individual project or program of projects can be studied in an area, the region must establish its vision and goals for the transportation system. This vision is articulated in the LRTP, which is designed to help the region achieve these goals. Long Range Transportation Plans typically have at least a 20-year time horizon, sometimes longer, and articulate the community's long-term vision by building upon future projections of population, economic development, and transportation needs. These plans also may include a short-term element, in which specific transportation improvements are programmed for each of the coming years. This type of planning requires an assessment that allows a prioritization of projects for inclusion in the short-term and an analysis that permits the community to understand what a realization of the long-term plan means for their community. This long-term vision includes understanding how the benefits of one or more transportation investments at a particular location contribute to:

- Other investments that may be under consideration
- The identification of investments that may not be justified by current conditions, but may be justified by future conditions
- The region's or state's economy
- The benefits of the region's entire transportation system
- How these contributions change over time.

The economic component of LRTPs supports the visualization of what the plan implementation implies for the community. In other words, the focus often is more on economic performance (supporting planned or expected growth in population, employment, land use, and transportation use), rather than specific impacts (e.g. noise, air quality, labor productivity, construction jobs supported). As a result, the LRTP planning process advances through broad, more regionally-defined steps, including:

1) Defining a regional vision and goals
2) Developing alternate improvement strategies (capital, operating, and policy) to meet these goals
3) Evaluating and prioritizing these improvement strategies
4) Developing the LRTP.

In this process, the early decisions are about what the region wants the community to look like in 20 or 30 years and what type of transportation investments or other policy decisions will help it get there. While, later decisions are about identifying specific projects or project types and identifying those projects that are most important to the regional vision and goals. Economic considerations may be involved in the development of regional goals (particularly if economic development is a part of these goals) as well as the evaluation of potential improvement strategies for inclusion in the LRTP. The level of economic information—the need to understand the tradeoffs associated with the improvement strategies—similarly intensifies as the transportation planning process advances.

Using Economics in the Project Prioritization Process (3) (4)

The Board of the Hampton Roads Transportation Planning Organization (HRTPO) directed staff to develop a methodology to assist the Board in indentifying which projects should have the highest priority for regional investment. HRTPO staff and their consultant team developed a prioritization tool that ranks candidate regional transportation projects based *on Project Utility*, *Project Viability*, and *Economic Vitality*. The tool is used to assess candidate projects for inclusion in the region's LRTP and to prioritize them according to their score across the three components that reflect HRTPO's program priorities.

Project Utility considers the project's ability to solve an existing transportation issue, which could be correlated to congestion, safety, infrastructure condition, or ridership. ***Project Viability*** indicates the readiness of the project to be constructed based on available funding and completion of required documentation. ***Economic Vitality*** provides additional insight for a project's ability to support regional plans for future development and economic growth of the region. Projects are grouped by mode for the scoring process, divided as follows: Highway, Bridge/Tunnel, Bicycle and Pedestrian, Systems Management/Transportation Demand Management/Operational Improvements, Transit, and Intermodal improvements. Project Utility and Project Viability apply to all modes. Economic Vitality applies to Highway, Bridge/Tunnel, Transit, and Intermodal projects.

The developers of HRTPO's project prioritization tool define a candidate project's economic vitality as its ability to impact regional economic growth through increased capacity and/or increased opportunity. In particular, the economic vitality assessments gauge how improvements in the region's transportation network reduce constraints on commerce and industry, improve productivity and labor market access, and expand opportunity for new business.

Economic Vitality Scoring Factors and Weights

Criteria	Points
Highways and Bridges & Tunnels	
Total Reduction in Travel Time	30
Labor Market Access	20
Addresses the Needs of Basic Sector Industries	30
Increased Opportunity	20
Total	100
Transit	
Labor Market Access	45
Addresses the Needs of Basic Sector Industries	20
Increased Opportunity	20
Economic Distress Factors	15
Total	100
Intermodal	
Total Reduction in Travel Time	20
Labor Market Access	20
Impact on Truck Movements	15
Improves Interaction between Modes of Travel	15
Increased Opportunity	30
Total	100

Source: HRTPO Project Prioritization, Presentation by Camelia Ravanbakht, PhD on July 21, 2010

For the 2034 LRTP update, which must be financially constrained, approximately 155 candidate projects totaling $30 billion were identified across the region. By contrast, only about $2 billion of traditional sources of revenues was available for transportation projects. The prioritization tool thus provides valuable information as planners work to communicate the relative merits of candidate projects to the public and as decision makers weigh the tradeoffs among candidates for inclusion in the LRTP.

3.1.2 Project and Programming Investments

Once the LRTP is in place, the region's planning process can begin to focus on the development and implementation of specific projects or programs. Project and programming analyses typically have a near-term time horizon that concentrates on implementing projects over several years. This type of planning requires an analysis that examines not only how these transportation investments help the region achieve the desired future economic performance established in the LRTP, but also establishes how the construction and operation of specific project(s) help resolve a transportation problem or issue—and as a result, generate economic impacts or benefits for the region. The traditional four-step planning process for projects and near-term programming advances from:

1) An identification of goals and needs
2) Documentation of the transportation deficiencies relative to the goals and needs
3) Analysis of economic and environmental impacts (direct and indirect) for the alternative approaches to addressing the deficiencies
4) Selection of a preferred alternative—which is usually a result of compromise among competing interests and may not yield the first-best outcome uniformly across all evaluation criteria.

Broadly, these steps define the problem and gradually advance the level of understanding and detail concerning the project or program being evaluated. The level of decision associated with these steps advances similarly from addressing:

1) Is this project/program feasible?
2) Is this project/program the best project?
3) Is this project/program worth pursuing further?
4) What is the best configuration of the project/program?
5) Should the community invest resources in this project/program?

As projects develop, these steps often become intertwined in the National Environmental Policy Act of 1969 (NEPA) process. For transportation investments wishing to receive federal funding, permits, or require federal approval, the NEPA process is designed to ensure that a project's engineering and transportation needs appropriately consider and balance the potential social, economic, and environmental impacts associated with the project's implementation. Since transportation projects vary in size and complexity, the NEPA documentation requirements also depend upon the degree of potential impact. One or more of the following documents will need to be prepared in order for a project to receive federal funds: (*5*)

- *Notice of Intent (NOI)*: Prepared for projects that will require an Environmental Impact Statement (EIS).
- *Categorical Exclusion (CE)*: Prepared for projects that do not have a significant impact on the human and natural environment; and therefore, do not require an Environmental Assessment (EA) or an EIS.
- *Environmental Assessment (EA)*: Prepared for projects that are unsure whether there will be a significant impact on the human and natural environment. If the EA determines there will be a significant impact, an EIS must be prepared. If the EA determines that there will be no significant impact, a formal decision is issued called a *Finding of No Significant Impact (FONSI)*.
- *Environmental Impact Statement (EIS)*: Prepared for projects that will have a significant impact on the human or natural environment. A Draft and Final EIS are prepared, which provide a full description of the proposed projects, existing conditions, analysis of the impacts (both beneficial and adverse) of all reasonable alternatives, any mitigation efforts needed, and public involvement in the evaluation process. The *Record of Decision (ROD)* documents the final decision of the EIS, including how the decision was made and any measures required to mitigate the project impacts on the human and natural environment.

More today than in previous decades, the NEPA documentation is becoming a key tool in deciding whether the project in question is worth the "costs"—either in terms of money or impacts to the environment. Some projects now are stopped at the NEPA phase due to the forecasted cost (in millions and billions) and the inability of the agency to pay for them or have a plan to pay for them.

Whether through NEPA or other project or programming activities, early decisions are about whether it makes sense to continue down this path—while later decisions are about the expenditure of millions or billions of dollars. As with the LRTP, the level of economic information—the need to understand the tradeoffs associated with the project or program—similarly intensifies as the transportation planning process advances (including any NEPA requirements).

3.2 Linkages to Other Plans or Programs

Beyond those studies that are required by federal law, agencies may undertake a variety of other studies that utilize economics. Examples include: Corridor Management Plans and Corridor Studies, Border Crossing Studies, Freight Plans, and studies that arise because of special legislative or political interest or even through special operational funding.

- *Asset management plans* and *performance monitoring* are examples where economics supports a program rather than a specific project. For example, a state DOT's asset management program might use economic analysis applications in different types of asset decision making, such as the decision to invest in new projects, analysis to minimize asset life cycle costs through activities to evaluate or preserve existing assets, and the evaluation of new technologies. Some asset programs use benefit cost analysis (BCA) as a means to prioritize competing investments.

  Washington State's (WSDOT's) *The Gray Notebook*, a quarterly report summarizing a set of standard metrics, links performance measures to strategic goals, as shown below in Figure 3-2. The performance metrics are designed to track progress in meeting six Legislative policy goals (Safety, Preservation, Mobility, Environment, Economic Vitality, and Stewardship)—and WSDOT's own strategic goals. In this instance, the economic analysis is a sustained effort over time that does not support project selection, but rather monitors performance in meeting a legislative policy goal for the department.

Figure 3-2: Snapshot of WSDOT's The Gray Notebook Performance Dashboard

Performance Dashboard

✓ Goal has been met. ↑ Performance is trending in a favorable direction. ↔ Trend is holding. ↓ Performance is trending in a unfavorable direction.

Policy goal/Performance measure	Previous reporting period	Current reporting period	Goal	Goal met	Progress	Comments
Safety						
Rate of **traffic fatalities** per 100 million vehicle miles traveled (VMT) statewide (annual measure, calendar years: 2008 & 2009)	0.94	0.87	1.00	✓	↑	The rate of highway fatalities continues to decline (a lower rate is better)
Rate of **strains and sprains / hearing-loss injuries** per 100 WSDOT workers[1, 7] (calendar quarterly measure: Q4 2010 & Q1 2011)	2.5/ 0.5	3.4/ 0.5	2.4/ 0.4	–	↓	Both strains/sprains and hearing loss were well over their goals for the quarter and for the year
Preservation						
Percentage of state **highway pavements** in fair or better condition (annual measure, calendar years: 2008 & 2009)	94.7%	93.0%	90.0%	✓	↔	Recovery Act-funded projects helped with backlog, but does not address all long-term needs
Percentage of **state bridges** in fair or better condition (annual measure, fiscal years: 2009 & 2010)	97.0%	98.0%	97.0%	✓	↑	Recovery Act funds contributed to increase in Good/Fair rating
Mobility (Congestion Relief)						
Highways: annual weekday **hours of delay** statewide at **maximum throughput speeds**[2] (annual measure: calendar years 2007 & 2009)	32 million	25 million	N/A	N/A	↑	Reduction of 21% driven by both reduced demand due to the economy and increased capacity
Highways: Average clearance times for **major (90+ minute) incidents** on 9 key western Washington corridors[7] (calendar quarterly measure: Q4 2010 & Q1 2011)	168 minutes	159 minutes	155 minutes	–	↑	Two extraordinary (6+ hour) incidents and seasonal weather affected the program's average clearance time this quarter
Ferries: Percentage of trips departing on time[3, 7] (quarterly, year to year: FY10 Q3, FY11 Q3)	91.5%	95%	90%	✓	↑	Performance is lower than one year ago, higher than previous quarter
Rail: Percentage of Amtrak Cascades trips arriving on time[4, 7] (quarterly, year to year: FY10 Q3, FY11 Q3)	59.1%	53.7%	80%	–	↓	WSDOT and Amtrak continue to evaluate projects and other means to improve on-time performance
Environment						
Cumulative number of WSDOT **stormwater treatment facilities** constructed or retrofitted[5] (annual measure: calendar years 2008 & 2009)	Over 800	Over 1,037	N/A	N/A	↑	Stormwater facilities will now be constructed under a new permit, with new requirements
Cumulative number of WSDOT **fish passage barrier improvements** constructed since 1990 (annual measure: calendar years 2008 & 2009)	226	236	N/A	N/A	↑	Ten additional retrofits were completed in 2009
Stewardship						
Cumulative number of Nickel and TPA **projects completed**, and **percentage on time**[7] (quarterly: FY11 Q2, FY11 Q3)	295/ 90%	300/ 89%	90% on time		↓	Performance decreased slightly from previous quarter, did not meet goal[8]
Cumulative number of Nickel and TPA **projects completed** and **percentage on budget**[7] (quarterly: FY11 Q2, FY11 Q3)	295/ 94%	300/ 94%	90% on budget	✓	↔	Competitive bidding and construction environment contribute to controlling costs[8]
Variance of total project costs compared to **budget expectations**[6, 7] (quarterly: FY11 Q2, FY11 Q3)	under-budget by 1.0%	under budget by 1.0%	on budget	✓	↔	Total Nickel and TPA construction program costs are within 1% of budget[8]

Data notes: N/A means not available: new reporting cycle data not available or goal has not been set. Dash (–) means goal was not met in the reporting period.
1 Sprains/strains and hearing loss are current high priority focus areas for WSDOT. Hearing loss rate based on preliminary data.
2 Compares actual travel time to travel time associated with "maximum throughput" speeds, where the greatest number of vehicles occupy the highway system at the same time (defined as 70%-85% of the posted speeds).
3 'On-time' departures for Washington State Ferries includes any trip recorded by the automated tracking system as leaving the terminal within 10 minutes or less of the scheduled time.
4 'On-time' arrivals for Amtrak Cascades are any trips that arrive at their destination within 10 minutes or less of the scheduled time.
5 Number of estimated facilities in permitted counties: Clark, King, Pierce, and Snohomish.
6 Budget expectations are defined in the last approved State Transportation Budget.
7 Washington's fiscal year (FY) begins on July 1 and ends on June 30. FY11 Q3 refers to the quarter ending March 31, 2011.
8 See page 58 for more information on the expanded view of capital projects in the current 2010 Legislative Transportation Budget for highway construction.

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Source: WSDOT, *The Gray Notebook*, March 31, 2011, p.vii.

- ***Freight and border studies***, in particular, have a large economic component. Most border studies are conducted to explore transportation and related economic issues that may arise between US states and other adjacent jurisdictions in Mexico and Canada due to NAFTA agreements. Freight studies have large economic components to them because freight transport is in itself a prerequisite for other types of economic activity, whether the activity involves supply, production, distribution, or consumption.
- The ***spot or location studies*** that arise due to a special interest may vary. Results range from recommending a course of action, proposing a future solution coupled with immediate short-term delivery fixes, conducting tourism and recreational travel studies, to identifying an appropriate alternative solution.

3.3 Chapter Conclusion

This chapter examined how economics is involved in the various planning stages for both project and programming transportation investments, including long-range planning. The transportation planning process is a decision support process that identifies the types of benefits or consequences (not always positive) that transportation investments create for their communities. It is a cooperative process that requires the participation of many parties with unique viewpoints, including public users, business organizations, community groups, environmental agencies, freight users, transportation providers, and state and regional planning organizations. As a result, the entire transportation planning process—from developing long-range plans to implementing projects—involves numerous steps that can require the coordination and inclusion of the following key input areas: data, safety, non-discrimination, environmental issues, air quality, economic development, fiscal constraint, and public involvement.

Broadly, this process moves transportation planning through the establishment of a vision and goals and developing a long-range plan and near-term program of investments to implementing individual projects through construction and operation. Economic considerations primarily are involved in the evaluation of:

- *LRTPs*: Economic considerations may be involved in the development of regional goals (particularly if economic development is a part of these goals), as well as the evaluation of potential improvement strategies for inclusion in the LRTP.
- *Project and programming investments*: This type of planning requires an analysis that examines not only how these transportation investments help the region achieve the desired future economic performance established in the LRTP, but also establishes how the construction and operation of specific project(s) help resolve a transportation problem or issue—and as a result, generate economic impacts or benefits for the region.
- *Asset management plans*: Asset management programs might use economic analysis applications in different types of asset decision making, such as the decision to invest in new projects, analysis to minimize asset life cycle costs through activities to evaluate or preserve existing assets, and the evaluation of new technologies.
- *Freight and border studies*: Most border studies are conducted to explore transportation and related economic issues that may arise between US states and other adjacent jurisdictions in Mexico and Canada due to NAFTA agreements. Freight studies have large economic components to them because freight transport is in itself a prerequisite for other types of economic activity, whether the activity involves supply, production, distribution, or consumption.
- *Spot or location studies*: Results range from recommending a course of action, proposing a future solution coupled with immediate short-term delivery fixes, to identifying an appropriate alternative solution.

CHAPTER 4 Types of Economic Analyses

The goal of an economic analysis (regardless of the type of study or planning stage) is to identify the tradeoffs (also called benefits or impacts) associated with the construction and implementation of the candidate transportation project or program. These impacts provide decision makers with the information necessary to determine whether to continue to study project or program alternatives further, invest in the project, or implement the program.

While this basic question of identifying the benefits or impacts is the same for all projects or programs, how these benefits or impacts are measured and evaluated may differ depending on the type of project(s) or the stage in the planning process. This chapter provides a summary of the various types of economic analyses that measure and evaluate these tradeoffs as well as a discussion on the appropriateness of each for program level and project level planning.

Chapter 4 Summary

Chapter 4 introduces four primary categories of benefits or impacts measured, including user, non-user, community, and wider economic benefits.

For the three major types of analysis used in transportation planning—benefit cost analysis, economic impact analysis, and return on investment—the chapter explains:

- Benefits or impacts each analysis measures
- How the analysis measures and evaluates these benefits or impacts.

4.1 Types of Benefits or Impacts Measured

Long-term (recurring) benefits or impacts generally are associated with the operation of the transportation project or program. In other words, they are experienced as long as the project(s) are in operation. The types of long-term benefits (or disbenefits as outcomes do not always have to be positive) that result from the construction and operation of a project or program generally can be classified into four primary categories: user, non-user, community, and wider economic benefits. These are summarized below. However, full chapters are dedicated to each in the Guidebook (see Chapters 7 through 10).

- *User benefits*: User benefits are those transportation benefits that are experienced directly by the users of the proposed transportation investment. These benefits include travel time, travel cost, as well as accidents avoided savings that result from using the new transportation investment.
- *Non-user benefits*: Non-user benefits are those transportation benefits experienced by people who are not directly using the new transportation investment. For example, if the proposed investment improves or adds additional transit service to the region, people who continue to use autos would experience travel time, travel cost, and accidents avoided benefits, because the vehicle miles traveled (VMT) on the parallel facilities would decline as more people divert to the new or improved transit service.
- *Community benefits*: These benefits are experienced by the entire community within the project area—both users and non-users. These benefits may include reduced emissions or other environmental benefits, noise reductions, greater walkability, greater access for transit-dependent populations, greater access to jobs from existing housing locations, and recreational benefits. Many of these benefits are not quantifiable and must be discussed qualitatively, stating what the benefits are and who the beneficiary groups are.
- *Wider economic benefits*: Recognizing the value of a complete—and to the degree possible—uniformly quantifiable assessment, transportation economists have begun to expand the range of benefits estimated in their analyses. Reflecting the expansion of economic outcomes considered and the scope of project evaluation, these benefit types fall under the umbrella-term “wider economic benefits.”

In addition to these long-term benefits, transportation programs and projects also generate short-term impacts. Short-term impacts generally are associated with construction activities and have been the focus of many economic recovery discretionary grant programs. These impacts include jobs and earnings associated with construction and tax base impacts that result from the acquisition of private land for construction. These impacts generally only occur for a limited period of time (e.g. the construction period). Once the time period ends, these impacts are no longer generated.

Short- and long-term benefits or impacts can be further differentiated into direct, indirect, and induced impacts, which reflect the level or depth of the impacts on the economy. These impacts may be positive or negative.

- *Direct*: The first-level impacts occur as a result of the project (e.g. construction purchases, construction hiring, operating purchases, operating hiring, safety, emissions, noise, and/or property tax revenues). Direct impacts or benefits generated by transportation investment are measured for both the short-term and the long-term.
- *Indirect*: The second-level impacts occur as the increase in construction or operations requires purchases from supporting industries, such as higher steel production, which in turn requires more chemicals, iron, ore, and limestone. Input-output tables trace these input chains back through the economy to arrive at the total requirements needed from all industries to support a given increase in the final demand for construction or operating and maintenance purchases. Indirect impacts generally are accounted for only in economic impact analyses that consider jobs, earnings, and other final demand or output measures.
- *Induced*: The third-level impacts occur as workers, hired as a result of the direct and indirect impacts of the project, spend a portion of their increased earnings on additional goods and services. These consumer demands generate further multiplier effects on supporting industries in the same way that the increase in construction or operating and maintenance expenditures do. Similar to indirect impacts, induced impacts generally are accounted for only in economic impact analyses that consider jobs, earnings, and other final demand or output measures.

In this Guidebook, the terms benefits, impacts, and disbenefits are used deliberately to distinguish between those outcomes that are associated with benefit cost analysis and economic impact analysis as described in the following sections.

- *Impacts*: Impacts are positive and/or negative outcomes experienced as a result of the program or project. Generally, impacts are *NOT* included in benefit cost analysis. These include construction jobs, earnings, and tax revenues.
- *Benefits*: Benefits are positive outcomes that are included in benefit cost analysis. These include user, non-user, community, and wider economic gains experienced as a result of the program or project.
- *Disbenefits*: Disbenefits are negative outcomes that are included in benefit cost analysis. These include user, non-user, community, and wider economic losses that are experienced as a result of the program or project.

4.2 Benefit Cost Analysis

Benefit Cost Analysis (BCA) is used to determine whether a project or program yields a positive return on investment by comparing the quantifiable direct benefits to the direct costs for a defined period of time (often the useful life of the project or program). As a result, it focuses on the net changes attributable to the project or program, i.e. those differences between an Improvement Case (with project or program) and Base Case (no build, or without project or program). In addition, the BCA only considers direct impacts; it should not include any multiplier effects (i.e. indirect and induced impacts). The BCA does not include multiplier effects because the multipliers describe the aggregate outcome of a series of transactions across the economy. Because each transaction—a purchase of construction workers' services for example—is a cost to the employer but a benefit to the wage earner. The two sides of the transaction offset one another in the BCA.

While every project has its own unique characteristics, the outcomes typically included in a BCA can be broadly classified as follows:

- *Direct transportation benefits that result from project operation*: As travelers divert to the new/improved transportation investment, travel time, travel cost, and accidents avoided savings are likely to accrue to users and non-users, due to increased mobility, reduced congestion, and reduced VMT in the region.
- *Economic benefits that occur in urban areas as the market responds to the improved level of service and accessibility*: As the transportation investment improves mobility and access to larger Metropolitan Statistical Areas (MSAs) or megaregions (regions made up of more than one MSA, including the non-MSA counties that lie between the MSAs), there is an opportunity to improve the productivity of both labor and land in the project area. The labor productivity gains (often referred to as agglomeration benefits) reflect the access to large pools of labor, frequent and relatively inexpensive transport, specialized technical and professional services, and a large client base that urban areas provide. With the transportation investment improving the mobility of the region, businesses and employees now have access to larger pools of labor and/or jobs, making it easier for businesses to hire more productive, skilled workers and for skilled workers to find better, higher-wage jobs. Similarly, the potential for land productivity gains reflects the willingness of residents and business enterprises to pay a premium for locations where access is improved relative to other locations without good transportation access. The estimation of these wider economic benefits is an evolving area within transportation economics and generally represents a higher-level effort of BCA analysis.
- *Environmental and community benefits*: Transportation investments improve mobility and potentially reduce VMT for autos and trucks as more people shift to non-auto modes or more efficient auto routes. As VMT are reduced, the study area has the potential to benefit from reduced emissions, reduced environmental or noise impacts, greater walkability, greater access for transit-dependent populations, improved recreational benefits,and the option of having an alternative/improved means to travel.
- *Residual value of the project assets*: Many transportation project assets will have a useful life that extends beyond the BCA period specified by the federal and state grant programs US DOT guidance indicates that this residual project value (beyond the analysis period) is a benefit and should be included in a BCA, as long as the expectation is the asset will be in service for its full useful life. (*6*) Residual value also may be referred to as salvage value, as it can actually be the salvage cost if demolition would be required. Salvage values generally are positive—however, they may be negative if the cost of demolition exceeds the value of the materials and equipment being salvaged.
- *Investments avoided*: As travelers divert to the new/improved transportation investment, VMT are likely to be reduced on parallel facilities, resulting in a decline in the wear and tear on other parallel assets. As a result of this reduced wear and tear, transportation investments required to maintain a state of good repair or improve these parallel assets may be avoided or deferred.

Since BCA is used to determine whether a project or program yields a positive return on investment, and thus focuses on the net changes attributable to the project or program, the elements that typically are included in an environmental document—such as construction jobs created and sustained, operations and maintenance jobs created and sustained, and the value of right-of-way (ROW) takings or purchases and associated tax revenues—are not included in benefit cost analyses. Jobs represent both a cost to the employer (paying a wage) and a benefit to the employee (receiving a wage). Similarly, any property tax revenues generated by the project are a benefit to the taxing authority while they are a cost to the taxpayer. Consequently, these impacts represent transfer payments, rather than net benefits.

It is also important to note that the costs included in the BCA go beyond the initial capital cost investment for the project or program. These costs should reflect life cycle costs, including capital costs (design/engineering, land, vehicles, construction, contingencies, and mitigation expenses), ongoing operations and maintenance costs, minor rehabilitation costs, and any major rehabilitation/replacement costs if the analysis period extends beyond the useful life of the assets. However, financing and debt service payments generally are not included in the final cost, as these costs are accounted for in the discounting process.

As part of a BCA, benefits and costs (both capital and operating) are monetized (or estimated as a dollar amount), discounted, and then compared to each other to develop a benefit cost ratio. The benefits are monetized so that they can be compared appropriately to the project costs. Additionally, the monetized benefits and costs are discounted to a present value (PV) in a BCA. Discounting accounts for the fact that a dollar today usually is greater than a dollar expected 10 years from now—because the dollar today could be invested and return more than a dollar in benefits 10 years from now (excluding inflationary impacts). As a result, benefits that are experienced today are more valuable than the benefits expected in future years.

Given the reliance on net changes attributable to the project or program, the BCA typically is performed near the end of each planning process phase because the estimation of benefits and costs relies largely on data from other parts of the planning process. This data must be finalized so that the BCA accurately reflects the investment's economic outcomes. Without complete and accurate data, the economic results will not evaluate the true benefits and costs associated with the project or program. This could lead to stakeholders and decision makers making ill-informed decisions or recommendations. Even small changes in one input can result in a change in the BCA results. So it is best to have complete data before performing a benefit cost analysis and communicating the results. That being said, if preliminary costs and data are available, it could be a good idea to pull together a preliminary benefit cost ratio to see what scale of benefits would be required for a competitive benefit cost ratio and if this level of benefit is possible.

Non-monetizable benefits cannot be included in the benefit cost ratio; therefore every attempt should be made to monetize project or program benefits in order to produce a benefit cost ratio that best reflects the investment. However, if some benefits cannot be quantified or monetized, they can be described qualitatively to provide additional support to the benefit cost ratio. When describing benefits qualitatively, it is important to clearly articulate what the benefits are, who receives them, how long they will be experienced, and the relative importance or magnitude of the benefits (including potentially using a descriptive scale, e.g. high, medium, low).

Addressing Non-monetized Benefits in BCA (7)

In Ann Arbor, MI two critical bridges along East Stadium Boulevard—a major east-west arterial roadway near the University of Michigan (UM), major public facilities, and in-town business centers—are in need of replacement. One bridge (over South State Street) has deteriorated to the point where city engineers had to remove several beams and reduce the weight limits on the bridge. It is expected that the bridge with reduced weight limits will provide about five years of save travel. The neighboring bridge (only 350 feet away and located over the Ann Arbor Railroad tracks) is also functionally obsolete and structurally deficient, with abutments that are too close to the railroad tracks and do not meet current American Association of Railroad Engineers Association standards.

The bridges represent critical access points for the City of Ann Arbor and the University of Michigan. They are adjacent to the UM Facilities Operation Center and less than a ¼-mile from the UM's 109,901-seat football stadium and 15,000-seat Chrysler Arena. In addition, several local schools are located on or near East Stadium Boulevard. Recognizing that letting the bridges deteriorate would create a huge traffic burden on the region and result in significant congestion, safety, and delay costs, the city developed a BCA to justify the investment and attract federal TIGER II funds. The BCA demonstrated that the reconstruction of the bridges in 2011 (at a cost of approximately $23 million in 2010 dollars) would generate about $253 million in monetized benefits (net present value, 2010 dollars) over the 15 year analysis period for the surrounding region—resulting in a benefit cost ratio of just over 11. In addition to the benefit cost ratio summary table, the BCA conclusion highlighted the importance of the non-monetized savings and benefits that were discussed in more detail in the application. The summary of the non-monetized savings and benefits included the following:

- *Savings from building the bridges*: Reduction in fuel consumption, vehicle emissions, and maintenance costs for surrounding roadways
- *Costs of not rebuilding the bridges*: Increased congestion and a disconnected road network that will lead to loss of business in the developed, urbanized area of the county, decreased property values of homes and businesses, increased maintenance costs on detour and/or cut-through streets, and additional emissions from congestion and longer detour routes
- *Benefits of building the bridges*: Safety improvements from widened facilities, marked bike lanes, and wider sidewalks, increased access including ADA-accessible and stair facilities allowing user to access sidewalks more easily, improved public park areas, increased bicycle and pedestrian mobility, higher visibility and foot traffic for nearby businesses, improved operations for privately-held, short-line, freight rail; and aesthetic improvements that create a more attractive business environment
- *Benefits of not rebuilding the bridges*: Less traffic and noise in the neighborhoods due to the loss of the bridges, which could be viewed positively by local residents and negatively by local businesses.

4.2.1 Appropriate Use for Program Level Planning

For programming exercises that require the prioritization of projects or project segments, a BCA is often useful to determine which projects or segments have the highest rate of return or net present value. Unlike, an economic impact analysis, BCA provides the required details for prioritizing because it considers the present value of the benefits (and their timing) in relationship to the project costs (both capital and ongoing operations and maintenance costs). The BCA will allow decision makers to determine which projects or segments provide the greatest return per dollar spent so that they can be prioritized appropriately with other planning considerations.

4.2.2 Appropriate Use for Project Level Planning

For project evaluations that require selecting the appropriate project alternatives for further study or for funding and construction, a BCA is often useful to determine which alternative has the highest rate of return or net present value. In this situation, the project benefits must be compared to the costs—in order to make sure that the rate of return is sufficiently positive to overcome any identified risk in the analysis. As a result, BCA is an appropriate tool for evaluating different project alternatives during earlier planning stages, as well as in later stages—when it is time for decision makers to make the final ruling on whether or not to fund the project or on the appropriate time to implement the project.

4.3 Economic Impact Analysis

Economic Impact Analysis (EIA) examines what changes occur because of the construction and implementation of a project or program and who would be affected by each change. It is used to estimate the impacts that result from construction and implementation, regardless of whether these impacts are a transfer. It is not limited to direct impacts, and frequently includes multiplier effects that quantify the indirect and induced impacts resulting from the direct spending associated with construction and operation of the program or project.

The impacts considered in an EIA may contain both quantifiable and non-quantifiable impacts, including those traditionally incorporated in a benefit cost analysis (as described in the previous section) as well as additional impacts summarized as follows:

- *Construction impacts*: The jobs and earnings created and sustained as a result of the capital costs associated with the transportation investment(s). These short-term construction impacts can include the direct, as well as the indirect and induced, impacts that last as long as the capital costs are expended.
- *Operations and maintenance impacts*: The jobs and earnings created and sustained as a result of the operations and maintenance expenditures (including labor) associated with the transportation investment(s). These long-term operations and maintenance impacts can include the direct, indirect, and induced impacts that occur as long as the project is in operation.
- *New project area development*: The new development (that comes from outside the defined region) is attracted to a study area due to the operation of the transportation investment. However, development that comes to a study area from other locations within the same community, or future development that would occur even without the project or program, would not be considered a direct impact of the transportation investment. This shifted development—and development that is already planned in the study area without the transportation investment—would occur even without the project or program. Therefore, it would not impact the location selections of these developers directly. These development impacts may include the short-term jobs and earnings created as a result of the construction of this new development as well as the long-term jobs and earnings associated with the occupation or use of the new development.
- *Value of any right of way (ROW) takings or purchases and associated tax revenue impacts*: The ROW takings or purchases necessary to construct and operate the transportation investment often involve the conversion of private property to non-taxed public use. As a result, this property value and the associated property tax revenues must be removed from the local property tax base and revenue projections. However, property taxes on new development are likely to offset the removal of these takings from the property tax rolls (at least partially).
- *Tax revenue impacts*: The jobs and earnings associated with the construction and operation of the transportation investment and any new development attracted to the region generate additional income and sales tax revenues for the defined region. Additionally, any new development attracted to the study area or increases in property values for existing properties translate into additional property tax and sales tax revenues for the region.

Unlike a BCA, an EIA is not concerned with the net changes associated with the construction and operation of the transportation investment(s). As a result, impacts viewed as economic transfers in a BCA (jobs, earnings, and property tax revenues) are estimated and included in the total impacts of an EIA.

As part of an EIA, impacts are monetized (or estimated as a dollar amount) when possible or described qualitatively, if they cannot be quantified or monetized. The impacts are monetized so that they can be appropriately compared to other project impacts. However, the monetized impacts are not necessarily discounted as in a BCA, because the impact stream is not compared directly to project costs. When benefits are described qualitatively, it is important to clearly articulate what the impacts are, who receives them, how long they will be experienced, and the relative importance or magnitude of the impacts—including potentially using a descriptive scale (e.g. high, medium, low).

Economic impact analysis generally is performed near the end of a planning process phase because the estimation of impacts relies largely on data from other parts of the planning process. This data must be finalized so that the EIA accurately reflects the impacts of the project or program. Without complete and accurate data, the economic results will not evaluate the true benefits and costs associated with the investment, which could lead to stakeholders and decision makers making ill-informed decisions or recommendations.

4.3.1 Appropriate Use for Program Level Planning

For a programming exercise that requires the prioritization of projects or project segments, an EIA is often useful to quantify specific impacts that are of interest to stakeholders and decision makers, such as the amount of new development attracted, tax revenue impacts, and/or jobs created. These impacts can provide additional information to decision makers as they are prioritizing projects. However, EIA does not provide sufficient details for prioritization on its own merit because it does not consider the present value of the benefits (or their timing) in relationship to the project costs (both capital and ongoing operations and maintenance costs). Since EIA results do not identify the projects that provide the greatest return per dollar spent, it generally is not used as one of the primary components of programming decisions.

4.3.2 Appropriate Use for Project Level Planning

For project evaluations, an EIA is useful to identify what changes because of a project's construction and implementation (both positively and negatively) and who is affected by the change. It provides insight into the magnitude of these impacts and can help eliminate or promote specific project alternatives in future planning efforts. In addition, EIA can help identify potential negative impacts on the region that could be reduced or eliminated through mitigation efforts. Because EIA does not include a direct comparison to total project costs or consider the present value of these impacts, it generally is not used to make final decisions on which projects should receive funding or the appropriate timing of construction. As a result, EIA primarily is used to evaluate different project alternatives during planning stages, particularly during the EA and EIS NEPA process.

4.4 Return on Investment Analysis

In order to make comparisons between transportation investments, an analysis must look at the full range of benefits or impacts (including user, non-user, community, and wider economic) and costs. This typically involves a benefit cost analysis that takes into account the direct effects (both positive and negative) to make sure that the project or program generates economic benefits that exceed the costs of the investment, including any community disbenefits (e.g. noise and pollution). This type of return on investment analysis can establish whether the investment promotes sufficient transportation and economic productivity benefits. Key measures for comparing the economic benefits of a project or program may involve the use of one or more of the following:

- *Net present value*: The net present value (NPV) of an investment is estimated by subtracting the total discounted costs from the total discounted benefits for a defined analysis period to help determine if the project or program is economically viable. A NPV that is greater than zero (0) indicates that the benefits exceed the costs and is therefore, economically viable. Projects and programs then can be compared and ranked against each other utilizing their NPV. The larger the NPV, the greater the benefits and the more downside risk the project or program can absorb.

- *Rate of return*: The rate of return (sometimes referred to as the internal rate of return) is the discount rate required so that the discounted total benefits equal the discounted total costs (i.e. NPV = 0). The higher the rate of return, the more economically viable the project or program is. When the rate of return is used in an analysis, a minimum rate of return is usually established so that decision makers will only consider those projects or programs that exceed this threshold.
- *Benefit cost ratio*: The benefit cost ratio is estimated by dividing the total discounted benefits by the total discounted costs for a defined analysis period to help determine if the project or program is economically viable. A benefit cost ratio of one (1) implies that the benefits equal the costs. A ratio greater than one implies that the benefits are greater than the costs, while a ratio less than one implies that the costs exceed the benefits. Given the risks associated with forecasting costs and benefits, a successful project or program generally has a BCA ratio well over one. The greater the ratio is over one, the more downside risk the project or program can absorb.
- *Pay-back period*: The pay-back period is the number of years of operation required for the present value of the total benefits to equal the present value of the total costs. This measure helps quantify the ability of the project or program to absorb risk. A shorter pay-back period indicates that there is less risk that the return on investment will be adversely impacted by uncertain forecasts and assumptions used in the economic analysis.
- *Equivalent Uniform Annual Cost*: The equivalent uniform annual cost (EUAC) represents the capital recovery cost of a project or program and can be used to identify the most cost-efficient alternative, assuming the benefits from the investment are the same. By annualizing the full costs (capital, operating, and any salvage value associate with the project or program), it allows investments with varying useful lives or cost streams to be compared.
- *Equivalent Uniform Annual Benefit*: The equivalent uniform annual benefit (EUAB) annualizes the value of the benefits for a project or program and can be used to identify the most beneficial alternative, assuming the costs of the investments are the same. By annualizing the full benefits, it allows projects or programs with varying benefit streams to be compared.

Monitoring the Performance of Transportation Operational Policies

The Florida Department of Transportation's District Four developed an ambitious Intelligent Transportation System (ITS) program to improve the operational performance of the District's road network. The system includes an integrated system of monitoring devices to identify and respond quickly to changes in traffic conditions, message boards to share information with drivers and allow them to adapt their travel routes, and quick response mobile units that are dispatched to manage incidents to prevent further hazard, clear incidents, and restore traffic flow.

In order to communicate the value of these services, support funding requests, identify opportunities to improve performance further, and prioritize potential future investments, the District regularly tracks its performance using benefit cost analysis. To support this initiative, the District has connected the benefit cost analysis into its data collection system in order to provide an automated real-time benefit cost performance tracking system at the push of a button. The automated analysis uses freeway incident management data on motorist delay times collected by the traffic management centers and monetizes them using accepted values of time and nationally accepted formulas for delay benefits. These benefits are divided by the total cost of the ITS program to obtain a benefit cost ratio.

In 2007, the first year that the automated benefit cost system was put in place, the BCA ratio for District Four's ITS program was over 16. Put another way, District motorists received $16 of benefits for every $1 spent on the ITS program. *(8)*

This Guidebook focuses on the return on investment methods associated with BCA and NPV, as these are considered the most commonly used methods. This does not imply that other methods (such as EUAC and EUAB described above) are less useful. Rather, the selection of the appropriate method should be driven by what is most understood by stakeholders in the region. It also may be beneficial to utilize more than one return on investment measure to make sure the results are consistent.

4.4.1 Appropriate Use for Program Level Planning

For programming exercises that require the prioritization of projects or project segments, return on investment measures often are useful to determine which projects or segments have the highest rate of return or net present value. An economic impact analysis, on the other hand, will not provide sufficient details for prioritizing because it does not consider the present value of the benefits (or their timing) in relationship to the project costs (both capital and ongoing operations and maintenance costs). The return on investment measures will allow decision makers to determine which projects or segments provide the greatest return per dollar spent so that they can be prioritized appropriately with other planning considerations.

4.4.2 Appropriate Use for Project Level Planning

For project evaluations that require selecting the appropriate project alternatives for further study or for funding and construction, these return on investment measures often are useful to determine which alternative generates the largest benefit in the shortest amount of time in comparison to the project costs. These measures help decision makers evaluate whether the rate of return is sufficiently positive to overcome any identified risks in the analysis. As a result, return on investment measures are appropriate tools for evaluating different project alternatives or alignments during earlier planning stages as well as in later stages—when it is time for decision makers to make the final ruling on whether or not to fund the project or the appropriate time to implement the project.

4.5 Chapter Conclusion

This chapter summarized the various types of economic analyses that measure and evaluate the tradeoffs associated with transportation plans and investments. The goal of an economic analysis (regardless of the type of study or planning stage) is to identify the tradeoffs (also called benefits or impacts) associated with the construction and implementation of the candidate transportation project or program. These impacts or benefits provide decision makers with the information necessary to determine whether to continue to study project or program alternatives further, invest in the project, or implement the program. The primary types of economic analyses include:

- *Benefit Cost Analysis*: BCA is used to determine whether a project or program yields a positive return on investment by comparing the monetized direct benefits to the direct costs for a defined period of time (often the useful life of the project or program). As a result, it focuses on the net changes attributable to the project or program, i.e. those differences between an Improvement Case (with project or program) and Base Case (no build, or without project or program).
- *Economic Impact Analysis*: EIA examines what changes occur due to the construction and implementation of a project or program and who would be affected by each change. It is used to estimate the impacts that result from construction and implementation, regardless of whether these impacts are a transfer. It is not limited to direct impacts, and frequently includes multiplier effects that quantify the indirect and induced impacts resulting from the direct spending associated with construction and operation of the project or program.
- *Return on Investment*: This typically involves benefit cost analysis that takes into account the direct effects (both positive and negative) to make sure that the project or program generates economic benefits that exceed the costs, including any community disbenefits (e.g. noise and pollution). This type of return on investment analysis can establish whether the investment promotes sufficient transportation and economic productivity benefits. Key measures for comparing the economic benefits of a project or program may

involve the use of one or more of the following: net present value, rate of return, benefit cost ratio, pay-back period, equivalent uniform annual cost, and equivalent uniform annual benefit.

CHAPTER 5 Key Questions for an Economic Analysis of a Transportation Project or Program

The first step of an economic analysis for transportation investments is to appropriately frame the analysis so that there is a general understanding of the scope of the project or program and the variety of stakeholder perspectives influencing investment decisions. It is important that the Planning Project Manager and the economics team work together to answer these framing questions to make sure that the economic analysis developed in later stages provides the appropriate economic measures for the project or program.

Chapter 5 Summary

Chapter 5 examines three important transportation planning questions to consider during an economic analysis of a project or program:

- Where are the benefits generated?
- Who receives the benefits?
- How long is the analysis period?

This chapter explores the issues associated with each of the questions that establish the framework for the economic analysis. By addressing these components of the analysis first, the Planning Project Manager and economics team will be able to determine what type of economic analysis is necessary, the appropriate scale of the analysis, as well as the appropriate methodology and tools to apply in the analysis.

5.1 Where are the Benefits Generated?

The study area for the economic analysis starts with the area that is associated with the immediate project (also sometimes called the corridor area) or program area. This is the location where the impacts or benefits originate. However, in many cases the impacts or benefits extend beyond this immediate project area through the trade and commercial connections associated with the transportation network. For example, jobs in the project corridor may be filled by people residing outside the immediate corridor, in neighboring towns or counties. As a result, the economic benefits or impacts are frequently reported for a larger spatial area, such as one or more Metropolitan Statistical Areas (MSAs), megaregions, counties, or states in order to more accurately reflect the total impacts of transportation investments.

When defining the study area for economic analyses, include those areas that will provide a large percentage of the labor, materials, and services for the project or program. It is important to select an area large enough to measure accurately the place where the local impacts will be felt, but not so large that it will overstate the benefits of the project or program. Given this fine line between an area that is too small or too large, it is important to involve the Planning

Importance of Megaregions

Megaregions are areas where multiple cities and MSAs are linked by economic, transportation, land use, and natural resources. The US megaregions identified below not only span multiple MSAs, but can include multiple states. *(9)*

- Arizona Sun Corridor
- Cascadia
- Florida
- Front Range
- Great Lakes
- Gulf Coast
- Northeast
- Northern California
- Piedmont Atlantic
- Southern California
- Texas Triangle

Future population and economic growth in the US is expected to occur primarily in these megaregions. This creates new challenges for local and regional planning organizations and places an additional need to coordinate policy, planning, and transportation investments across individual communities or MSAs. As a result, economic benefits and impacts also may need to focus on a larger area than traditionally considered.

Project Manager and the economics team in the selection of the appropriate study area.

5.1.1 Program Level Analysis

For program level economic analyses, the study area is best defined by the agency or agencies doing the programming; a common approach is to use the agency's area of jurisdiction. This is especially true if the programming agency is providing some of the funding for the projects in the program. As a result, the primary focus is generally on a larger spatial area that includes at least one MSA or state and could involve multiple MSAs or states depending on the location of the region and the scope of the study analysis.

5.1.2 Project Level Analysis

For project level economic analyses, the primary focus is generally on the local area impacts, rather than larger megaregion, state, or national impacts. However, depending on the funding partners, the project area could be expanded to include a larger multi-MSA region, megaregion, or state. For example, a transit investment in a large city is a project with a local focus. Therefore, a county-level or MSA defined study area is most appropriate. Similarly, if the economic analysis study area is too narrowly defined (e.g. one county in a large, seven-county MSA), the economic impacts could be understated as workers and materials likely will be supplied by the other counties in the MSA—not just the one county where the project is located physically.

When performing an economic analysis, it also may be appropriate to include results for multiple geographic areas, depending upon who the project stakeholders are. While a county may be the primary funding source for a project, the state also may want to know the larger economic impacts for the MSA or the state—particularly if it is a partner or potential partner in the project. In this instance, economic impacts could be reported at either the county, MSA and/or state level.

It is important to note, however, that when multiple study areas are defined for similar regions (i.e. the county is located in the MSA, which is located in the state), the economic results for each area are not additive because the county impacts are already included in the larger MSA or state results.

5.2 Who Receives the Benefits?

Once the study area or areas have been identified by the analysis team, the question shifts to who within the study area receives the benefits or impacts. The definition of the study area and the focus of the benefits may be influenced by the funding sources for the project or program. For example, if funding is provided entirely by one county, it may not be a priority to research and analyze the benefits for residents of a neighboring county. The sections below describe how the beneficiaries change based on the perspective of the defined region as well as the source of funds. The focus is primarily on project level perspectives, because an evaluation of a program or program scenarios involves a mix of projects. Consequently, an understanding of the perspectives of each of the projects that compose the program is necessary to evaluate the program.

5.2.1 Local Perspective

From the perspective of the local area, any impact that did not exist previously or comes from outside the local area is considered *new*—one that would not come to the region but for the transportation investment (whether project or program). The areas located outside this locally-defined area are quite large and could include anything from a neighboring city, county, or state to another country. However, this definition also means that any impact that moves from one location ***within*** the local area to another is not considered new because it represents a gain for one part of the region but an equal loss for another—a transfer.

For example, an economic analysis indicates that the introduction of a light rail extension in a metropolitan area attracts additional residential and commercial development (in excess of the development already planned) within a quarter-mile of the new station areas. From the perspective of the immediate station areas, all of this development is new because it is in excess of the development that is already planned for the local area. In other words, this development would not have come but for the light rail investment. However, from the perspective of the entire metropolitan area, it is likely that some of this development occurring around the immediate station areas is the result of businesses and residents from other parts of the metropolitan area moving to the station areas due to the improved regional access offered at these sites. As a result, the metropolitan area would not view this shift in development as new because the station areas experience a gain at the direct expense of another part of the metropolitan area.

Another consideration in determining whether or not an impact is new is the source of funds for the construction and operation of the transportation project or program. If the funding for the construction and/or operation is new (i.e. it comes from sources outside the local area, including state and federal), then all the jobs and earnings created by the construction and operation would be new to the local area. In other words, without the implementation of the project or program, these funds (and therefore their impacts) would not have occurred in the local area. However, if the funding comes entirely from local sources (including, but not limited to, city or county governments and tax revenues), then there is a high likelihood that these funds would be spent on similar projects in the local area, creating similar jobs and earnings impacts—even without the transportation project or program. As a result, the construction and operating jobs and earnings supported by local revenues are not considered new—but rather, they are jobs and earnings supported by the project or program.

5.2.2 Regional Perspective

From the perspective of a region (whether made up of several counties or MSAs), any impact that did not exist previously or comes from outside the region is considered *new*—one that would not come to the region but for the transportation investment (whether project or program). The areas located outside this defined region are large, but not as large as those outside the local area discussed in the previous section. It could include a county or city from outside the region, another state, or another country. However, this means that any impact that moves from one location within the region to another is not considered new because it represents a gain for one part of the region but an equal loss for another.

For example, an economic analysis indicates that the expansion of a highway connecting two MSAs attracts additional commercial activity (in excess of the activity already planned) to areas within a mile of the highway interchanges. From the perspective of the entire two-MSA region, it is likely that some portion of this additional commercial activity is the result of existing businesses from within the metropolitan areas moving to the highway corridor due to the improved regional access offered at these sites. As a result, the region would not view this shift in development as new because the interchange areas experience a gain at the direct expense of another portion of the metropolitan areas. However, if these businesses move to the corridor from within the region and are able to expand their business as a result of the improved access offered by the project, then the expanded portions of these businesses would be considered new to the region. Without the project, these business expansions would not have occurred in the region.

Another consideration in determining whether or not an impact is new is the source of funds for the construction and operation of the transportation project or program. If the funding for the construction and/or operation is new (i.e. it comes from sources outside the region, including any state and federal government programs), then all the jobs and earnings created by the construction and operation would be new to the region. In other words, without the implementation of the project or program, these funds (and therefore their impacts) would not have occurred in the region. However, if the funding comes entirely from regional sources (including but not limited to cities and counties in the region), then there is a high likelihood that these funds would be spent in the region on similar projects, creating similar jobs and earnings impacts—even without the transportation project or program. As a result, the construction and operating jobs and earnings supported by these regional revenues are not considered new—but rather, they are jobs and earnings supported by the project or program.

5.2.3 State Perspective

From the perspective of a state, any impact that did not exist previously or comes from outside the state is considered *new*—one that would not come to the state but for the transportation investment (whether project or program). The areas located outside this defined region are still relatively large, but are limited to another state or another country. As a result, this means that any impact that moves from one location within the state to another is not considered new because it represents a gain for one part of the state but an equal loss for another. An analysis from the state perspective would be similar to a regional analysis only it would be at the state level.

For example, an economic analysis indicates that the construction of a new interstate through a rural area of a state attracts additional commercial activity, and therefore jobs, (in excess of the growth already planned) to the towns along the new facility. From the perspective of the state, it is likely that some portion of this additional commercial activity is the result of existing businesses in the state moving to the interstate corridor due to the improved regional and national access offered at these sites. As a result, the state would not view this shift in development as new because the corridor areas experience a gain at the direct expense of another part of the state. However, if these companies are able to expand their business as a result of the improved access offered by the project or move to the corridor from outside the state, then the expanded portions of these businesses, as well as the previously out-of-state businesses, would be considered new to the region.

Another consideration in determining whether or not an impact is new is the source of funds for the construction and operation of the transportation project or program. If the funding for the construction and/or operation is new (i.e. it comes from sources outside the state, particularly federal sources), then all the jobs and earnings created by the construction and operation would be new to the state. In other words, without the implementation of the project or program, these funds (and therefore their impacts) would not have occurred in the state. However, if the funding comes entirely from state sources (including local sources), then there is a high likelihood that these funds would be spent in the state on similar projects, creating similar jobs and earnings impacts—even without the transportation project or program being evaluated. As a result, the construction and operations jobs and earnings supported by these state revenues are not considered new—but rather, they are jobs and earnings supported by the project or program.

Importance of Generating National Benefits *(10)*

A case in point is the project selection criteria used in the Transportation Investment Generating Economic Recovery (TIGER) grant program. The projects selected for funding had to demonstrate their ability to generate economic benefits for the US economy as a whole, not just a local region.

The Port of Miami Intermodal and Rail Reconnection Project, awarded a TIGER II grant in 2010, successfully demonstrated that the investment was necessary to expand the container capacity of the port as well as the US as a whole. The Port of Miami expansion is a key component of the port's ability to attract and serve the new Panamax vessels that will travel from Asia through the expanded Panama Canal beginning in 2014. Due to the need for a 50-foot channel and its location, the Port of Miami demonstrated that it is primarily in competition with Caribbean port and transshipment facilities for the opportunity to serve these larger vessels rather than other US East Coast ports. Without the investment in the Port of Miami, they successfully argued that it is highly likely that much of this cargo and the supporting distribution activities would be captured by foreign markets.

5.2.4 Federal Perspective

From the perspective of the US as a whole, any impact that did not exist previously or comes from outside the US is considered *new*—one that would not come to the US but for the transportation investment (whether project or program). The areas located outside this defined region are limited to other countries. As a result, this means that any impact that moves from one location within the US to another is not considered new because it represents a gain for one part of the country but an equal loss for another.

For example, an economic analysis that indicates the addition of a third track to an existing freight rail corridor connecting a state's only seaport to the national freight rail network attracts additional container traffic (in excess of the activity already planned) to the seaport. From the perspective of the state, all of the additional container traffic (in excess of planned growth) is new to the state because it would not have come but for the freight rail investment. However, from the perspective of the nation, it is likely that some portion of this additional container traffic is the result of container ships already destined for a US port moving to this particular port, due to the improved access to the freight rail network offered at the site. As a result, the US would not view this shift in container traffic as new because the gain experienced at the port is at the direct expense of another nearby port along the US coastline. However, if the state can demonstrate that there is excess demand for port capacity along the US coastline that is accommodated by the project, then the containers handled at the project port that are in excess of current US container traffic are a benefit to the US. Without the project, this additional container traffic would not have occurred within the US.

As the US cannot supply all goods and services required for transportation investment (including indirect and induced), it is likely that these investments would generate economic impacts and benefits in other nations. These international leaks may not benefit the US directly, but they could result in indirect and induced impacts in the US as these international businesses and consumers may purchase additional US goods and services. As a result, it may be important to recognize the impact of the project on US exports and imports. Projects that facilitate exports may have more long-term economic benefits than projects that facilitate imports because they utilize a greater share of US-provided goods and services.

Another consideration in determining whether or not an impact is new is the source of funds for the construction and operation of the transportation project or program. From the national perspective, only funding for the construction and/or operation that comes from outside the US is considered new. For any local, state, or private funding that originates from within the US, there is a high likelihood that these funds would be spent on similar projects somewhere in the country, creating similar jobs and earnings—even without the transportation project or program. As a result, the construction and operating jobs and earnings supported by these investments generally are not considered new—but rather, they are jobs and earnings supported by the project or program.

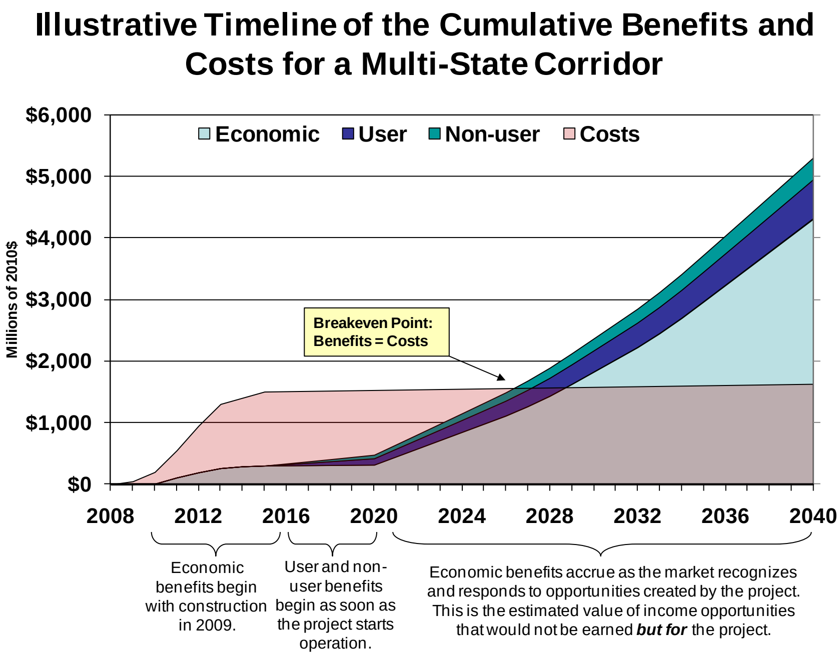
As competition for federal dollars continues to increase, it will become more important for projects seeking federal money to demonstrate their economic benefits not only locally but nationally.

5.3 How Long is the Analysis Period?

The selection of an appropriate time horizon often depends on the nature of the project or program and the type of funding being used. The first year of the analysis period frequently is the first year that the investment experiences costs or benefits. Therefore, it is usually the first year of construction. The end year of the analysis period should be far enough in the future to capture most of the benefits of the project or program, but should not exceed the useful life of its assets. This period of benefit capture typically falls between 20 and 50 years.

Figure 5-1 provides an example of how the cumulative (or sum of all) costs and benefits associated with a project change over time. Initially the costs are greater than the benefits, but as the analysis period moves forward, the benefits begin to outweigh the project costs, supporting the justification for the project.

Figure 5-1: Annual Cost and Benefit Flow Analysis



Note: In Figure 5-1, the pink color for costs overlaps the blue benefits, altering the appearance of the colors slightly.
Source: AECOM

5.3.1 Program Level Analysis

For program level analysis, how the economic analysis is used influences the analysis period, because comparisons need to be made between projects or programming scenarios. If the analysis is being used to compare projects in the program for prioritization, the analysis period may be defined by the Metropolitan Planning Organization (MPO), state, or agency responsible for the prioritization, so that all projects are being compared against the same number of years. For example, the TIP typically is a three- to four-year program of projects, while the LRTP is at least a 20-year plan. Benefits or impacts tend to increase with the number of years included in the analysis period (especially if they are not discounted). Therefore, it is important to make sure that projects are being compared on equal terms. Similarly, if the analysis is being used as part of a grant application, it is possible that the funding agency will define the analysis period—again so that the results are comparable between projects.

If the analysis period is defined by an agency or group other than the project sponsors, and the sponsors believe that some of the major benefits lie outside the selected period, it could be appropriate to estimate these benefits and show them in addition to the required analysis period (i.e. in a separate column, table, or written section). This way the project meets the analysis period requirements but also provides the decision makers with additional, essential data on what important benefits occur outside this period and why they also should be taken into consideration.

5.3.2 Project Level Analysis

For project level analysis, the appropriate analysis period can change depending on the types of project(s) being evaluated. The useful life of transportation projects vary by asset type: transit facilities (generally 40 years), buses (7-12 years), rail vehicles (25 years), bridges (50-75 years), and roads (20-50 years). As a result, the period when benefits are generated by these assets can vary. The planning and economics project teams should work together to decide which period is appropriate to capture most of the benefits generated by the project and for which forecast data is available.

> **Useful Life and the Analysis Period in a Benefit Cost Analysis**
>
> If a BCA is performed, it is important to note that if the analysis period exceeds the useful life of the assets, then the rehabilitation or replacement costs for these assets must also be included in the analysis. Similarly, if the useful life of an asset exceeds the analysis period—a tunnel, for example, typically has a useful life that exceeds 50 years—then the residual value of the asset can be included as a benefit in the BCA.
>
> A longer analysis period often does not translate into larger benefits for a BCA due to the impacts of discounting.

5.4 Chapter Conclusion

This chapter explored the issues associated with each of the questions designed to establish the framework for the economic analysis. By addressing these components of the analysis first, the Planning Project Manager and economics team will be able to determine what type of economic analysis is necessary, the appropriate scale of the analysis, as well as the appropriate methodology and tools to apply in the analysis.

- *Where are the benefits generated?*: When defining the study area for economic analyses, include those areas that will provide a large percentage of the labor, materials, and services for the investment. It is important to select an area large enough to accurately measure the place where the local impacts will be felt, but not so large that it will overstate the benefits of the project or program.
- *Who receives the benefits?*: The answer to this question often depends on the funding sources for the project or program because where the funds come from helps define the perspective of the analysis. From the perspective of the defined area (whether local, regional, state, or federal), any impact that did not exist previously or comes from outside this defined area is considered *new*—one that would not come but for the transportation investment (whether project or program).
- *How long is the analysis period?*: The selection of an appropriate time horizon often depends on the nature of the investment and the type of funding being used. The first year of the analysis period frequently is the first year that the project experiences costs or benefits. Therefore, it is usually the first year of construction. The end year of the analysis period should be far enough in the future to capture most of the benefits of the project or program, but should not exceed the useful life of its assets. This period of benefit capture typically falls between 20 and 50 years.

CHAPTER 6 Practical Advice for Managing an Economic Study to Support the Transportation Planning Process

There is more than one defensible way to conduct an economic analysis, even using the same data set and evaluating the same project, program, or policy. Many of the questions discussed in this Guidebook do not have a single answer, including:

- Which model or other type of analysis can answer the question?
- Which discount rate should be applied?
- Which perspective (local, regional, state, or federal) should be applied when analyzing the impact of a project or megaproject?
- When there are multiple ways to proceed with an economic study, how do you choose the way forward?

The appropriate answers are driven by the purpose in requesting the study and an understanding of how the analysis will be used in the decision making process.

Chapter 6 Summary

Chapter 6 presents advice on the following:

- General steps to apply in an economic analysis
- Need to distinguish short-term and long-term impacts
- Considerations when selecting or constructing a modeling approach;
- Descriptions of several common tools and models that can be used
- A comparison of the most common models used in terms of general methodology, advantages, and disadvantages
- Importance of objective and impartial economic analyses in transportation planning.

This chapter provides practical advice for managing an economic study and determining how the economic analysis can best support the overall purpose of the transportation project or program. It discusses the general steps in an economic analysis, the importance of distinguishing short-term from long-term impacts, things to consider when selecting a methodology or modeling approach, as well as best practices.

As noted in Chapter 3, economics can support many facets of the overall transportation planning process. The purpose of the study influences how the study is conducted because the analysis can play different roles at different stages of the planning process. If the purpose of the study is to prioritize several alternatives according to several key criteria, this suggests a different approach than conducting a full benefit cost analysis. Similarly, if the purpose is to understand impacts locally, taking a national perspective in the modeling and analysis is not helpful to decision makers.

An additional consideration in managing an economic study is how the analysis will be used. For example, if the analysis is developed in the context of a controversial project, the analysis itself can become an aspect of the debate. Those who favor the analysis results argue that it “proves the case,” while those who oppose the recommendation indicated by the analysis maintain that it was incomplete or inappropriate. In these instances, the selection of an approach that is transparent and can be explained to all parties is essential. Similarly, if the analysis is being conducted to determine the validity of moving forward with a multi-billion dollar project, a comprehensive analysis from a variety of perspectives is warranted. If, however, the purpose is to prioritize intersections for signal upgrades, the scale of the analysis should be pared back, because the same level of detail is not required.

6.1 General Steps in an Economic Analysis

Performing an economic analysis generally involves eight basic steps, regardless of the type of analysis or project. These steps help establish the evaluation criteria, analysis process, and presentation of results. Following these basic steps will help ensure that planners, stakeholders, decision makers, and analysts share the same understanding of the project, its impacts, and how the economic analysis results will be used. These steps were assembled from two primary sources (FHWA's *Economic Analysis Primer* and *NCHRP Report 342*) (*11*) (*12*) and are discussed below.

Although the steps below are listed sequentially, in the actual conduct of a study, the work may progress in an iterative fashion—with the analysis moving back and forth between steps. For example, after collecting data in Step 5, the economics team may return to Step 2, if new project data that were not anticipated become available. The steps are summarized to make sure the key components in the analysis are not missed.

6.1.1 Step 1: Establish objectives

The economic objectives of the project or program must be established early by decision makers and stakeholders so that there is a general understanding of what type of analysis needs to be performed (e.g. EIA or BCA) and how projects will be viewed to be successful. For a transportation investment to be successful, it must solve a transportation problem. The problem may be one of physical access, congestion, reliability, or hazardous travel. However, for the project or program to generate transportation user, non-user, community, or other economic benefits, it must solve a transportation problem.

In addition to solving a transportation problem, some projects or programs may have an economic development component. Different areas or localities have different economic development goals so objectives can vary from one area to another and can include such possibilities as job creation, productivity increases, and higher-wage jobs. Without the establishment of clear economic objectives, there is a greater likelihood of generating results that are misinterpreted—or not comparable among projects being considered. In managing an economic study, this is a point in the process where the Planning Project Manager and the economics team should have a frank conversation about the motivations for undertaking the study and the ways that the resulting information will be used.

6.1.2 Step 2: Define level of effort for screening alternatives

The level of effort for the economic analysis should be based on three primary considerations:

1) Complexity of the project or program
2) Planning phase
3) Availability of data.

Generally, the most detailed analyses should be saved for the later planning phases (after earlier screening phases), when decision makers must choose among the most promising of project alternatives, or saved for those large capital investments that are more complex or controversial and/or involve numerous stakeholders.

The first consideration for the level of effort required for the economic analysis is the complexity of the project or program. If the project or program being evaluated is relatively low cost, it is possible that the analysis required could be less detailed than that expected with a high cost, complex, or controversial investment. For these lower cost or more simple investments, often the level of detail for the input data is not available, particularly in regards to travel demand or forecasting model results. As a result, a more qualitative approach may be more appropriate to discuss the types of benefits expected, magnitude of these benefits (e.g. high, moderate, low), and which populations mostly likely would experience these benefits.

Projects or programs also inevitably fall into different stages in the transportation planning process (e.g. EA and EIS), and as a result, information concerning how the project(s) will be built and operated—the basis on which the travel demand or forecasting analysis and benefit analyses are performed—is often incomplete and subject to change. As a result, the level of detail and rigor of the benefit analysis should be structured based on the stage of planning and data available.

If the travel demand or forecasting data are available, the benefits may be quantified, even if the data are still in an early phase of development or are expected to change due to future planned improvements in the modeling process. However, the evaluation of these preliminary results should address the risks associated with the impacts at this stage. Given the uncertainty concerning project inputs in the early stages of planning, an acceptable approach could be a preliminary assessment that balances sponsors' need for an early "snapshot" of the benefits with the very real downside risks of assessing and reporting on a project or program before it is fully developed.

The difference between these preliminary or more simplified assessments and more comprehensive analyses is primarily the level of effort required to quantify the benefits and the quality of the data that underpin the estimates, not the benefits considered. Each assessment type can consider all applicable benefits using the best project information available at the time. This can include both quantifiable and qualitative descriptions of potential benefits. If the data are available for quantifying the benefits, the analysis should be performed—as quantified and monetized benefits are easier to understand and more fully reflect the magnitude of the benefits, particularly when the project or program is being compared with other investments. If the data are not available and/or the sponsors agree, a more qualitative approach can be taken to discuss the types of benefits expected, magnitude of these benefits (e.g. high, moderate, low), and which populations mostly likely would experience these benefits. However, it is important to recognize that a qualitative approach will make it more difficult for decision makers to compare the project or program benefits fully with other investments.

6.1.3 Step 3: Specify assumptions

This step helps frame the analysis by establishing the basic project assumptions that will be used throughout the transportation planning process as well as those required only for the economic analysis. Assumptions to specify include discount rates to be used, future traffic or travel growth, underlying population and employment growth, land use plans and assumptions, and useful life of the project or program facilities. These assumptions are discussed in more detail for each of the economic measures described in Chapter 11 and Chapter 12.

6.1.4 Step 4: Define base case and identify alternatives

The base case establishes the foundation for the level of benefits expected from various alternatives and ultimately influences which one will be viewed as generating the greatest benefit. The base case represents the existing conditions in the project area and is used to compare the effects of the project or program being studied as part of the economic analysis. It is essential that the base case reflect a reasonable picture of what the future without the project or program would look like. If the base case involves no investment at all, then the benefits may be over-stated. Similarly, if the base case includes some aspects of the project or program then the benefits could be under-estimated. The base case for the project or program may be the No Build alternative, Transportation Systems Management (TSM) alternative, or both—as described below.

All alternatives (base and improvement cases) should match those used throughout the project or program analysis, especially the travel demand or forecasting analysis.

- *No Build alternative*: Generally represents existing conditions in the study area without the project or program being studied. It generally keeps the existing assets in a state of good repair, but does not include any major improvements or investments. In addition, it can include transportation projects currently under construction or funded for construction and operation. The No Build alternative is the base case for projects undergoing the NEPA process and only includes those projects already programmed in the study area.

- *Transportation Systems Management alternative*: In addition to the No Build, the TSM generally includes more lower-cost capital and operational improvements than the Build alternatives as well as additional local jurisdiction land use decisions that could alter demand for a transportation facility or service. The logic behind the TSM is that if the project or program were not built, some lower-cost improvements would have to be made to deal with growing congestion or the continued degradation of existing assets. The improvements may include such things as smaller infrastructure investments/modifications, Intelligent Transportation Systems (ITS) improvements, traffic management procedures, and increased bus service. The TSM alternative is frequently used in the FTA New Starts process to compare build alternatives with alternate, lower-cost solutions to the transportation problem.
- *Improvement/build alternative*: Represents the transportation project or program being evaluated.

6.1.5 Step 5: Define the analysis period and collect data

The definition of the analysis period establishes the time period for which benefits (and costs, if doing a BCA) will be estimated and compared. As a result, the analysis period must be long enough to capture the bulk of the benefits and costs. It is also important to estimate the residual value or salvage value of the project if the analysis period is less than the service or useful life of the project. Additionally, the salvage value may include the salvage cost if demolition would be required. Salvage values generally are positive—however, they may be negative if the cost of demolition exceeds the value of the materials and equipment being salvaged.

In general, the selection of an appropriate time horizon often depends on the nature of the investment or the type of funding programs being used. The first year of the analysis period frequently is the first year that the project or program experiences costs or benefits. Therefore, it is usually the first year of construction. The end year of the analysis period should be far enough in the future to capture most of the benefits of the investment, but should not exceed the useful life of its assets. This period of benefit capture typically falls between 20 and 50 years. The analysis period also should be the same for all components of the economic analysis so that the benefits and costs are comparable.

6.1.6 Step 6: Estimate impacts or benefits (and costs, if appropriate) relative to base case

Once the steps above have been completed and input data received for the base case and alternatives being considered, the impacts or benefits (and costs) can be estimated, either quantitatively or qualitatively. Chapter 11 and Chapter 12 summarize the data requirements and options for estimating economic measures quantitatively as well as qualitatively for EIA and BCA, respectively. The methodologies, tools, and software available to help with this estimation are discussed in more detail in the next section of this chapter.

6.1.7 Step 7: Evaluate risk

In developing an economic analysis, it is important to consider the impacts of risk associated with any forecast involved in economic analyses—including the forecasts of population, employment, travel demand results, economic benefits, costs, and revenue. Risk stems from the fact that forecasts are predictions of the future based on available information at the time the forecast was developed (which usually includes some combination of historic data, professional judgment, and forecasts of other variables provided by local, state, or federal governments or other experts). Even with the most rigorous forecast, it is likely that the actual data in the future will be different from the forecast. However, it is a matter of *how different* (0.5% vs. 20%) and *how dependent* the results of the economic analysis are on these forecasts being close to the actual result.

A sensitivity analysis (or risk analysis) is a means to measure how sensitive the results of the economic analysis are to changes in the input forecasts of such factors as population, employment, and travel demand—either separately or combined. There are two general types of sensitivity analysis that can be performed on the results of an economic analysis to provide confidence in the ability of the project or program to meet the expected results: a uni-dimensional stress test and a more dynamic risk analysis that uses Monte Carlo simulation. Each sensitivity analysis has a role with certain advantages and disadvantages, as summarized below.

- *Uni-dimensional stress test*: With a stress test, one or more uncertainty variables (e.g. inflation, population, ridership) are selected, and the analysis is run with alternative values of these variables that typically represent baseline, high, and low scenarios. This approach can define the upper and lower extremes, answering the important question: How bad could it get? This type of sensitivity analysis is the most common and simplest to perform. It is also the easiest for the general public to understand. However, it does not recognize that all uncertainty variables likely change simultaneously, not just the ones selected in the "stress test." Nor does it recognize that there is a lower probability of outcomes that are farther away from the most likely value. While "How bad it could get" is clearly important information, it does not address the likelihood of the pessimistic outcome.
- *Risk analysis with Monte Carlo simulation*: Risk analysis with Monte Carlo simulation addresses some of the concerns associated with the uni-dimensional stress test, particularly the ability to change multiple variables at the same time and the likelihood of a pessimistic outcome. Risk analysis examines the probability of failure by replacing point values of uncertainty variables with a pessimistic, likely, and optimistic range, permitting all uncertainty variables to vary simultaneously and summarizing the results over a large number of iterations (model runs). Risk analysis quantifies the "down-side" risk and provides decision makers with some comfort or confidence in the economic analysis results. Running a risk analysis with Monte Carlo simulation is more complex than a stress test and requires the purchase and application of software.

Because the estimation of benefits (and costs) is based on assumptions about the future, there are many elements of risk associated with the economic analysis. It is essential that the risks are identified and analyzed sufficiently to determine how likely it is that these risks could occur and what the resulting impacts on the economic analysis would be. How detailed these risks are analyzed depends on the complexity of the project or program, its expense, as well as how far along it is in the transportation planning process.

6.1.8 Step 8: Compare impacts and rank alternatives

Once the impacts (and costs) have been estimated and any risk assessments performed, the results of project or program alternatives can be compared. For EIA, this is a comparison of the impacts only—so the investments may be ranked by the size of the positive impacts generated through user, non-user, and economic impacts. For a BCA, the net present value of these benefits and costs can be compared between alternatives to determine which ones best meet the stated goals and needs of the project or program.

6.2 Distinguishing Short-term and Long-term Impacts

Determining whether the economic impacts or benefits are short-term or long-term is important so that they are not overstated in the economic analysis. Short-term impacts generally are associated with construction activities, including jobs, earnings, and tax base changes that result from the acquisition of private land for construction. These impacts generally only occur for a limited period of time (e.g. the construction period). Once the time period ends, these impacts no longer are generated.

Long-term impacts, or recurring impacts, generally are associated with the operation of the project or program. In other words, these benefits are experienced as long as the project or program is in operation and include benefits such as user (travel time, travel cost, and accidents avoided savings), non-user, community, and wider economic benefits.

6.3 Things to Consider When Selecting or Constructing a Modeling Approach

Models are a structured way of analyzing a problem. They can range from a matrix of screening criteria and associated scores for project alternatives—to a single regression equation or a multi-equation econometric modeling system. Selection of a modeling approach—either tailoring an existing tool to the circumstances of the specific analysis or constructing a new spreadsheet or econometric model—is guided by four primary considerations.

1) The first is the ***type of study questions*** that you want to address. There are models that are built to address the unique operating characteristics of particular modes—grade crossing improvements and value of port operations analysis, for example. In addition, if the study will require a comprehensive and detailed technical analysis with multiple scenarios or multiple project types (modes), as in programmatic analysis, the use of a private sector model may be an efficient way to advance the estimation work.
2) The second consideration is ***model scale***. A model built to capture state impacts would not be a good choice for a corridor study where the objective is to understand the impacts on local communities. Similarly, a model constructed for local impacts would not be a good selection for assessing the national economic implications of an investment.
3) The ***availability of data*** is an additional consideration. Each type of model requires specific data inputs for the methodology that underpins it. If these data are not available, the model cannot address the problem. Although data collection and selection of methodology often are described as different activities, in actual practice these are iterative activities.
4) Finally, recognize that ***multiple tools*** may be required to provide the most comprehensive assessment possible. It is important to be willing to use all the information and tools necessary to provide a complete evaluation of the project or program for decision makers and the public.

6.3.1 Common Tools and Models

Several tools and strategies are used to assess the impacts from different types of modal investments, including econometric models, input-out models, multipliers, federal agency models, and private sector models. A basic introduction to the most common types of tools or models is presented below. ***It is not an exhaustive list, nor is it an endorsement of any model.*** A table summarizing the user friendliness, level of data required, and level of expertise required for the tools and models follows this introduction.

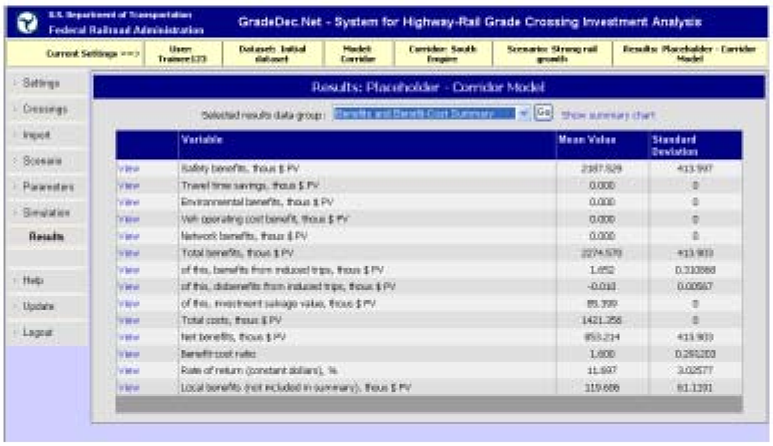
- Econometric models: An econometric model is a structured quantitative analysis often used as part of an economic analysis. It uses the past relationship between economic variables (e.g. population, employment, income) to predict the future values of another economic variable (e.g. housing stock, retail sales tax revenue), and frequently involves regression analyses. If, for example, a regression is run and finds that a community adds one house for every six new residents (some new residents are children who are born and "move" to existing houses), and something is known about future population growth, a prediction can be made about housing growth too.

  The econometric model's prediction is only good to the extent that past relationships hold into the future. If an investment is expected to result in a large structural change in an economy, it is useful to pair an econometric model with another type of assessment. This pairing will help identify imbalances that might develop, risks, and how the structural model might "miss." These supplemental assessment tools might include leading indicators, interviews with knowledgeable professionals, or formal risk assessment.

  Examples of econometric models available from federal agencies as well as the private sector include:

  - GradeDec.NET: Developed by the Federal Railroad Administration (FRA), GradeDec.NET estimates the safety, time, and cost savings benefits associated with grade crossing improvements or eliminations from the local, regional, state, or national perspective. For the estimation of safety benefits, the model uses the US DOT's Accident Prediction and Severity (APS) Model and Resource Allocation Method. The APS Model is comprised of three sub-models: a formula for accident prediction, a formula for estimating the severity of the accidents that are predicted (fatal, non-fatal, and property damage only), and a formula for resource allocation. The coefficients for the accident prediction and accident severity parts of the model are updated annually and are derived empirically through regression analysis that relates accident outcomes and grade crossing characteristics. In addition, the model includes a queuing routine that underpins the travel time and cost savings and the emissions avoided. GradeDec.NET is a free, web-based application that is available through the FRA website. A sample of GradeDec.NET's results page is shown in Figure 6-1.

Figure 6-1: GradeDec.NET Results Page



Source: FRA, GradeDec.NET User's Manual, 2008, p. 44.

- HERS-ST: Developed by the Federal Highway Administration (FHWA), HERS-ST is an extension of the HERS model that FHWA uses to examine the relationship between highway investment and performance for the biannual *Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance (C&P)* report to Congress. HERS-ST performs a BCA on programs of projects to determine the appropriate prioritization necessary to meet highway performance goals from the state perspective. The model may be applicable for long-range planning, what-if analyses, and programming projects. The analysis estimates benefits associated with travel time, safety, vehicle operating, emissions, and highway agency costs and can be run to optimize investments based on highway performance results—with or without funding constraints. The use of HERS-ST requires highway section data in the Highway Performance Monitoring System (HPMS) data format. HERS-ST is a free software package that is available for download through the FHWA website.

- REMI: Developed by Regional Economic Models, Inc. (REMI), the REMI model is a useful tool for policy and investment analysis for a wide variety of applications, including transportation. The structure of the model incorporates inter-industry transactions (I-O model), as well as behavioral equations from economic theory that allow the model to respond to changes in an area's economy resulting from strategic investments. Since the region is defined by the user, the REMI model can support local, regional, state, or national perspectives.

  The REMI model distinguishes itself from a traditional I-O model in that it allows for substitution among production factors in response to changes in factor costs over time. For example, in the model, wages respond to changes in labor market conditions; migration responds to changes in expected income; and, the share of local and export markets responds to changes in regional profitability and production costs.

Additionally, the REMI model considers the impacts of transportation costs and accessibility on the region's business and labor productivity. By collecting producers, suppliers, and consumers in urban centers, communication, transport, distribution, and production activities are less costly. Retailers, for example, benefit from a concentration of consumers in a relatively small geography. Consumers benefit as their search costs are reduced and their choices are expanded. Businesses also benefit from being in an urban area because they have a greater range of suppliers and access to specialized goods, services, and labor that make their own production more cost efficient. These so-called agglomeration economies, which are modeled by REMI, diminish the cost of transactions and make the urban area's firms more productive. The REMI model is available for lease via the REMI website.

- TREDIS: Developed by Economic Development Research Group, Inc. (EDR), the Transportation Economic Development Impact System (TREDIS) is specifically designed to develop economic impact and benefit cost analyses for transportation investments of all modes (highway, bus, rail, aviation, maritime, and multi-modal) as well as freight and passenger transportation. TREDIS includes six modules that can be used separately or in any combination: 1) Travel Cost (estimates user benefits), 2) Market Access (estimates agglomeration and productivity impacts), 3) Economic Adjustment (estimates economic impacts in the form of jobs and wages that are not included in BCA), 4) Benefit-Cost (calculates the NPV of the benefits and costs for a user-defined analysis period), 5) Tax and Finance (estimates fiscal impacts as well as impacts from toll and pricing scenarios), and 6) Freight and Trade (estimates commodity flow impacts as well as value of trade flows).

  The sophistication of the web-based model also can vary depending on the needs of the user—from a sketch planning/early assessment tool to a comprehensive analysis tool. The TREDIS model provides default values for many of the variables used in the modules, and users may work from these or develop their own values using sketch planning methods, travel demand software, or in-house GIS software.

  The business attraction component (agglomeration) is estimated using the Local Economic Assessment Package (LEAP). This tool draws on a database of local economic conditions and research to estimate how quantified changes in access improve the competitiveness of the study area to attract business. Productivity impacts are estimated based on recent research describing how expanding market breadth increases the effective density of economic activity for a study area. Since the region is defined by the user, the TREDIS model can support local, regional, state, or national perspectives. The TREDIS model is available for lease on EDR's TREDIS website.

- Rapid Fire: Developed by Calthorpe Associates, the Rapid Fire model is designed to evaluate statewide, regional, and/or county level policy scenarios on climate, land use, and infrastructure. The model is based on inputs for a base year and up to three predefined horizon years (2020, 2035, and 2050). It is a user-friendly spreadsheet-based tool that allows the impacts of various combinations of compact, urban, and more sprawling growth scenarios to be compared across the following metrics: land consumption, transportation, public health, water use, energy use, fiscal impacts, and greenhouse gas emissions.

  Rapid Fire can analyze up to four scenarios. These scenarios have default values in the model that can be changed easily by the user. Additionally, each scenario includes two components: land use option and policy package. The land use option allows the user to vary the population and employment growth in the three land development categories: urban, compact, and standard—each of which is associated with different travel behaviors, housing mix, and commercial profiles. The policy package allows the user to vary the auto and fuel efficiency, building efficiency, and utility use assumptions for the four scenarios. The Rapid Fire model is available for lease on the Calthorpe Associates website.

- **Input-Output (I-O) models:** I-O models, a type of econometric model, predict for a future year the number and distribution of earnings, output, and employment in a defined region for each industry sector—based on the region's inter-industry purchasing patterns. Since the region is defined by the user, I-O models can support local, regional, state, or national perspectives. The inter-industry purchasing patterns come from I-O accounting tables, which trace the extent to which each industry sector generates demand for inputs from other sectors. Since these tables are based on history, these models can be used as long as the structure of the economy does not change (e.g. firms migrate) as a result of the project or program.

  The major advantage of using I-O techniques is that they allow estimation of both the direct and indirect economic effects of changes in demand for particular goods and services. For example, the construction of a highway project requires an increase in the output of the construction industry. This increase in construction requires, among other things, higher steel production, which in turn requires more chemicals, iron, ore, and limestone. Input-output tables trace these supply chains back through the economy to arrive at the total goods and services needed to support a given increase in the final demand for highway construction.

  The use of I-O models also allows for the estimation of induced economic impacts that result from changes in demand for particular goods and services. The direct and indirect effects are stated in terms of employment and earnings that accrue to the benefit of resident workers. These workers will spend a portion of their increased earnings on additional goods and services—and these consumer demands will generate further multiplier effects in the same way that the increase in highway construction did. The impacts associated with the increase in goods and services needed to accommodate employee (household) purchases represent the induced impacts of the project or program.

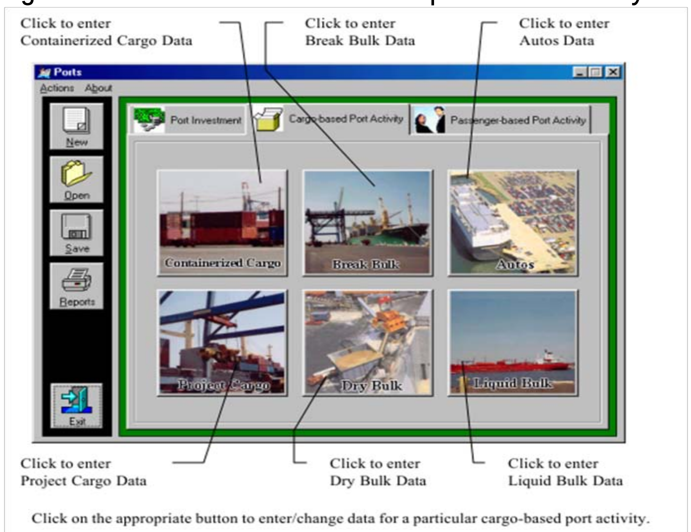
  Examples of I-O models frequently used in transportation planning are described below. Input-Output methods also underpin the REMI and TREDIS models discussed under econometric models.

  - **Multipliers:** Multipliers are produced by I-O models for a specified area. They are factors that estimate how changes in final demand for a particular industry impact employment, earnings, value added, and output for all industries in a study or benefit area. With the purchase of materials and labor to construct a transportation project, a chain of transactions result. This chain of transactions is captured by the I-O table or model and is used to calculate the multipliers for a specified region. Since the region is defined by the user, I-O models can produce multipliers to support local, regional, state, or national perspectives.

    The specification of the region influences the values of the multiplier coefficients. Generally, the larger, more economically diverse the region, the higher the value for the coefficients—since more inputs (e.g. labor, materials, intermediate goods) would be supplied by the region as opposed to being purchased from outside the region. The multipliers reflect the supplier linkages for each industry—and thus account for any leakage from the local economy (i.e. those goods and services that are not available locally and must be purchased from outside the defined region).

  - **MARAD Port Economic Impact Kit:** Developed by the US DOT Maritime Administration (MARAD), the Port Economic Impact Kit is an I-O based model that has been used for more than 25 years and has been the leading resource for quantifying the local and national economic impacts of the port industry. It measures the direct, indirect, and induced economic impacts that result from port activities for a national or local region. These activities include capital investment (including dredging), ongoing cargo activity, and ongoing passenger activity. Figure 6-2 depicts the data entry tab for ongoing cargo activity. Direct impacts include the jobs and incomes that result from the direct spending by the port industry. The indirect impacts produced by the model are the result of the port industry buying from other industries in the region—while the induced impacts result from the spending by the employees of the port industry and port industry suppliers. The Port Economic Impact Kit is published on a CD-ROM that is available for purchase from the National Technical Information Service (NTIS).

Figure 6-2: MARAD Port Economic Impact Kit Data Entry for Cargo Based Activity



Source: MARAD, Port Economic Impact Kit User's Guide, 2000, p.22.

- National Scenic Byways and All-American Roads Economic Impact Tool: Developed by Economic Stewardship, Inc. for the America's Byways Resource Center, the economic tool is designed to estimate the amount of economic activity that is attributable to the presence of the byway. It is a spreadsheet-based tool that has a user interface that is similar to many tax preparation software programs so that it can be used by economists or non-economists. There are four sections to the tool that can be used independently or in combination, depending on the needs of the user: 1) Enter/Edit Economic Activity Data (including visitor profiles, visitor spending, visitor counts, investments, property values, and employment), 2) Enter/Edit Tax Rate Data (including property taxes; sales, use, and lodging taxes; and income taxes), 3) Enter/Edit Economic Multiplier Data (importing RIMS II multipliers purchased from BEA), and 4) View Impact Analysis Results (including summary of input data, summary of all economic impacts, total visitor spending impacts, other economic output results, employment impact results, earnings impact results, tax impact results, and impact results by intrinsic quality).

  In addition, the tool includes an interactive "But For Test Worksheet" that is designed to help the user determine whether or not impacts truly are due to the presence of the byway—and to what extent they are due to the byway. This helps ensure that the results are reasonable and do not include impacts that are not really the result of the byway or the actions of the byway organization. The "But For Worksheet" involves addressing the following factors to determine how to apportion the impacts of an investment to the byway:
  - Proximity to the byway
  - Not part of regular maintenance
  - Investors sought out byway information
  - Investors asked byway group for support
  - Byways cited as contributing factor
  - Byway group helped get funding
  - Marketed as being along the byway
  - Contributes to user enjoyment of byway

- Byway group is touting the investment
- Comfortable publicly attributing investment to byway.

The National Scenic Byways and All-American Roads Economic Impact Tool is a free tool. It is published on a CD-ROM that is available for order from the America's Scenic Byways Resource Center.

- Regional Input-Output Modeling System (RIMS II): Developed by the US Bureau of Economic Analysis (BEA), RIMS II is an I-O model that produces economic multipliers so that the user can estimate the direct, indirect, and induced jobs and earnings produced—given a change in final demand or a direct change in employment or earnings for a particularly industry (i.e. construction). The RIMS II multipliers are developed in accordance with the specific industry structure of the user-defined region in terms of inter-industry purchasing patterns. This is the information that comes from I-O accounting tables, which trace the extent to which each industry sector generates demand for inputs from other sectors. The model is based at the county level. The counties can be aggregated into a user-defined region (which can include a multi-county region, state, or the US) and has the capability of providing impact measures across more than 500 industry classifications. The RIMS II multipliers are available for purchase on the BEA website. Figure 6-3 provides a sample of the RIMS II multiplier tables.

Figure 6-3: RIMS II Multipliers, Sample Table 2.5

RIMS II Multipliers (2008/2008)
Table 2.5 Total Multipliers for Output, Earnings, Employment, and Value Added by Industry Aggregation
Sample Region Annual Series (Type II)

INDUSTRY	Multiplier					
	Final Demand				Direct Effect	
	Output/1/ (dollars)	Earnings/2/ (dollars)	Employment/3/ (jobs)	Value-added/4/ (dollars)	Earnings/5/ (dollars)	Employment/6/ (jobs)
1. Crop and animal production	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2. Forestry, fishing, and related activities	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3. Oil and gas extraction	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4. Mining, except oil and gas	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5. Support activities for mining	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6. Utilities*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
7. Construction	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8. Wood product manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9. Nonmetallic mineral product manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: US Department of Commerce, Bureau of Economic Analysis (BEA).

- IMPLAN: Developed by MIG, Inc., IMPLAN is an I-O model that produces economic multipliers to estimate the direct, indirect, and induced jobs and earnings produced by a given change in final demand or direct change in employment or earnings. However, unlike RIMS II, IMPLAN is a software package that estimates these direct, indirect, and induced impacts as well as provides the multipliers used to develop the impacts. The impact reports (as well as all background data) from the model can be exported as CSV or Excel files. The IMPLAN system uses a national level I-O table as well as estimates of sector activity for over 400 industries, including final demand, final payments, industry output, and employment down to the zip code level. As a result, it can support economic analyses from the local, regional, state, or national perspective. The IMPLAN system is available for purchase on the MIG, Inc. website.

Most of the models and tools discussed above focus on estimating the benefits or impacts of individual projects, which may be compared against each other for programming purposes. However, the HERS-ST model is designed as a programming tool for highway investments.

6.3.2 Comparison of the Most Common Models Used in Transportation Economics

RIMS II, IMPLAN, REMI, and TREDIS are the primary models used for economic analysis in transportation, regardless of project type. Many of the other models and tools presented in the previous section focus on specific types of projects or impacts (i.e. port projects or grade crossing benefits), and as a result, are not applicable to all transportation projects. Table 6-1 below summarizes the primary use of RIMS II, IMPLAN, REMI, and TREDIS in economic analyses for transportation investments, as well as the advantages and disadvantages of each.

Table 6-1: Summary of RIMS II, IMPLAN, REMI, and TREDIS Economic Analysis Models

Economic Analysis Model	General Methodology	Advantages	Disadvantages
RIMS II	Multipliers generated through an I-O approach. Users develop their own spreadsheet analysis to estimate the impacts using the multipliers.	• Has a proven track record, not just in transportation. • Multipliers are available down to county level. • Inexpensive and purchase orders are turned around quickly. • Provides flexibility so that you can apply the multipliers to your own analysis to estimate the direct, indirect, and induced impacts.	• Does not account for any structural changes in the economy. Assumes the structure of the past continues. • Does not estimate impacts directly. Must apply the multipliers to your own analysis.
IMPLAN	I-O model that generates multipliers and allows for the estimation of impacts within the model.	• Has a proven track record, not just in transportation. • Multipliers and analysis are available down to zip code level. • Provides model structure to easily set up the impact analysis and estimate the direct, indirect, and induced impacts, if desired. Also can use the multipliers independently.	• Does not account for any structural changes in the economy. Assumes the structure of the past continues. • More expensive than RIMS II.
REMI	Model with an I-O approach that allows for substitution among production factors (in response to changes in relative costs over time) and accounts for agglomeration impacts. Impacts are estimated within the model.	• Has a proven track record, including success in the transportation industry. • Allows for structural changes in the economy. • Allows for substitution of production factors in response to relative costs. • Provides model structure to estimate the direct, indirect, and induced impacts. • Accounts for agglomeration impacts.	• Not necessarily a transportation-specific model (although a transportation model is available). It is more complicated to use than many tools and likely will need to be run by an economist. • One of the most expensive options due to all the capabilities. Need to make sure that these capabilities do not exceed project or programming needs.
TREDIS	Web-based model that estimates economic impacts, as well as BCA, for all modes of transportation investments using IMPLAN multipliers. Made up of modules that can be run independently or together.	• Has a proven track record and was specifically developed for transportation investments. • Provides easy to use web-based model structure to estimate the direct, indirect, and induced impacts as well as a benefit cost ratio. • Can have multiple users of the same model. • Accounts for agglomeration impacts. • Flexibility to use all six modules independently or together.	• Does not allow substitution of production factor in response to relative changes in costs. • More expensive than some options due to all the capabilities. Need to make sure that these capabilities do not exceed project or programming needs.

Source: AECOM

6.4 Importance of Transparency in Methods and Assumptions

The development, prioritization, selection, and funding of transportation projects and programs balances competing interests and perspectives. This can create pressure to use the economic analysis in an advocacy role. Economic analysis within the transportation planning process must be conducted in as objective and non-partial a manner as possible. This is an ethical requirement for the analysis team, but also central to getting the most value from the economic analysis.

A biased or self-serving economic assessment of a project or program will be dismissed by readers, and may trigger opposition that reduces the credibility of the project or program and its sponsors. More fundamentally, however, it devalues some of the most useful information that economics can provide to the transportation planning process. Sometimes the most valuable findings concerning a project or program are that it does not score well in a benefit cost analysis or that it delivers negative impacts that were unforeseen in the project development process.

While delivering bad news is always difficult, this is an opportunity to revisit the project or program, refine it, and improve the ultimate product that is delivered to the traveling public. In this way, the economic analysis can 1) inform the project or program sponsor about the weakness of a candidate project or programming approach; 2) potentially change the sponsor's recommendation; and 3) help the sponsor to develop a new solution to the transportation problem being addressed. This is one of the strongest means for economics to contribute to the decision support role of the transportation planning process.

6.5 Chapter Conclusion

This chapter provided practical advice for managing an economic study and determining how the economic analysis can best support the overall purpose of the transportation project or program.

- *General steps in an economic analysis*: Performing an economic analysis generally involves eight basic steps, regardless of the type of analysis or project. Following these basic steps will help ensure that planners, stakeholders, decision makers, and analysts share the same understanding of the project, its impacts, and how the economic analysis results will be used. These steps include: 1) establish objectives, 2) define level of effort, 3) specify assumptions, 4) define the base case and identify alternatives, 5) define analysis period and collect data, 6) estimate impacts (and costs, if appropriate) relative to the base case, 7) evaluate risk, and 8) compare impacts and rank alternatives. In the actual conduct of a study, it is important to note that the work may progress in an iterative fashion—with the analysis moving back and forth between steps.
- *Distinguishing short-term and long-term impacts*: Short-term impacts generally are associated with construction activities, including jobs, earnings, and tax base changes that result from the acquisition of private land for construction. These impacts generally only occur for a limited period of time (e.g. the construction period). Once the time period ends, these impacts no longer are generated. Long-term impacts, on the other hand, generally are associated with the operation of the project or program. In other words, these benefits are experienced as long as the project or program is in operation and include benefits such as user (travel time, travel cost, and accidents avoided savings), non-user, community, and economic benefits.
- *Considerations when selecting a modeling approach*: Models are a structured way of analyzing a problem. They can range from a matrix of screening criteria and associated scores for project alternatives—to a single regression equation or to a multi-equation econometric modeling system. Selection of a modeling approach—either tailoring an existing tool to the circumstances of the specific analysis or constructing a new spreadsheet or econometric model—is guided by four primary considerations: 1) type of study questions being addressed, 2) scale of the model, 3) availability of data, and 4) recognizing that multiple tools may be needed.

CHAPTER 7 User Benefits

This chapter focuses on estimating the user benefits that may be included in economic impact analyses or benefit cost analyses. It provides an overview of user benefits, what to consider when selecting a methodology, influence of other parts of the planning study on the user benefits estimation, when the user benefit analysis should be performed, and methods available to evaluate these benefits.

Chapter 7 Summary

Chapter 7 explores conducting a user benefit analysis as part of the transportation planning process. The chapter discusses:

- Definitions of the three types of user benefit measures
- Types of impacts that user benefits have
- Unique methodological considerations for user benefits analysis
- Other parts of the planning study that contribute to an economic analysis of user benefits
- When to do a user benefits analysis
- Evaluation methods.

7.1 Overview

User benefits are those transportation benefits that are experienced directly by the users of the proposed transportation investment(s). These benefits may include travel time, travel cost, and accidents avoided savings that are experienced as a result of using the new transportation investment(s).

- *Travel time savings*: The investment in the new/improved transportation facility may allow travelers who use the new or improved facility to make their trips in less time. The time that they save has value. The total value of this benefit is based on the amount of time saved (measured in hours) and the value of travelers' time (measured in dollars per hour). The quantity of travel time saved (in hours) is estimated by the travel demand or forecasting model. The value of travelers' time is based on local wage rates, the quantity of local and intercity travel, and the distribution of personal (leisure) and business travel.
- *Travel cost savings*: As travelers divert to the new/improved transportation investment (usually auto travelers switching to transit or another non-auto mode), the cost per passenger mile traveled may be reduced or total vehicle miles traveled (VMT) may be reduced—both resulting in a travel cost savings for users. The amount of VMT diverted or avoided altogether is estimated by the travel demand or forecasting model. The value of vehicle operating costs per mile can be applied to VMT diverted or avoided to obtain the estimate of costs saved. *In addition, if these users are now using transit, the cost of the transit trip must be netted out of the cost savings, as these transit trip expenses are new costs incurred by the travelers.*
- *Accidents avoided savings*: As auto travelers divert to the new/improved transportation facility (particularly transit or other safer modes of travel), their exposure to the hazard of being involved in a travel accident is reduced. This hazard reduction has value. The value is based on the degree to which travelers' exposure to risk is reduced and the potential cost if that risk materializes. The change in exposure to travel accident risk is based on the predicted amount of travel (VMT) and the comparative likelihood of a fatal, injury, or property damage only accident occurring when using the existing transportation facilities and the new/improved transportation facilities. The amount of VMT is estimated using the travel demand or forecasting model. Crash rates and average accident costs can be applied to VMT avoided to estimate the number of accidents avoided and the avoided costs associated with these accidents.

User benefits are direct impacts experienced by the users of the transportation project or program; because they do not involve transactions in the economy they do not generate significant indirect or induced benefits that would require an I-O or multiplier analysis. However, these benefits, particularly travel time savings, can be the catalyst for capital or monetary gain in the form of land premium and labor productivity benefits, and or the attraction of new residential and commercial development, which are estimated separately and included in the wider economic benefits discussed in Chapter 10.

7.2 What to Consider When Selecting a Methodology

As noted in Chapter 6, performing an economic analysis generally involves eight basic steps, regardless of the type of analysis or investment. The first three steps help establish the evaluation criteria and appropriate methodology to estimate the benefits, while the next five define the steps in the actual analysis or estimation of these benefits. As these are described in Chapter 6, they are not repeated here. However, the keys to selecting an appropriate methodology for the user benefits analysis are highlighted in this section.

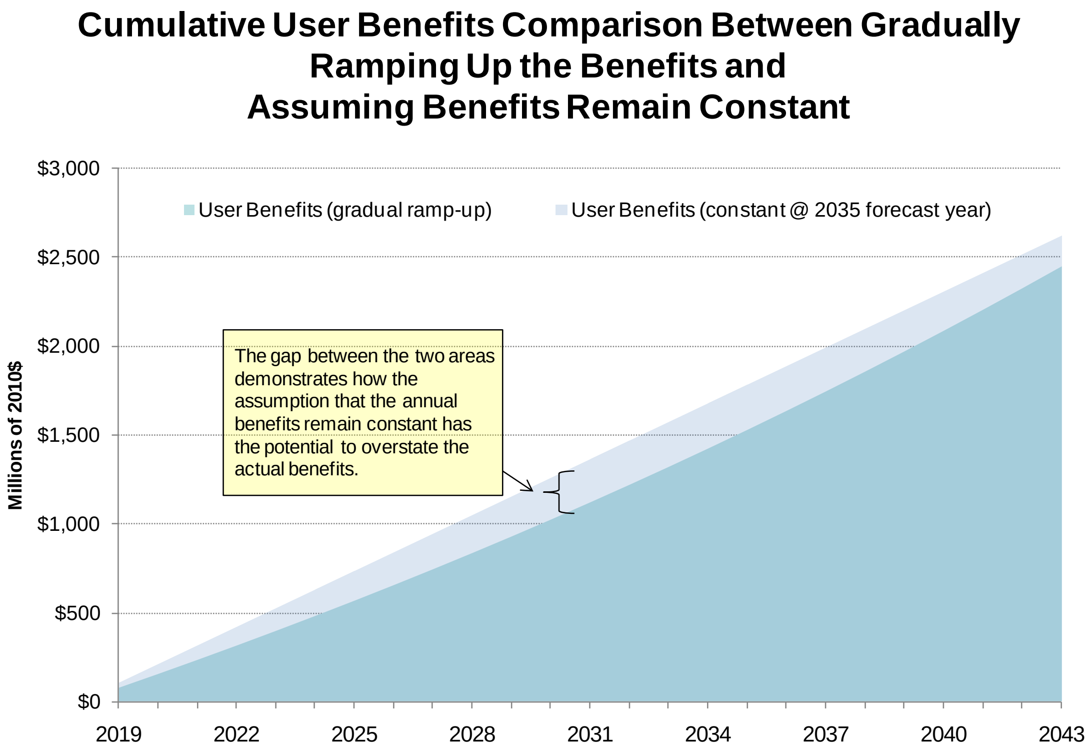
For a transportation project or program to be successful, it must solve a transportation problem. The problem may be one of physical access, congestion, reliability, or hazardous travel, but for the investment to generate either transportation user benefits or economic benefits, it first must solve a transportation problem. For example, a transportation project that has a high priority for encouraging economic development in a region must offer sufficient user benefits to encourage the attraction of new economic development in the region. As a result, the estimation or consideration of user benefits for any project or program likely will be one of the primary measures used to evaluate the transportation investment, regardless of whether an economic impact or benefit cost analysis is being conducted.

To evaluate user benefits several key assumptions need to be considered. These assumptions help frame the analysis and ensure that the assumptions that underpin the economic analysis are consistent with other parts of the project or program development process. The assumptions that help identify the appropriate methodology to estimate the user travel time, travel cost, and accidents avoided benefits include the following:

- *Future annual traffic or travel growth*: The travel demand or forecasting model generally provides results for one year in the future (i.e. the forecast year). Consequently, the results are annual results for that one forecast year. A BCA or EIA evaluates the impacts for a multiple year period, and therefore requires travel time savings for each year. In general, assuming the same travel time savings for each year in the analysis period is likely to over- or under-state the actual impacts (as shown in Figure 7-1) because travel volumes and associated benefits build up gradually to the forecast year and then may continue to increase in each year after the forecast year (assuming population and employment levels in the region are increasing).

  In order to account for this variation in annual benefits over time properly, the analysis should consider ramping up to the forecast year benefits and then, if appropriate, continue to grow the benefits in the years after the forecast year. Whether to assume an annual ramp up in the benefits, as well as the annual growth rate to apply, should be discussed with the travel demand or forecasting team members. However, a good rule of thumb for a reasonable annual growth rate strategy is not to exceed the population or employment growth in the corridor—which often are the main drivers of ridership growth (assuming no service changes). This assumption is conservative, as population and employment growth are likely to exceed traffic growth. Figure 7-1 demonstrates how assumptions regarding annual travel and user benefit growth can influence the cumulative benefits.

Figure 7-1: Influence of Assumptions Regarding Travel and User Benefit Growth



Source: AECOM

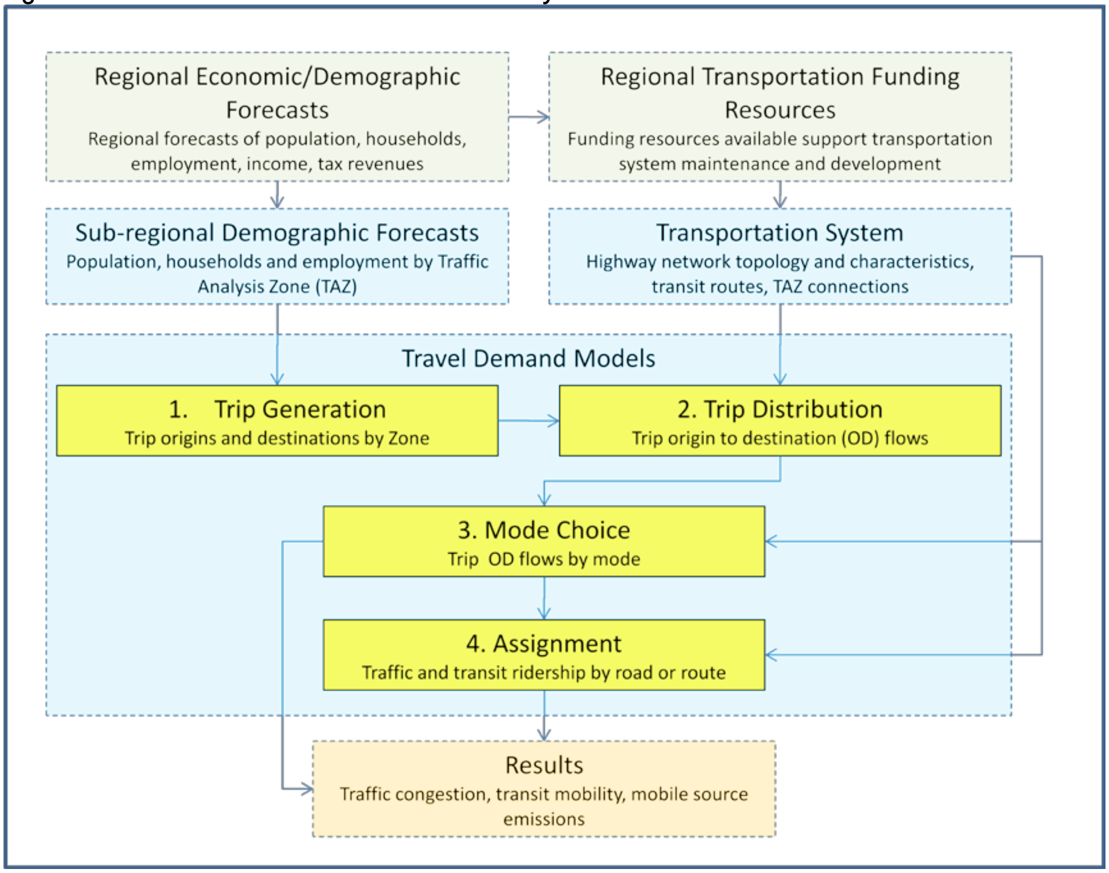
- *Discount rates and base year dollars*: When conducting a BCA, a base year dollar (a historic year to report all dollar amounts in, such as 2010) should be established as well as an appropriate discount rate to apply in the analysis. The establishment of a base year for dollar amounts ensures that all costs and benefits are reported in the same dollar values. The discount rate, on the other hand, allows the benefits and costs to be stated in a net present value so that the dollar amounts reflect the appropriate impact of time. If a project receives federal money, the US Office of Management and Budget (OMB) requires a 7.0 percent real discount rate to be applied in the analysis. However, this rate is rather steep given the recent interest rate history. Consequently, decision makers and project team members also may want to evaluate the impacts of a lower discount rate on the results of their analysis results.

7.3 Other Parts of the Planning Study that Contribute to the Economic Analysis

The monetization of user benefits associated with the transportation investments requires inputs from one primary area within the project or programming process—the travel demand or forecasting analysis model. The travel demand or forecasting process provides the economic analysis with essential data, such as VMT diverted, new transit riders, and travel time savings.

Travel demand forecasts and their underlying models are among the most visible elements of the regional planning process. Metropolitan Planning Organizations (MPOs) are responsible for preparing forecasts of traffic volumes, congestion, transit ridership, and emissions that underlie many important decisions, such as the determination of regional air quality conformity and investment in new highways and transit facilities. These regional and local economic analyses provide the foundation for projections of future year travel demand as shown in Figure 7-2.

Figure 7-2: Interaction between Economic Analysis and Travel Demand Forecasts



Source: AECOM

The travel demand modeling process begins with regional forecasts of economic activity that are used to predict future economic activity, jobs, and, eventually, population and households. These factors contribute to an understanding of the financial resources available to support ongoing transportation systems operation and enhancement. Regional economic forecasts also support the development of demographic forecasts of population, households, and employment in each geographic subdivision of the metropolitan area. These subdivisions are typically known as Traffic Analysis Zones or TAZs.

The formal travel modeling process begins with ***Trip Generation***, which uses estimates of population, households, and employment to determine the expected amount of travel beginning and ending in each TAZ. A detailed set of trip rates are used to estimate the number of work, shopping, and other trips produced in a zone from the number and composition of households in the TAZ. Employment and other indicators of economic activity are used to estimate the number of trips attracted to each zone.

The second step in the process, ***Trip Distribution***, links trips produced and attracted in each TAZ to produce a table of origin-to-destination flows. This process uses information on the highway and transit travel times to estimate the likelihood that residents of one TAZ will be employed or shop in another zone. This process accounts for the fact that persons doing grocery shopping are likely to do so relatively near home, while other trips such as employment are likely to occur at more distant locations.

Mode Choice uses the results of *Trip Distribution* to determine whether travelers walk, bike, use an automobile, or ride transit to complete each trip. Mode choice depends on the time and cost of each modal option together with information on the characteristics of each traveler, such as household income and auto ownership.

The fourth and final step is known as *Assignment*. This step involves determining the best path for each highway or transit trip to connect from the trip origin to the trip destination. At the conclusion of this step, the number of vehicles on each roadway and the number of riders on each bus or train are known.

The statistics generated by the mode choice and assignment steps, together, feed the overall transportation planning process with estimates of future year congestion, transit ridership, and mobile source emissions. These data are used by MPOs to determine whether the region will be in conformity with future year air quality requirements and to plan for investments in new highway and transit facilities.

The travel demand or forecasting analysis is based on decisions about how the investment will be built and operated—which are framed by the purpose and need of the project or program. As a result, the user benefits analysis is connected in some way to all aspects of the planning study because the user benefit are a quantification of the transportation travel impacts associated with each decision made about the construction and operation of the project or program.

7.4 When to do the Analysis

The best time to perform the user benefits analysis is at the end of each phase of the transportation planning process (e.g. EA and EIS). User benefits are a quantification of the travel choices associated with the construction and operation of the project or program. As a result, the user benefits cannot be finalized until these construction and operating plans have been completed and incorporated into the travel demand or forecasting analysis model.

The general principle that underpins this connection is that economic assessment does not produce information that defines the project or program. Rather, it evaluates the economic outcomes associated with the project or program that are defined through the planning process. This explains why the economic assessment cannot be coincident with planning efforts to estimate capital costs, travel demand modeling, and operations planning—because these tasks collectively define how the project will be built, operated, and used. The economic assessment then evaluates the economic outcomes associated with those project qualities.

7.5 Evaluation Methods

The methods for evaluating the user benefits associated with a transportation project or program include the use of both qualitative and quantitative analysis tools. The appropriate methodologies and tools are highly dependent upon the size and complexity of the project, the stage in the planning process (including evaluating project alternatives to selecting a project to construct), and the data available. The qualitative and quantitative options are summarized below.

Using Travel Demand Information to Calculate Benefits (13)

The Milton-Madison Bridge connects the communities of Madison, IN and Milton, KY. Built in 1929, the historic bridge is now both structurally and functionally obsolete. There are already weight restrictions on the use of the bridge, and recent inspection results (2009) indicate that the bridge life is limited to less than 10 years, *regardless of any repairs made to the existing structure.* Recognizing the critical role the bridge plays in the economic health of both communities, Milton and Madison collaborated to develop a BCA to demonstrate the value of replacing the bridge.

Without the bridge, current users would increase travel time and VMT, resulting in increased vehicle operating, safety, and environmental costs to cross to the other community. The next nearest river crossings are located at Markland Dam (26 miles upstream) and I-65 in Louisville (46 miles downstream). In order to understand how travel would change in the region if residents were unable to use the Milton-Madison Bridge, project sponsors and their consultant team applied the travel demand model to calculate the additional VMT required. They found that local residents would incur an additional 500,000 VMT daily, if they were forced to travel to another crossing. Based on transportation modeling as well as US EPA and US Department of Energy (DOE) guidance, maintaining the Milton-Madison Bridge at its current location avoids these additional VMT and results in as much as six million gallons of fuel saved and carbon reductions of 53,000 metric tons annually.

7.5.1 Quantitative

If the travel demand or forecasting model results are available to estimate the user benefits, these benefits generally can be monetized by an economic analyst or consultant without purchasing any economic models. These are direct benefits that do not result in significant indirect or induced benefits that would require the purchase of an I-O or other econometric model. However, if the project or program analysis is relatively complex or is for a large capital investment, an econometric model may be purchased—enabling the user to estimate a range of benefit types, including user benefits and other economic impacts.

7.5.1.1 Spreadsheet Analysis

An economic analyst or consultant can estimate the value of the user benefits associated with travel time, travel cost, and accidents avoided savings by developing a spreadsheet analysis.

However, this spreadsheet analysis requires interpreting and distributing data from the travel demand or forecasting model—as well as making assumptions about future travel growth, distribution of trips, accident rates, and values of time, vehicle operating costs, and accidents avoided. Chapter 12 addresses specific user benefit measures and what they mean, what data are needed to quantify these measures, and how the measures relate to other parts of the planning process. This discussion provides the framework for what needs to be considered and addressed in the spreadsheet analysis, as well as where to look for different sources of data.

7.5.1.2 Econometric Modeling

In addition, econometric models developed specifically for transportation investment analysis (as opposed to general econometric models that are applied for a transportation investment analysis) are likely to calculate the user benefits associated with travel time, travel cost, and accidents avoided savings. These models will require the user to input the results from the forecast year of the travel demand or forecasting model and validate other assumptions, including travel growth, distribution of trips, accident rates, and values of time, vehicle operating costs, and accidents avoided. Generally, more sophisticated econometric models require greater technical expertise of the user.

The use of econometric models to calculate user benefits only is relatively costly. However, if the model is being applied to estimate other aspects of the economic analysis, this may be a logical way to calculate the user benefits. In addition, the use of an econometric model developed specifically for transportation studies will provide a methodology that has a proven track record, using nationally accepted methodologies.

7.5.2 Qualitative

The emphasis on quantifiable impacts in economic assessment does not in any way suggest that non-quantifiable project outcomes are not important. They can be critical in choosing an alignment or selecting an alternative. The emphasis on quantification reflects the economic analyst's effort to put all impacts into a common metric in order to make a comprehensive assessment and to understand which types of impacts are most influential in making the case for or against a project or program.

That said, when some outcomes cannot be monetized, it is incumbent upon the economic analyst to provide a qualitative discussion of effects and any information available on their scope. Omitting information on outcomes because it cannot be monetized provides decision makers with an incomplete picture of the overall impact of the project or program and can lead to bad decisions, particularly regarding environmental or livability impacts. Alternately, the error can reverse in direction; a good project can be passed over for funding because some of the more difficult to describe or estimate impacts are omitted—leading it to be undervalued in the assessment.

A qualitative approach to user benefit analysis is needed if the project or program evaluation does not include a travel demand or forecasting analysis—or if the travel demand or forecasting model cannot provide estimates of travel time saved, new users, and reductions of VMT. When conducting a qualitative assessment of user benefits, the discussion should focus on the following:

- Types of user benefits expected—including whether travel time, travel cost, and/or accidents avoided savings would be generated by the project or program
- Who would experience these benefits—including specific populations or communities served by the project or program
- Magnitude of these benefits—including a relative scale or ranking of the potential impacts of each project alternative or program scenario (e.g. high, moderate, low) as well as a description of how these rankings were selected
- Potential risks to user benefits—including the identification of which project components (e.g. alignment, operating plans, and/or demographic growth) would have the greatest impact on the user benefit analysis.

7.5.3 Risks

Because the estimation of user benefits is based on assumptions about the future, there are many elements of risk associated with the analysis. It is essential that these risks are identified and analyzed sufficiently to determine how likely it is that they could occur and the resulting impacts on the project or program evaluation. The areas of greatest risk associated with each of the user benefits are highlighted below.

- *Travel time savings*: The greatest risks associated with the travel time benefits are those associated with the forecasts of travel time saved for each project or program alternative. As a result, it might be of value to perform a sensitivity analysis on the user travel time savings using estimates of travel time saved that are lower than those forecasted. The results of this test provide decision makers with a better understanding of how sensitive the ranking of the project or program is to changes in travel time saved.
- *Travel cost savings*: The greatest risks associated with the travel cost benefits are those associated with the forecasts of VMT avoided and the number of new transit trips (for transit projects). As a result, it might be of value to perform a sensitivity analysis on the user travel cost savings using estimates of VMT avoided and/or a number for new transit trips that are lower than forecasted. The results of this test provide decision makers with a better understanding of how sensitive the ranking of the project or program is to changes in VMT avoided and/or new transit trips.
- *Accidents avoided savings*: As with travel cost savings, the greatest risks associated with the accidents avoided benefits are those associated with the forecasts of VMT avoided. As a result, it might be of value to perform a sensitivity analysis on the user accidents avoided savings using estimates of VMT avoided that

are lower than those forecasted. The results of this test provide decision makers with a better understanding of how sensitive the accidents avoided ranking of the project or program is to changes in VMT avoided.

The risk assessment also should discuss the potential risks to travel time, travel cost, and accidents avoided benefits qualitatively, including the source of these risks, likelihood of the risks, and opportunities to mitigate these risks.

7.6 Chapter Conclusion

This chapter focused on the consideration of user benefits in economic analysis. User benefits are those transportation benefits that are experienced directly by the users of the proposed transportation investment(s), and include travel time, travel cost, and accidents avoided savings that are experienced as a result of using the new transportation investment(s).

For a transportation project or program to be successful, it first must solve a transportation problem. The problem may be one of physical access, congestion, reliability, or hazardous travel, but for the investment to generate either transportation user benefits or economic benefits, it must solve a transportation problem. As a result, the estimation or consideration of user benefits for any project or program likely will be one of the primary measures used to evaluate the transportation investment, regardless of whether an economic impact or benefit cost analysis is being conducted.

The monetization of user benefits associated with the transportation investment requires data (such as VMT diverted, new transit riders, and travel time savings) from one primary area within the project or programming process—the travel demand or forecasting analysis model. The travel demand or forecasting analysis, in turn, is based on decisions about how the project or program will be built and operated—which are framed by its purpose and need. As a result, the user benefits analysis is connected in some way to all aspects of the planning study because the user benefits are a quantification of the transportation travel impacts associated with each decision made about the construction and operation of the project or program. Given this dependence on specific project definitions and travel forecasting analysis, user benefits traditionally are estimated towards the end of each phase of the transportation planning process.

CHAPTER 8 Non-User Benefits

This chapter focuses on estimating the non-user benefits that may be included in economic impact analyses or benefit cost analyses. It provides an overview of non-user benefits, what to consider when selecting a methodology, influence of other parts of the planning study on the non-user benefits estimation, when the non-user benefits analysis should be performed, and methods available to evaluate these benefits.

Since this chapter deals with many of the same savings as user benefits, much of the information provides hyperlinks to Chapter 7 for additional details. They key consideration in this chapter is the differences between user and non-user benefits.

Chapter 8 Summary

Chapter 8 explores conducting a non-user benefit analysis as part of the transportation planning process. The chapter discusses:

- Definitions of the three types of non-user benefit measures
- Types of impacts that non-user benefits have
- Unique methodological considerations for non-user benefits analysis
- Other parts of the planning study that contribute to an economic analysis of non-user benefits
- When to do a non-user benefits analysis
- Evaluation methods.

8.1 Overview

Non-user benefits are those transportation benefits that are experienced by people who are not using the new transportation investment(s) directly. Like user benefits, these may include travel time and accidents avoided savings. However, non-user benefits represent those benefits experienced on parallel facilities as more people divert to the new transportation investment(s).

- *Travel time savings*: The investment in the new/improved transportation facility may allow travelers who use parallel facilities to make their trips in less time—as more people divert to the new transportation investment. The time that they save has value. The total value of this benefit is based on the amount of time saved (measured in hours) and the value of travelers' time (measured in dollars per hour). The quantity of travel time saved (in hours) for non-users may be estimated by the travel demand or forecasting model. The value of travelers' time is based on local wage rates, the quantity of local and intercity travel, and the distribution of personal (leisure) and business travel.
- *Accidents avoided savings*: As auto travelers divert to the new/improved transportation facility (particularly transit or other safer modes of travel), or as truck freight is collected on a new truck only route or diverted to rail, exposure to the hazard of being involved in a travel accident is reduced for travelers who remain on the existing facilities. This hazard reduction has value. The value is based on the degree to which travelers' exposure to risk is reduced and the potential cost if that risk materializes. The change in exposure to travel accident risk is based on the predicted amount of travel (VMT) and the comparative likelihood of a fatal, injury, or property damage only accident occurring using the existing transportation facilities and the new/improved transportation facilities. The amount of VMT is estimated using the travel demand or forecasting model. Crash rates and average accident costs can be applied to non-user VMT avoided to estimate the number of accidents avoided and the avoided costs associated with these accidents.

8.2 What to Consider When Selecting a Methodology

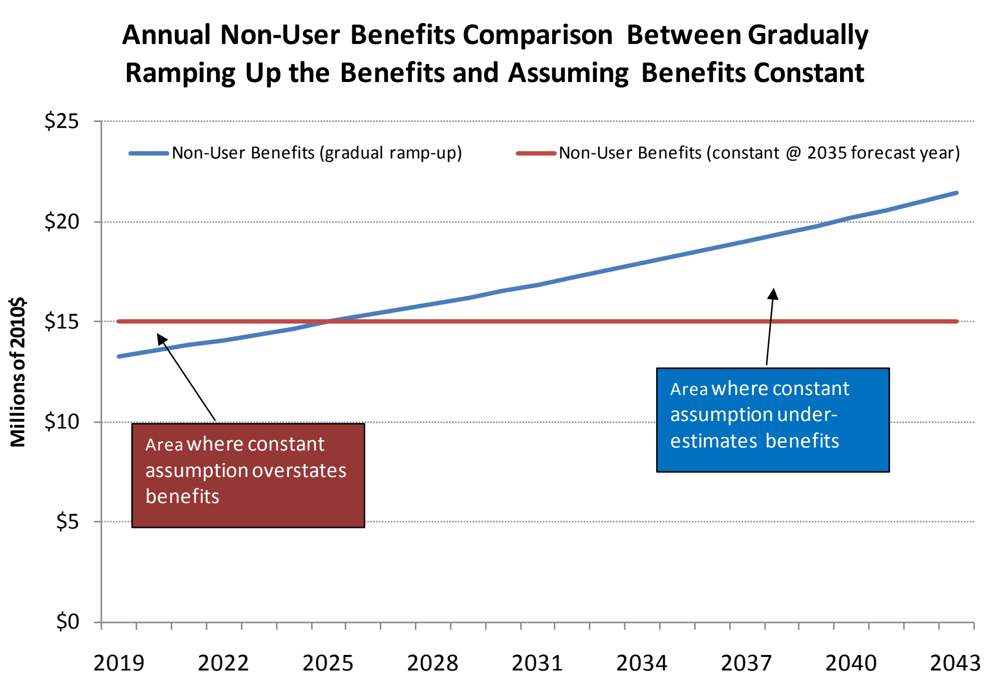
As noted in Chapter 6, performing an economic analysis generally involves eight basic steps, regardless of the type of analysis or investment. The first three steps help establish the evaluation criteria and appropriate methodology to estimate the benefits, while the next five define the steps in the actual analysis or estimation of these benefits. As these are described in Chapter 6, they are not repeated here. However, the keys to selecting an appropriate methodology for the non-user benefits analysis are highlighted in this section.

The methodology for user and non-user benefits analysis is similar. In order to generate non-user benefits, the transportation project or program first must solve a transportation problem and create user benefits. These user benefits result in the diversions of travelers to the new facility—frequently resulting in fewer users and less congestion on parallel facilities. As a result, the estimation or consideration of non-user benefits for any project or program likely will be an important measure (although secondary to user benefits) to evaluate the transportation investment, regardless of whether an economic impact or benefit cost analysis is being conducted.

To evaluate the non-user benefits several key assumptions need to be considered. These assumptions help frame the analysis and ensure that the assumptions that underpin the economic analysis are consistent with other parts of the project or program development process. The assumptions necessary to evaluate non-user benefits are similar to those discussed in the user benefits chapter and are referenced below.

- *Future annual traffic or travel growth*: The travel demand or forecasting model generally provides results for one year in the future (i.e. the forecast year). A BCA or EIA, on the other hand, evaluates the impacts for a multiple year period and, as such, requires non-user savings for each year. In general, assuming the same non-user benefits for each year in the analysis period is likely to over- or under-state the actual impacts, as shown in Figure 8-1, because travel volumes and associated benefits build up gradually to the forecast year and then may continue to increase in each year after the forecast year (assuming population and employment levels in the region are increasing). See user benefits section for more details (7.2).

Figure 8-1: Influence of Assumptions Regarding Travel and Non-User Benefit Growth



Source: AECOM

- *Discount rates and base year dollars*: When conducting a BCA, a base year dollar (a historic year to report all dollar amounts in, such as 2010) should be established as well as an appropriate discount rate to apply in the analysis. See user benefits section for more details (7.2).

8.3 Other Parts of the Planning Study that Contribute to the Economic Analysis

The monetization of non-user benefits associated with the transportation investment requires inputs from one primary area within the project or programming process—the travel demand or forecasting analysis model. See user benefits section on travel demand modeling in economic analysis for more details (7.3).

The travel demand or forecasting analysis is based on decisions about how the investment will be built and operated—which are framed by the purpose and need of the project or program. As a result, the non-user benefit analysis is connected in some way to all aspects of the planning study, because the non-user benefits are a quantification of the transportation travel impacts associated with each decision made about the construction and operation of the project or program.

8.4 When to do the Analysis

The best time to perform the non-user benefits analysis is at the end of each phase of the transportation planning process (e.g. EA and EIS). Like user benefits, non-user benefits are a quantification of the travel choices associated with the construction and operation of the project or program. As a result, the non-user benefits cannot be finalized until these construction and operating plans have been completed and incorporated into the travel demand or forecasting analysis model.

The general principle that underpins this connection is that economic assessment does not produce information that defines the project or program. Rather, it evaluates the economic outcomes associated with the project or program that are defined through the planning process. This explains why the economic assessment cannot be coincident with planning efforts to estimate capital costs, travel demand modeling, and operations planning—because these tasks collectively define how the project or program will be built, operated, and used. The economic assessment then evaluates the economic outcomes associated with those project qualities.

8.5 Evaluation Methods

The methods for evaluating the non-user benefits associated with a transportation project or program include the use of both qualitative and quantitative analysis tools. The appropriate methodologies and tools are highly dependent upon the size and complexity of the project, the stage in the planning process (including evaluating project alternatives to selecting a project to construct), and the data available. The qualitative and quantitative options are summarized below.

8.5.1 Quantitative

If the travel demand or forecasting model results are available to estimate the non-user benefits, these benefits generally can be monetized by an economic analyst or consultant without purchasing any economic models. However, if the project or program analysis is relatively complex or is for a large capital investment, an econometric model may be purchased—enabling the user to estimate a range of benefit types, including non-user benefits and other economic impacts.

8.5.1.1 Spreadsheet Analysis

An economic analyst or consultant can estimate the value of the non-user benefits associated with travel time, travel cost, and accidents-avoided savings by developing a spreadsheet analysis. However, this spreadsheet analysis requires interpreting and distributing data from the travel demand or forecasting model—as well as making assumptions about future travel growth, distribution of trips, accident rates, and values of time, vehicle operating costs, and accidents avoided. Chapter 12 addresses specific non-user benefit measures and what they mean, what data are needed to quantify these measures, and how the measures relate to other parts of the planning process. The discussion in Chapter 12 provides the framework for what needs to be considered and addressed in the spreadsheet analysis, as well as where to look for different sources of data.

8.5.1.2 Econometric Modeling

Econometric models developed specifically for transportation investment analysis (as opposed to general econometric models that are applied for a transportation investment analysis) are likely to calculate the non-user benefits associated with travel time, travel cost, and accidents avoided savings. The user benefits section on econometric modeling discusses the data required in more detail (7.5.2.2).

The use of econometric models to calculate non-user benefits only is relatively costly. However, if the model is being applied to estimate other aspects of the economic analysis, this may be a logical way to calculate the non-user benefits if the requisite input data are available. In addition, the use of an econometric model developed specifically for transportation studies will provide a methodology that has a proven track record, using nationally-accepted methodologies.

8.5.2 Qualitative

The emphasis on quantifiable impacts in economic assessment does not in any way suggest that non-quantifiable project outcomes are not important. They can be critical in choosing an alignment or selecting an alternative. The emphasis on quantification reflects the economic analyst's effort to put all impacts into a common metric in order to make a comprehensive assessment and to understand which types of impacts are most influential in making the case for or against a project or program.

That said, when some outcomes cannot be monetized, it is incumbent upon the economic analyst to provide a qualitative discussion of effects and any information available on their scope. Omitting information on outcomes because it cannot be monetized provides decision makers with an incomplete picture of the overall impact of the project or program and can lead to bad decisions, particularly regarding environmental or livability impacts. Alternately, the error can reverse in direction; a good project can be passed over for funding because some of the more difficult to describe or estimate impacts are omitted—leading it to be undervalued in the assessment.

A qualitative approach to non-user benefit analysis is needed if the project or program evaluation does not include a travel demand or forecasting analysis—or if the travel demand or forecasting model cannot provide estimates of non-user travel time saved and non-user reductions of VMT. When conducting a qualitative assessment of non-user benefits, the discussion should focus on the following;

- Types of non-user benefits expected—including whether and how non-user travel time, travel cost, and/or accidents avoided savings would be generated by the project or program
- Who would experience these benefits—including specific populations or communities
- Magnitude of these benefits—including a relative scale or ranking of the potential impacts of each project alternative or program scenario (e.g. high, moderate, low), as well as a description of how these rankings were selected
- Potential risks to non-user benefits—including the identification of which project components (e.g. alignment, operating plans, and/or demographic growth) would have the greatest impact on the non-user benefit analysis.

8.5.3 Risks

Because the estimation of non-user benefits is based on assumptions about the future, there are many elements of risk associated with the analysis. It is essential that these risks are identified and analyzed sufficiently to determine how likely it is that they could occur and the resulting impacts on the project or program evaluation. The areas of greatest risk associated with each of the non-user benefits are highlighted below.

- *Travel time savings*: The greatest risks associated with the non-user travel time benefits are those associated with the forecasts of non-user travel time saved for each project or program alternative. As a result, it might be of value to perform a sensitivity analysis on the non-user travel time savings using estimates of travel time saved that are lower than those forecasted. The results of this test provide decision makers with a better understanding of how sensitive the ranking is to changes in non-user travel time saved.
- *Accidents avoided savings*: The greatest risks associated with the non-user accidents avoided benefits are those associated with the forecasts of non-user VMT avoided. As a result, it might be of value to perform a sensitivity analysis on the non-user accidents avoided savings using estimates of non-user VMT avoided that are lower than those forecasted. The results of this test provide decision makers with a better understanding of how sensitive the ranking of the project or program is are to changes in non-user VMT avoided.

The risk assessment also should discuss the potential risks to non-user travel time and accidents avoided benefits qualitatively, including the source of these risks, likelihood of the risks, and opportunities to mitigate these risks.

8.6 Chapter Conclusion

This chapter focused on the consideration of non-user benefits in economic analysis. Non-user benefits include the similar transportation benefit types as user benefits—travel time and accident reduction savings. However, the difference lies in who experiences these benefits. Non-user benefits are those transportation benefits that are experienced by people who are not using the new transportation investment(s) directly. These benefits may include travel time and accidents avoided savings that are experienced on parallel facilities as more people divert to the new transportation investment(s).

The monetization of non-user benefits associated with the transportation investment requires data (such as VMT diverted and travel time savings for non-users) from one primary area within the project or programming process—the travel demand or forecasting analysis model. The travel demand or forecasting analysis, in turn, is based on decisions about how the project or program will be built and operated—which are framed by its purpose and need. As a result, the non-user benefit analysis is connected in some way to all aspects of the planning study because the non-user benefits are a quantification of the transportation travel impacts associated with each decision made about the construction and operation of the project or program.

Given this dependence on specific project definitions and travel forecasting analysis, non-user benefits traditionally are estimated towards the end of each phase of the transportation planning process (e.g. EA and EIS). However, not all travel demand or forecasting analyses will be able to differentiate between users and non-users. If the disaggregated non-user data are not available, then non-user benefits are included in the user benefit estimation and should not be estimated again.

CHAPTER 9 Community Benefits

This chapter focuses on the analysis of community benefits that may be included in economic impact analyses or benefit cost analysis. It provides an overview of community benefit types, what to consider when selecting a methodology, influence of other parts of the planning study on the community benefits estimation, when the community benefit analysis should be performed, and methods available to evaluate these benefits.

Chapter 9 Summary

Chapter 9 explores conducting a community benefit analysis as part of the transportation planning process. The chapter discusses:

- Definitions of community benefits and their connection and overlap with other measures
- Examples of community benefits
- Other parts of the planning study that contribute to an economic analysis of community benefits
- When to do a community benefit analysis
- Evaluation methods.

9.1 Overview

Community benefits are experienced by the entire community within the project area, not just a select group, such as users or non-users. Beneficiaries include people who live, work, or visit the area. These benefits, also sometimes called public or livability benefits, include but are not limited to environmental (e.g. air quality, water quality, light, noise), fiscal impacts, greater walkability (see case study presented later in this chapter), greater access for transit-dependent populations, greater access to jobs from existing housing locations, and greater access to recreational benefits. The preceding list includes a tremendous variety of potential outcomes. The common element is that community benefits or impacts are secondary outcomes or byproducts of transportation investment that occur when the new transportation facilities are integrated into regional plans and programs to achieve broader community goals and objectives. Thus, the variety of potential community benefits or impacts is as diverse as the range of community goals and objectives.

Although the primary motivation for making a transportation investment typically is to improve accessibility, safety, or mobility—impacts measured by user benefits (see Chapter 7)—transportation investment also can help achieve other community goals and objectives, such as generating more economic outcomes by leveraging financial resources and using the transportation planning process to advance supportive projects, policies, or decisions. Many of these benefits are not quantifiable and must be discussed qualitatively—stating what the benefits are and who the beneficiary groups are.

9.2 What to Consider When Selecting a Methodology

As noted in Chapter 6, performing an economic analysis generally involves eight basic steps, regardless of the type of analysis or investment. The first three steps help establish the evaluation criteria and appropriate methodology to estimate the benefits, while the next five define the steps in the actual analysis or estimation of these benefits. As these are described in Chapter 6, they are not repeated here. However, the keys to selecting an appropriate methodology for the community benefits analysis are highlighted in this section.

As noted above, the variety of benefit types that fall under the heading “community benefits” is much more diverse than those typically considered for user or non-user benefits. As a result, the variety of data sources utilized in their analysis is much greater as well. It is common for project data to be supplemented by a variety of data sources—many that are non-traditional from a transportation perspective. For example, a recreational benefits analysis might collect information on the number of visitors to a neighborhood park or number of visitors and length of stay for a

Walkability Case Study *(14)*

With the growing emphasis within the transportation planning community to include improvements to the pedestrian experience, economists have begun to explore ways to quantify these outcomes. In particular, walkability is the degree to which an area within walking distance of a specific location encourages walking for recreation or for errands. Planners are interested in walkability for a variety of reasons—as a viable alternative mode of transportation for short distance trips, to reduce the incidence of preventable illnesses tied to obesity and inactivity, and to reinforce and create desirable places to live and work.

Economic theory suggests that if walkability is an amenity that increases the preference for locations, then real estate in more walkable neighborhoods would have higher land values than similar properties in less walkable neighborhoods—all other factors held equal. Emerging research has begun to document this connection.

Using Walk Score, a measure that rates the walkability of a location by determining the distance to educational, retail, food, recreational, and entertainment destinations, economists Gary Pivo and Jeffrey Fischer tested whether commercial properties with high walk scores also had higher property values. The authors are careful to note that any economic value associated with greater walkability may reflect the value of greater accessibility by other travel modes as well. That said, the authors argue that "the fact that walkability may produce accessibility benefits for non-walkers does not diminish the validity of any findings that walkable urban form is associated with higher property values. It only means that it brings with it an indivisible package of benefits that accrue to other forms of transportation as well." *(15)*

The researchers estimated hedonic equations that relate the financial performance of a commercial property to characteristics of the property. Hedonic regression is a method of estimating value by decomposing an item into its characteristics and obtaining a value of each. It is widely used in real estate economics. For example, in the walkability research, Pivo and Fischer investigated how the financial performance of a property varied with the walkability, regional supply, regional demand, regional property market conditions, national property market performance, individual building characteristics, local security conditions, property tax rates, density, transit access, journey to work time, regional congestion, and state location.

Pivo and Fischer found a positive correlation between walkability scores and property value, controlling for all the other variables noted above. In particular, a 1.0 unit increase in the Walk Score was associated with a 0.9 percent premium for office properties, a 0.9 percent premium for retail properties, and a 0.1 percent premium for apartment properties. The findings suggest that the efforts of planners and the private sector efforts to create walkable environments have the potential to yield positive returns on investment.

large state or national park with camping facilities. Additionally, fiscal impacts may be estimated by collecting information on parcel values from the assessor's office and tax rates from the taxing jurisdiction.

As described in Chapter 4, a BCA also requires the comparison of the incremental change between a base line (or a without project or program scenario) and an improvement (or with project or program scenario). In order to make this comparison and defend it, the analyst must consider whether the community baseline can be projected credibly. While project activities likely have collected or developed forecasts of employment, population, and travel characteristics already, it is much less likely that they have developed forecasts of recreational park visits, walkability, or land values. As a result, the analyst must evaluate whether these projections can be made credibly in the context of the analysis on the basis of other known variables. For example, one might forecast visitation to a neighborhood park based on the historical ratio of observed visits to population within a mile of the park. If that ratio has been constant historically, then the ratio could be applied to projections of future population within the same mile of the park to estimate future park visitation.

The availability of data and forecasts is an important consideration in the selection of a methodology—as it may not be practical in terms of available time or budget to assemble and analyze the supplemental data needed to construct a community benefits analysis. Or, it may be that some local jurisdictions do not have the requisite data that would allow the assessment to be made.

An additional question in deciding whether to do the analysis is whether the community benefit is truly a "new" benefit, or rather, is captured in another part of the analysis. In developing the analysis, avoiding double counting is one of the most important considerations.

Finally, as noted elsewhere in the Guidebook, if an impact or benefit cannot be quantified, it still should be described qualitatively. It is essential that decision makers have as complete an understanding as possible of the potential benefits that a project, program, or policy might have when making their determination.

9.3 Other Parts of the Planning Study that Contribute to the Economic Analysis

The consideration of the community benefits of a transportation investment can touch on most other parts of the project or program development process. As community benefits may entail issues of equity, the environment, health, walkability, and more broadly—quality of life, the range of potential inputs from other parts of the planning study is particularly large. ***The general principle that underpins this connection is that economic assessment does not produce information that defines the project or program. Rather, it evaluates the economic outcomes associated with the project or program that are defined through the planning process.*** This explains why the economic assessment cannot be coincident with planning efforts to estimate capital costs, travel demand modeling, and operations planning—because these tasks collectively define how the project or program will be built, operated, and used. The economic assessment then evaluates the economic outcomes associated with those project or program qualities.

The planning and economics team must work closely to ensure that the economic assessment draws on all relevant information produced as part of the project development process. The estimation of air quality benefits draws on information directly from the travel demand or forecasting modeling, which provides a gauge of the change in VMT. The estimation of fiscal impacts may be generated using information on the ROW that is developed by the engineering team. This may entail either the identification of property acquisitions needed to assess the effects on local tax revenues due to conversion from a private use to a public one, or alternatively, the identification of parcels that might become more valuable due to their proximity to the new transportation facility (see land productivity discussion in Chapter 10).

9.4 When to Conduct a Community Benefits Analysis

The question of when to include an assessment of community benefits depends on the context in which the analysis is being conducted. It would be very unusual for an economic study of a transportation project to focus on community benefits alone without also evaluating the user or non-user benefits associated with a project or program. Rather, community benefit assessments are typically an element of a larger study. In the case of the preparation of an environmental document, the community benefits are identified as elements of the environmental document. Similarly, certain grant funding applications have requirements to consider community benefits. Sometimes there are special interests among project stakeholders about a project's impact or the collective impact of a program of projects. Investing in an economic analysis to document the community benefits can help project sponsors articulate the broader benefit of the project or program to the community. It can help to answer the "why invest" question for voters and taxpayers who may not be direct beneficiaries of the investment. Additionally, in the case of benefit cost analysis, best practice is to be as comprehensive as possible in the consideration of potential benefits.

A final consideration in the decision about whether to include community benefits in the economic study is the recognition that small incremental transportation investments can have a large and measurable effect on quality of life in a community. In other words, a large-scale project is not a prerequisite for a project to have a big effect on a community.

9.5 Evaluation Methods

As noted above, because the estimation of community benefits encompasses a particularly wide range of potential benefit types, there is no standard methodological recipe for these benefits. From the perspective of a planner managing an economic study, the analysis should be transparent, and it should address the motivations for doing the study. If, for example, the project is the construction of a pedestrian walkway over a busy arterial, some part of the analysis should discuss the connectivity between the neighborhoods on each side of the arterial. To ignore this aspect in the analysis is to ignore the reason for the project. Depending on the scale of the study and the available data, the assessment can be qualitative and quantitative. In the discussion that follows, methods are identified for the most common community benefits considered. General considerations are also provided to assist in cases where community benefits may be unique to a specific locality.

9.5.1 Quantitative

If the travel demand or forecasting model results and supplementary data are available, some community benefits may be estimated and monetized by an economic analyst or consultant. Typically these estimates can be completed with thoughtful spreadsheet analysis.

- *Emissions avoided*: Air quality impacts are estimated using information on VMT reduced or diverted to another cleaner mode of travel. The travel demand model provides this estimate. A potential impact of a project or program on air quality arises both from the diversion or reduction of VMT, and from the aggregation of compact mixed-use development patterns. This development pattern allows people to conduct at least some of their daily lives without using automobiles or transit—the "trip not taken." It also allows more energy-efficient construction, heating, and cooling. The carbon footprint and greenhouse gases (GHG) profile of a corridor is, in part, a direct outgrowth of its community characteristics, which in turn reflects the transportation-land use nexus. While research is emerging to quantify this latter effect, the benefit of compact development also may be discussed qualitatively as an addition to the quantification of diverted or reduced VMT.
- *Greater access for transit dependent populations*: This estimate can be generated through GIS analysis of the data that underpins the environmental justice analysis of an environmental document and travel demand modeling. Typically, as part of the project's development, planners have evaluated the difference in travel times with and without the project. Using this same metric, a GIS analysis can calculate the difference in the spatial area accessed within a 30 or 45 minute travel time and the job opportunities associated with that greater access.
- *Fiscal impacts*: This estimate quantifies the change (increase or decrease) in tax revenues available to a jurisdiction for providing community services that result from a change in underlying property value. It is a straightforward application of the community's tax rate for each property type applied to the value of the land for parcels affected by the project or program. The parcel values are acquired from the assessors' records.

There are, however, many more potential community benefits that might arise in the context of a study. The underlying strategy is to collect what is known about the benefit and describe it objectively for the decision makers. If it can be quantified, do it. If not, to the extent possible, describe how many beneficiaries there are, who they are, where they are, and how this might change in the future.

9.5.2 Qualitative

The emphasis on quantifiable benefits in economic assessment does not in any way suggest that non-quantifiable project outcomes are not important. They can be critical in choosing an alignment or selecting an alternative. The emphasis on quantification reflects the economic analyst's effort to put all benefits into a common metric in order to make a comprehensive assessment and to understand which types of benefits are most influential in making the case for or against a project or program.

That said, when some outcomes cannot be monetized, it is incumbent upon the economic analyst to provide a qualitative discussion of effects not included and any information available on their scope. Omitting information on outcomes because it cannot be monetized provides decision makers with an incomplete picture of the overall benefit of the project or program and can lead to bad decisions. Alternately, the error can reverse in direction; a good project can be passed over for funding because some of the more difficult to describe or estimate benefits are omitted—leading it to be undervalued in the assessment.

When conducting a qualitative assessment of community benefits, the discussion should focus on the following;

- Types of community benefits expected—including number of employees, residents, or visitors who would be affected by the project or program
- Who would experience these benefits—including specific populations or communities served by the project or program
- Magnitude of these benefits—including a relative scale or ranking of the potential benefits of each project alternative or program scenario (e.g. high, moderate, low), as well as a description as to how these rankings were selected
- Potential risks to these benefits—including the identification of which project components (e.g. alignment, operating plans, and/or demographic growth) would have the greatest effect on the benefit analysis.

9.6 Chapter Conclusion

The assessment of community benefits complements the assessment of other outcomes such as user and non-user benefits. While certain types of analysis require their inclusion—environmental impact statements and select grant programs—good analytical practice argues for their inclusion in order to provide a complete assessment of the project or program outcomes. The question really is the level of detail with which they are addressed. This level is determined by whether the data and resources are available to conduct the analysis. Inclusion of community benefits can be useful in communicating the contribution of the project or program to key stakeholder groups and the broader public.

CHAPTER 10 Wider Economic Benefits

This chapter describes the introduction of wider economic benefits into the assessment of transportation projects or programs. It identifies the types of benefits that typically fall under the umbrella-term "wider economic benefits," provides an overview of each type of benefit, discusses what types of projects might have these benefits, describes connections to other parts of the planning study, and provides an overview of the methods available to evaluate these benefits.

Chapter 10 Summary

Chapter 10 addresses the emergence of wider economic benefits in the assessment of transportation projects or programs. The chapter discusses:

- Definitions of wider economic benefits
- Potential wider economic benefit measures
- What to consider when selecting a methodology
- Other parts of the transportation planning study that contribute to an economic analysis of wider economic benefits
- When to do the analysis
- Evaluation methods.

10.1 Overview

The economic assessment of transportation investment is not a static field. All of the following have combined to advance the state of practice and allow economic analysts to quantify project outcomes that previously were described only qualitatively in economic assessments:

- Decision makers' need for a complete assessment of performance for a project or program
- Increasing interest in how transportation infrastructure supports economic competitiveness
- Greater emphasis on formal project or program justification and evaluation
- Advances in economic research.

The emphasis on quantifiable benefits in economic assessment does not in any way suggest that non-quantifiable project outcomes are not important. Best practice for economic evaluation specifies that non-quantifiable benefits be identified and discussed qualitatively in the assessment to provide the decision makers with as complete a picture as possible of the likely outcomes for the project or program.

The emphasis on quantifiable benefits in economic assessment does not in any way suggest that non-quantifiable project outcomes are not important. They can be critical in choosing an alignment or selecting an alternative. The emphasis on quantification reflects the economic analyst's effort to put all benefits into a common metric in order to make a comprehensive assessment and to understand which types of benefits are most influential in making the case for or against a project or program.

That said, when some outcomes cannot be monetized, it is incumbent upon the economic analyst to provide a qualitative discussion of effects not included and any information available on their scope. Omitting information on outcomes because it cannot be monetized provides decision makers with an incomplete picture of the overall benefit of the project or program and can lead to bad decisions. Alternately, the error can reverse in direction; a good project can be passed over for funding because some of the more difficult to describe or estimate benefits are omitted—leading it to be undervalued in the assessment.

Recognizing the value of a complete—and to the degree possible—uniformly quantifiable assessment, transportation economists have begun to expand the range of benefits estimated in their analyses. Reflecting the expansion of economic outcomes considered and scope of project evaluation, these benefit types fall under the umbrella-term "wider economic benefits." While this is an evolving field within transportation economic assessments, the three main types of wider economic benefits coming into more common use within empirical analyses are described below.

- *Agglomeration impacts*: The term agglomeration refers to the concentration of economic activity within a region. Transportation investment that significantly reduces travel time between cities or increases the ability to move large numbers of people in and out of an urban market improves accessibility—increasing the number of workers and suppliers of other goods and services accessible to a firm. As a result, the range of choice expands, and firms are able to select those workers and suppliers that represent the best "match" for their needs. When the match between workers and firms—or between suppliers and producers—improves, the productivity of the market increases because firms are using workers with the best skill set for their needs and suppliers are using specialized expertise that best fits their needs. This is the agglomeration benefit. Past theoretical and empirical evidence has confirmed that the level of agglomeration affects the productivity of firms and workers in an area, even after controlling for characteristics specific to firms and workers in that area, such as the mix of industries. *(16)*

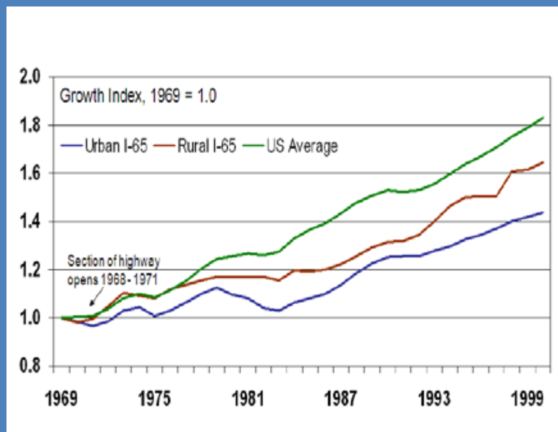
- *Land premium impacts*: Just as labor markets become more productive when accessibility improves, the value of land improves as well. Residents and commercial enterprises will be willing to pay a premium for locations where access is improved relative to other locations without good transportation access. Studies have shown that an increase in property values near transit lines can range from 0 to over 30 percent—with selectively higher amounts possible. *(17)* This land premium impact is distinct from station area development because the impact here is to existing properties in close proximity to the station areas, absent additional private development.

- *Option value*: Option value analysis captures the value non-users place on having an alternative means to travel. For example, in a highly congested highway corridor where travel times are variable and unreliable, auto travelers may place value on the option to use a different mode (such as transit, intercity rail, or perhaps a variable toll lane) that guarantees a trip within a known and reliable travel time. In this way, option value is like a mobility insurance premium. While the concept of an option value is comparatively

Highway Investment Does Not Always Spark Economic Growth

Although the success stories receive much attention in the development literature, economic success is not certain. In Northwest Indiana, I-65 between Gary (part of the Chicago megaregion) and Indianapolis (the state capital) was completed between 1968 and 1971. This section of highway travels through rural counties, with the exception of its endpoints and Lafayette (location of Purdue University and a shopping destination for the surrounding rural communities).

The figure below plots the annual job growth of the rural and urban portion of this highway corridor, comparing the rates of growth to the US average rate. Both the urban and rural portions of the corridor have lagged the US rate since the interstate was opened. Moreover, the figure illustrates that there was no significant acceleration in job growth following the completion of the highway. Although the highway improved access in this corner of the state, the restructuring of the steel industry in the 1970s and the absence of other competitive advantages have outweighed the benefits of highway access.



Source: BEA

new to transportation economic assessments, it is widely used in environmental economics. For example, in an environmental context, people are willing to pay a premium to ensure that natural environments or wildlife species exist so that they can view them in the future.

10.2 What to Consider When Selecting a Methodology

As noted in Chapter 6, performing an economic analysis generally involves eight basic steps, regardless of the type of analysis or investment. The first three steps help establish the evaluation criteria and appropriate methodology to estimate the benefits, while the next five define the steps in the actual analysis or estimation of these benefits. As these are described in earlier chapters, they are not repeated here. However, wider economic benefits differ in a key aspect and that is their "newness" in economic analysis.

This newness has several implications for economic analysis. First, there is no established methodology for most of these wider benefits. Of those described above, the land premium benefit is the most identifiable in transportation analysis. Even here, with a range of 0 to 30 percent, there is considerable variation in findings and room for further research. Second, because these benefits are new to decision makers and the public, there is greater opportunity for misunderstandings of the findings. Lastly, because this is an evolving area of economic assessment, assumptions should be conservative when required, and the inclusion of sensitivity analysis is particularly important so that the results are defensible.

10.3 Other Parts of the Planning Study that Contribute to the Economic Analysis

The consideration of the wider economic benefits of a transportation investment can touch on most other parts of the project or program development process. There is no standard methodological recipe for these benefits. Thus, there is no standard set of requisite data. As wider economic benefits may entail market responses to transportation investments or policies—the range of potential inputs from other parts of the planning study is particularly large. *The general principle that underpins this connection is that economic assessment does not produce information that defines the project or program. Rather, it evaluates the economic outcomes associated with the project or program that are defined through the planning process.* This explains why the economic assessment cannot be coincident with planning efforts to estimate capital costs, travel demand modeling, and operations planning—because these tasks collectively define how the project or program will be built, operated, and used. The economic assessment then evaluates the economic outcomes associated with those project or program qualities.

The planning and economics team must work closely to ensure that the economic assessment draws on all relevant information produced as part of the project or program development process. The estimation of agglomeration and land premium benefits draws on information directly from the travel demand or forecasting modeling, which provides a gauge of the change in accessibility. The estimation of option value will require data on the congestion and reliability of existing transportation modes in the corridor where the project or program will be constructed. Some of this information may have been developed for a Purpose and Need statement.

The data to support an analysis of wider economic benefits, however, rarely can be constructed on project or program data alone. The estimation of this type of benefit typically requires that supplementary data be collected by the economics team. The nature of the supplementary data needed can vary widely, particularly depending on how agglomeration and land premium benefits are supported by a specific project or program. As a result, this type of analysis draws on a fundamental understanding of how the project or program connects to the community and broader economy and on the expertise of the economics team to produce a transparent, defensible analysis tailored to the specific project or program circumstances. While this type of analysis can be more demanding, it provides decision makers with solid information on project qualities that were previously considered intangibles.

10.4 When to do the Analysis

The question of when to include an assessment of wider economic benefits hinges on what type of project or program is being evaluated. Because agglomeration and land premium benefits are generated by changes in accessibility, projects or programs that do not affect accessibility will not, by definition, generate these benefits—therefore, no analysis is required. In addition, the scope of the project or program must be large enough to generate a significant change in accessibility—what economists call a structural change. Small incremental changes would not be sufficient to generate productivity benefits on either the labor (agglomeration) or land (land premium) sides of the market. For example, the introduction of high speed rail that halves the travel time between two cities is a major change that may induce agglomeration benefits. However, the addition of a turn lane that allows traffic on an arterial to flow more smoothly is not a sufficiently large change to induce productivity gains.

Similarly, because option values are generated when travelers gain a new mode or path of travel, the investment must be sufficiently large to offer an alternative travel option to those that are currently in use. Incremental improvements to add lanes or improve safety without adding to the traveler's portfolio of options cannot, by definition, offer an alternative travel option—therefore, no analysis is required.

10.5 Methods

As noted above, because the estimation of wider economic benefits is an evolving area within transportation economics, there is no standard methodological recipe for these benefits. From the perspective of a planner managing an economic study, the analysis should be transparent and it should address the motivations for doing the study. Depending on the scale of the study and the available data, the assessment can be quantitative or qualitative.

10.5.1 Quantitative

If the travel demand or forecasting model results and supplementary data are available, these benefits may be estimated by an economic analyst or consultant through the use of regression modeling or other economic analysis—without purchasing any economic models. However, if the project or program analysis is relatively complex, or is for a large capital investment, a specialized econometric model may be purchased to estimate the agglomeration benefits.

The use of an econometric model developed specifically for transportation studies will provide a methodology that has a proven track record using nationally accepted methodologies. This is an important consideration if the project or program is controversial. Econometric models developed specifically for transportation investment analysis (as opposed to general econometric models that are being applied for a transportation investment analysis) are likely to calculate the user and non-user benefits associated with travel time, travel cost, and accidents avoided savings. Some of these econometric models also may be able to estimate other types of economic impacts—improving the efficiency of the analysis.

In addition, a hedonic estimation model may be developed by the economic consultant. The hedonic property method sometimes is used to estimate the land premium associated with access to a transportation facility. It is based on the idea that the value of a property can be disaggregated into the value of its individual characteristics—e.g. how large it is, how new it is, or its proximity to transportation facilities. The value of each component is estimated separately through regression analysis. While hedonic regression is used widely in a variety of contexts, it is more difficult technically because it is data-intensive. Because the analysis requires the decomposition of the property into its component parts, the omission of an important variable—e.g. number of bathrooms in a house—can bias the results obtained for the transportation access variable.

Regardless of the method selected, it is important to make sure that any agglomeration effects that might be implicitly or explicitly included in future land use forecasts by the model are included in the base case. These future planned land use impacts are expected even without the transportation investment and, as such, are not attributable to the investment. It also important to remember that calculating an agglomeration benefit is difficult because there also may be an associated increase in congestion—eroding any agglomeration benefit. Therefore, it is important to make sure that the planned future land use assumptions in the agglomeration base case match the land use assumptions applied in the travel demand or forecasting model.

10.5.2 Qualitative

The emphasis on quantifiable benefits in economic assessment does not in any way suggest that non-quantifiable outcomes are not important. They can be critical in choosing an alignment or selecting an alternative. The emphasis on quantification reflects the economic analyst's effort to put all benefits into a common metric in order to make a comprehensive assessment and to understand which types of benefits are most influential in making the case for or against a project or program.

That said, when some outcomes cannot be monetized, it is incumbent upon the economic analyst to provide a qualitative discussion of effects not included and any information available on their scope. Omitting information on outcomes because it cannot be monetized provides decision makers with an incomplete picture of the overall impact of the project or program and can lead to bad decisions. Alternately, the error can reverse in direction; a good project can be passed over for funding because some of the more difficult to describe or estimate benefits are omitted—leading it to be undervalued in the assessment.

A qualitative approach to the assessment of wider economic benefits is needed if the project or program evaluation does not include a travel demand or forecasting analysis (in the case of agglomeration and land premium benefits) or data on existing modes of travel in the corridors are not documented (option value). When conducting a qualitative assessment of wider economic benefits, the discussion should focus on the following;

- Types of wider economic benefits expected—including number of travelers who would be affected by the project or program and the magnitude of potential travel time savings
- Who would experience these benefits—including specific populations, industries or communities served by the project or program
- Magnitude of these benefits—including a relative scale or ranking of the potential changes in density and changes inbenefits of each project alternative or program scenario (e.g. high, moderate, low), as well as a description as to how these rankings were selected
- Potential risks to these benefits—including the identification of which project components (e.g. alignment, operating plans, and/or demographic growth) would have the greatest effect on the benefit analysis.

10.6 Chapter Conclusion

This chapter introduced the inclusion of wider economic benefits into the assessment of transportation investments, plans, and programs. Recognizing the value of a complete—and to the degree possible—uniformly quantifiable assessment, transportation economists have begun to expand the range of benefits estimated in their analyses. Reflecting the expansion of economic outcomes considered and scope of project or program evaluation, these benefit types fall under the umbrella-term "wider economic benefits." While this is an evolving field within transportation assessment, the three main types of wider economic benefits coming into more common use within empirical project analyses include agglomeration, land premium, and option value.

The question of when to include an assessment of wider economic benefits hinges on what type of project or program is being evaluated.

- *Agglomeration and land premium*: Because agglomeration and land premium benefits are generated by changes in accessibility, projects or programs that do not affect accessibility will not, by definition, generate these benefits—therefore, no analysis is required. In addition, the scope of the project or program must be large enough to generate a significant change in accessibility—what economists call a structural change. Small incremental changes would not be sufficient to generate productivity benefits on either the labor (agglomeration) or land (land premium) sides of the market.
- *Option value*: The investment must be sufficiently large to offer an alternative travel option to those that are currently in use. Incremental improvements to add lanes or improve safety without adding to the traveler's portfolio of options cannot, by definition, offer an alternative travel option.

The consideration of the wider economic benefits of a transportation investment can touch on most other parts of the project development process. The general principle that underpins this connection is that economic assessment does not produce information that defines the project or program. Rather, it evaluates the economic outcomes associated with the project or program that are defined through the planning process. This explains why the economic assessment cannot be coincident with planning efforts to estimate capital costs, travel demand modeling, and operations planning—because these tasks collectively define how the project or program will be built, operated, and used.

CHAPTER 11 EIA Measures and How Impacts Should be Quantified

After the economic analysis has established an appropriate framework and identified the appropriate methods and tools to apply, the Planning Project Manager and the economics project team members must work together to identify the appropriate impact measures for the transportation project or program. Economic measures are developed to assess the level of economic activity or impacts associated with the construction and operation of the transportation investment. These measures can come in a variety of forms, including both quantitative and qualitative. Regardless of their form, these measures should establish what the impacts are, the magnitude of the impacts, and who will experience the impacts.

Chapter 11 Summary

Chapter 11 discusses potential economic measures to use for Economic Impact Analyses. Potential impacts to consider include jobs, earnings, and property taxes. For each impact area, the chapter presents:

- Definitions of potential measures
- Their data needs
- Qualitative analysis options for the measures
- Involvement of other parts of the planning process.

This chapter focuses on identifying appropriate measures for the impacts that may be included in economic impact analyses. It addresses specific measures, what they mean, what data are needed to quantify these measures, and how the measures relate to other parts of the transportation planning process.

All measures may not apply to all projects or programs; nor will all studies be able to quantify all measures. The planning and economics team members will need to assess whether each measure applies to the project or program, the importance of the measure, and whether the data are available to quantify the measure.

11.1 Overview

This chapter discusses the potential economic measures for transportation projects and programs developing an economic impact analysis. An EIA examines what changes due to the construction and implementation of a project or program and who is affected by the change. It is used to estimate the impacts for a defined period of time that result from construction and implementation of the project or program—regardless of whether they are a transfer or net change (i.e. difference between an improvement case and base case). Economic impact analysis is not limited to direct impacts, and frequently includes multiplier effects that quantify the indirect and induced impacts.

Ability to Quantify Impacts

The ability to quantify many of the economic measures often depends upon the data and planning phase of the transportation project or program. If the project or program is relatively low-cost, or in the early stages of planning, the analysis detail may not be such that a quantifiable impact can be calculated. As a result, a simplified or qualitative approach may be acceptable for these situations.

The difference between simplified and comprehensive assessments is primarily the level of effort and information that underpins the estimates, not the number of impacts considered. Each assessment type can consider all applicable impacts—using the best project or program information available at the time. This can include both quantifiable as well as qualitative descriptions of potential impacts.

The potential EIA measures addressed in this chapter include:

- *Jobs and earnings* associated with project or program construction and operation and new development construction and operation.

- *Property tax impacts* that result from the construction and operation of the project or program, as well as from new development attributable to the project or program.

In addition to these impacts, an EIA also may include the economic benefits included in a BCA (i.e. user, non-user, community, and wider economic benefits). However, the impacts associated with an EIA are not identical to those included in a BCA. Consequently, to distinguish the benefits that *would only be included in a BCA*, the measures associated with user, non-user, and wider economic benefits are discussed in Chapter 12.

11.2 Jobs and Earnings

A transportation project or program has a substantial beneficial effect on the defined regional economy. These investments generate direct, indirect, and induced employment and earnings as a result of the construction and operation expenditures associated with the transportation investment and any resulting new development. These project- or program-related expenditures support or create jobs in the regional economy, providing wages and benefits for workers in the region.

Jobs and *employment* generally are defined in job-years in an EIA. A job-year is a full- or part-time job for one person for one year. For example, a job for one person that has a duration of twenty years would be reported as twenty job-years, even though it is one job recurring for twenty years. Job-years are used in EIA because they place a value on the length of the impact. In other words, recurring jobs (or long-term impacts) are weighted more heavily than one-time jobs (or short-term impacts). ***However, if the employment numbers are not labeled appropriately, job-year results may be misinterpreted by stakeholders, decision makers, and the general public.***

Earnings in an EIA are defined as the sum of wages and salaries, incomes of sole proprietors or partnerships, and employer contributions for health insurance (excluding contributions for social insurance, such as Social Security). Earnings generally are estimated for each year and summed for a defined analysis period.

Please note that if employment and earnings are reported for more than one region (e.g. MSA and state), the MSA and state impacts are not additive. The MSA impacts are already accounted for in the state impacts.

11.2.1 Project Construction

Definition

Construction of the transportation project or program generates direct, indirect, and induced employment and earnings in the regional economy. These construction-related impacts are short-term impacts that only last for the duration of the construction cycle.

Data Needs

To estimate the regional economic impacts from the construction of the project or program, the following data are needed:

1. *Total project or program capital costs by major cost category (in base year dollars)*: The economic impact of capital expenditures varies by expenditure type and depends on the amount of locally produced goods and services embodied in the purchases. Therefore, the construction and professional services costs (e.g. soft costs, such as planning and design) must be identified because these goods and services would be purchased in the local economy. While every building material required for the project or program may not be produced locally, the I-O model or the multipliers purchased reflect the supplier linkages for the construction and professional services industries, and thus account for this leakage from the local economy.

   By contrast, vehicles, financing, and land purchases, are unlikely to be purchased from the local economy or generate jobs. Most US regional economies do not produce transit vehicles, limiting the potential local impact this purchase can have. Although there is likely to be some assembly required upon delivery of the vehicles, and it is possible that a component of the vehicle might be made by a local supplier, these possibilities represent a negligible share of the vehicle cost and typically are excluded from this analysis.

Similarly, ROW expenditures generally are for real property only, while financing costs reflect the debt service payments only. The transaction costs associated with these land and financing expenditures usually are included in the professional services cost category. Since there is no labor associated with the ROW and financing expenditure categories, there is no economic impact to the pure land or financing costs.

In sum, there are two types of capital expenditures that are expected to impact the economy: *general construction* and *professional services* (or soft costs).

2. *Input-output model or construction and professional services multipliers for the region*: I-O models are a type of econometric model that predicts how changes in final demand impact the quantity and distribution of output, value added, earnings, and employment in a region for each industry sector based on the specific industry structure of the region. These predictions are based on the region's historic inter-industry purchasing patterns (who buys what from whom—the historic pattern of inter-industry transactions).

   As a result, the I-O model and/or multipliers provide an estimate of the direct, indirect, and induced employment and earnings impacts generated by the construction of the project or program. The I-O model or multipliers must be purchased for the study area(s).

3. *Funding sources (local, state, and federal) to be used to construct the project or program*: In order to isolate the potential economic effects of the project or program on the regional economy, it is necessary to distinguish those funding resources that are new to the economy and that would not be invested in the region, but for the project, from those that would be spent in the region (even without the project or program) with similar economic effects (e.g. funds that would be allocated to the construction of other transportation projects in the region).

   The funds that are considered "new" depend on the definition of the region. For a local region, state and federal funds are considered new, while for the state only federal funds are considered new. New funding sources generate *new* jobs and earnings (those that would not come, but for the project), while the remaining funding sources *support* jobs and earnings in the region—because these impacts likely would occur in the region even without the project or program.

Qualitative Analysis Options

If any of the data above are not available, the actual construction employment and earnings impacts will be difficult to quantify. Similarly, if either the capital costs or the I-O models are not available, an exact estimate of the employment and earnings impacts cannot be calculated.

If only the order of magnitude of the capital costs is known, or an I-O model or multipliers have not been purchased, the potential employment and earnings impacts can be described qualitatively—as long as the defined region is the same for all projects or programs. The estimate of the employment and earnings is based on capital expenditures, and the multiplier effects would be the same for all construction activities in the defined region. Therefore, the greater the cost of the construction and professional services activities for the project or program, the greater the impacts will be. Consequently, the project or program could be ranked by order of magnitude, with the most expensive options receiving the highest rank. It would have to be noted that this ranking does not consider the source of funding for the project or program, and as a result, does not address the potential for "new" versus "supported" or "retained" jobs.

If only the funding sources are unknown, the potential employment and earnings impacts can be quantified. These impacts could be shown and described as supported jobs—using a conservative assumption that all funds would be from within the defined region. Alternatively, the planning and economics teams could make an assumption about the general sources of funding (local, state, or federal) to estimate the potential new jobs and earnings created by the construction of the project or program. This assumption, and its basis, should be documented and reported clearly along with the employment and earnings impacts.

Involvement of Other Parts of the Planning Process

The estimation of the construction impacts from the transportation investment requires inputs from two primary areas within the project or programming process: 1) development of the capital cost estimate and 2) development of the financial plan. As a result, these construction impacts cannot be finalized until the capital costs and financial plan are complete. *If the economic impacts from the construction of the transportation investment have been developed and changes occur to either the capital costs or the financial plan, the EIA must be revisited to make sure that the impacts have not changed.*

11.2.2 Development Construction

Definition

Construction of any new residential or commercial development (or redevelopment that has a greater density or higher value use) associated with the project or program generates direct, indirect, and induced employment and earnings in the regional economy. These construction-related impacts are short-term impacts that only last for the duration of the construction cycle for the new development.

New residential and commercial development must be in excess of the development that is already planned for the local area and would not have come, but for the transportation investment. Planned development generally includes any housing or employment growth that is captured in the local or MPO demographic forecasts—assuming these local forecasts do not include the impacts associated with the transportation investment. The planned development should match the assumptions used in other parts of the analysis, including travel demand and land use. New development does not include any development that results from existing businesses and residents in the defined region moving to the project area—because this gain is experienced at the direct expense of another part of the region.

Data Needs

To estimate the regional economic impacts from the construction of the new development, the following data are needed:

1. *Total capital costs for the new development (in base year dollars)*: The capital costs for the new development are not likely to be included in the project or program capital cost estimates. Rather, the market analysis prepared to determine the amount of new residential and commercial development that is directly attributable to the project or program, should estimate the value of this new development. The development value generally is based on total square feet of new development and the average regional construction price per square foot for the type of development planned (e.g. multi-family housing or midrise office).

   As discussed in the data needs for project construction (11.2.1), the economic impact of the development construction varies by expenditure type and depends on the amount of locally produced goods and services embodied in the purchases. In sum, there are two types of development capital expenditures that impact the economy: *general construction* and *professional services* (or soft costs). The I-O model or the multipliers purchased reflect the supplier linkages for the construction and professional services industries and thus account for this leakage from the local economy.

2. *Assumptions regarding market absorption of new development*: The new development attracted by the transportation investment likely would not occur during the first year of project or program operation. Instead, the development impacts are more likely to build over the analysis time horizon as use of the

transportation investment gains momentum in the region. As a result, the analysis should make assumptions regarding how quickly and over how many years the new development will be constructed and absorbed by the market. This treatment implicitly allows the real estate market to adjust to the improved mobility and access provided by the transportation investment rather than receive the total impact in the first year (or years) of operation.

3. *Input-output model or construction and professional services multipliers for the region*: As mentioned in the data needs for project construction (11.2.1), I-O models are a type of econometric model that predicts how changes in final demand impact output, value added, earnings, and employment in a region for each industry sector based on the specific industry structure of the region. The I-O model or multipliers must be purchased for the study area(s).

Qualitative Analysis Options

If any of the data listed above are not available, the actual construction employment and earnings impacts associated with the new development will be difficult to quantify. If either the construction costs or the I-O models are not available, an exact estimate of the employment and earnings impacts cannot be calculated.

If only the order of magnitude of the construction costs is known (i.e. square feet by type), or an I-O model or multipliers have not been purchased, the potential employment and earnings impacts can be described qualitatively—as long as the defined region is the same for all projects or programs. The estimate of the employment and earnings is based on capital expenditures, and thus, the multiplier effects would be the same for all construction activities in the defined region. Therefore, the greater the cost of the construction activities associated with the new development, the greater the impacts. Consequently, the new development associated with the project or program could be ranked by order of magnitude, with the most expensive development options receiving the highest rank.

If a detailed market analysis is not available, but the stakeholders and project team members believe that additional, new development would result due to the transportation investment, some additional research should be undertaken to substantiate this claim. This research should involve interviewing real estate developers and economic development agencies in the region to help identify the potential for new development offered by the project or program. While this approach represents a reasonable second-best estimate in the absence of data, attempts should be made to use these findings cautiously and conservatively. A good check on this type of information is to compare the predictions made by the collective group of commercial and economic developers to historical experience as a benchmark.

Involvement of Other Parts of the Planning Process

The estimation of the new development construction impacts requires inputs from two primary areas within the project or programming process: 1) detailed market or land use analysis and 2) travel forecasting model. The detailed market or land use analysis is a direct input into the construction impacts. On the other hand, the travel forecasting model is a secondary input—because without the generation of travel time savings (that result from improved mobility and access in the region), it is unlikely that new residential and/or commercial development would be attracted to the project or program region.

As a result, the development construction impacts cannot be finalized until the market or land use analysis and travel forecasting results are complete. *If the economic impacts from the construction of the new residential and commercial development have been estimated and changes occur to either the market or land use analysis, or the travel forecasting results, the EIA must be revisited to make sure that the impacts have not changed.*

11.2.3 Project Operation

Definition

The operation and maintenance (O&M) of the transportation project or program generates direct, indirect, and induced employment and earnings in the regional economy. These operations-related impacts are long-term impacts that last as long as the project or program is operating.

Data Needs

To estimate the regional economic impacts from the O&M of the project or program, the following data are needed:

1. *Annual O&M expenditures (in base year dollars)*: The economic impact of O&M expenditures varies by expenditure type and depends on the amount of locally produced goods and services embodied in the purchases. Goods and services required for the project or program O&M would be purchased in the local economy. Although every material required for O&M is not produced locally, the I-O model or the multipliers purchased reflect the supplier linkages for the transportation industry, and thus account for this leakage from the local economy.

2. *Input-output model or transportation services multipliers for the region*: As mentioned in the data needs for project construction (11.2.1), I-O models are a type of econometric model that predicts how changes in final demand impact output, value added, earnings, and employment in a region for each industry sector based on the specific industry structure of the region. The I-O model or multipliers must be purchased for the study area(s).

3. *Funding sources (local, state, and federal) to be used to operate the project or program*: In order to isolate the potential economic effects of the O&M expenditures on the regional economy, it is necessary to distinguish those funding resources that are new to the economy and that would not be invested in the region, but for the project, from those that would be spent in the region (even without the project or program) with similar economic effects (e.g. funds that would be allocated to the O&M of other projects in the region). See 11.2.1 data needs for more details on how to determine whether the funding is new.

Qualitative Analysis Options

If any of the data listed above are not available, the actual O&M employment and earnings impacts will be difficult to quantify. If either the annual O&M expenditures or the I-O models are not available, an exact estimate of the employment and earnings impacts cannot be calculated.

If only the order of magnitude of the O&M costs is known, or an I-O model or multipliers have not been purchased, the potential employment and earnings impacts can be described qualitatively—as long as the defined region is the same for all projects or programs. The project construction section (11.2.1) on qualitative analysis options discusses this in more detail. The principles are the same for O&M expenditures as they are for capital expenditures. Similarly, if only the funding sources are unknown, the potential employment and earnings impacts still can be quantified. These impacts could be shown and described as supported jobs also as discussed in 11.2.1.

Involvement of Other Parts of the Planning Process

The estimation of the O&M impacts for the transportation investment requires inputs from two primary areas within the project or programming process: 1) development of the O&M cost estimate and 2) development of the financial plan. As a result, these operations impacts cannot be finalized until the O&M costs and financial plan are complete. ***If the economic impacts from the operation of the transportation investment have been developed and changes occur to either the O&M costs or the financial plan, the EIA must be revisited to make sure that the impacts have not changed.***

11.2.4 Development Tenants

The tenants who use the new commercial development (or redevelopment that has a greater density or higher value use) associated with the project or program generates direct, indirect, and induced employment and earnings in the regional economy. These development-related impacts are long-term impacts that last as long as this new development is occupied by commercial businesses.

It is important to note that in order to be "new," the commercial development must be in excess of the development that is already planned for the local area and would not have come, but for the transportation investment. Planned commercial or industrial development generally includes any employment growth that is captured in the local or MPO demographic forecasts—assuming these local forecasts do not include the impacts associated with the transportation investment. The planned development should match the assumptions used in other parts of the analysis, including travel demand and land use. New commercial development does not include any development that results from existing businesses in the defined region moving to the project area—because this gain is experienced at the direct expense of another part of the region.

Data Needs

To estimate the regional economic impacts from the occupation of new commercial development, the following data are needed:

1. *Total employees occupying the new commercial development*: The market analysis prepared to determine the amount of new development in the region that is directly attributable to the project or program should estimate the total number of employees occupying the new commercial development. The employment estimate generally is based on total square feet of new commercial development and an assumption on the average square feet required per employee for the type of commercial activity planned (e.g. office or retail).

2. *Total earnings for the employees occupying the new commercial development (in base year dollars)*: The market analysis may or may not provide the earnings associated with the new commercial employees in the region. However, an estimate of these earnings can be prepared, assuming an average annual wage for all jobs in the region or an average annual wage for the commercial industries located in the development. Average wage data is available through the US Bureau of Economic Analysis website or through state labor market department websites.

3. *Assumptions regarding market absorption of new development*: As discussed in the data needs for development construction (11.2.2), the new development attracted by the transportation investment likely would not occur during the first year of project or program operation. As a result, the analysis should make assumptions regarding how quickly and over how many years the new development will be constructed and absorbed by the market. In addition, the analysis should assume that there is some delay in occupation of the new development. In other words, the occupation should follow the construction.

4. Input-output model *or retail, office, industrial and food service* multipliers *for the region*: As mentioned in the data needs for project construction (11.2.1), I-O models are a type of econometric model that predicts how changes in final demand impact output, value added, earnings, and employment in a region for each industry sector based on the specific industry structure of the region. The I-O model or multipliers must be purchased for the study area(s). The industries for the multipliers should be based on the industries likely to occupy the development.

Qualitative Analysis Options

If any of the data listed above are not available, the occupied commercial development employment and earnings impacts will be difficult to quantify. If either the annual direct employment and earnings or the I-O models are not available, an exact estimate of the employment and earnings impacts cannot be calculated.

If a detailed market analysis is not available, but the stakeholders and project team members believe that additional, new commercial development would result due to the transportation investment, some additional research should be undertaken to help substantiate this claim as discussed in the qualitative analysis options for new development construction (11.2.2).

If only the order of magnitude of the size of the new commercial development is known, or an I-O model or multipliers have not been purchased, the potential employment and earnings impacts can be described qualitatively—as long as the defined region is the same for all projects or programs. The project or program could be ranked by order of magnitude, with the options that have the largest associated new commercial development employment receiving the highest rank.

Involvement of Other Parts of the Planning Process

The estimation of the new occupied commercial development impacts requires inputs from two primary areas within the project or programming process: 1) detailed market or land use analysis and 2) travel forecasting model. The detailed market or land use analysis is a direct input into the development occupation impacts. On the other hand, the travel forecasting model is a secondary input—because without the generation of travel time savings (that result from improved mobility and access in the region)—it is unlikely that new commercial development would be attracted to the project or program region.

As a result, the new development occupation impacts cannot be finalized until the market or land use analysis and travel forecasting results are complete. ***If the economic impacts from the new occupied commercial development have been developed and changes occur to either the market or land use analysis or the travel forecasting results, the EIA must be revisited to make sure that the impacts have not changed.***

11.3 Property Taxes

The construction and operation of the transportation project or program have the potential to impact property tax bases (or values), and therefore revenues, for project jurisdictions in the following ways:

- Full and partial acquisition of property parcels along the project or program corridor ROW
- Attraction of new residential and commercial development (from outside the defined region)
- Attraction of residential and commercial/industrial redevelopment that has a greater density or higher value use
- Increase in the property values of existing development located in the project or program corridor.

These changes in property values impact the amount of tax revenue received by local governments, as well as the disposable income of property owners who pay property taxes.

The ***property tax base*** is equal to the total assessed value of the properties within a local property tax jurisdiction, adjusted for any exemptions or reductions that are not subject to property taxes.

Property tax revenues are equal to the total property tax base in a jurisdiction multiplied by the local tax rate.

11.3.1 Property Acquired to Permit Construction and Operation of Project

Definition

The construction and operation of the transportation project or program may require full and/or partial acquisitions of property parcels along the ROW. These takings or purchases would convert property that is largely privately owned, and therefore taxable, to non-taxed public use. Consequently, these properties would be removed from the tax bases of the local jurisdictions and would reduce the property tax revenues collected.

Data Needs

To estimate the regional property tax impacts that result from the construction and operation of the transportation project or program, the following data are needed:

1. *Identification of each parcel required*: The properties (both full and parcel acquisitions) required for construction and operation of the transportation project or program should be identified as part of the capital cost estimate. For each of these parcels, the team developing the capital cost estimate should be able to provide the following:
    - Tax or Property Identification Number
    - Property address
    - Property type (e.g. residential or commercial)
    - Property tax jurisdiction
    - Total square feet of the property—as well as the square footage required, if it is a partial acquisition
    - Portion of the building or improvement required, if it is a partial acquisition.

2. *Assessed value of each parcel required*: The team developing the capital cost estimate also should be able to provide the assessed value for each parcel—including total assessed value, as well as the land and building improvement components. Any homeowner exemptions that are not subject to property taxes also should be identified. It is important to make sure that these values are for the most recent tax year available. If the assessed values from the capital cost team are for a prior year, check the county or local assessor's office website for more up-to-date information. With the tax or property identification number of each parcel, it is relatively easy to update these values, using a local assessor's website, if necessary.

3. *Tax rate for each parcel*: The tax rate for each property can be identified using the local assessor's website. Some areas have numerous local option taxes; so it is important to verify the tax rates for each parcel and jurisdiction. If there is an average or effective tax rate available for each jurisdiction in the analysis, this rate can be used in place of parcel-specific data. However, it is important to carefully document the source of the rate applied in the analysis.

Qualitative Analysis Options

If any of the data listed above are not available, the actual reduction in the property tax base and the resulting impact on property tax revenues cannot be calculated. If the data are not available to estimate the property tax impact, a qualitative analysis should acknowledge that the acquisition of any property for the construction and/or operation of the transportation project or program would reduce the total assessed property value and property tax revenues for each jurisdiction.

Involvement of Other Parts of the Planning Process

The estimation of the property tax impacts associated with the construction and operation of the transportation project or program requires inputs from one primary area within the project or programming process—development of the capital cost estimate. As a result, the property tax impacts cannot be finalized until the capital cost estimate and property parcels required are complete. ***If the property tax impacts from the construction and operation of the transportation project or program have been developed and changes occur to properties required for acquisition in the capital cost estimate, the EIA must be revisited to make sure that the impacts have not changed.*** The changes can include parcels being added or removed, changes in the amount of a parcel required, or changes in the type of taking (land or building improvement).

11.3.2 New Development Added to the Tax Base

Definition

The operation of the transportation project or program may result in the attraction of new residential and commercial development (or redevelopment that has a greater density or higher value use). As a result, these new properties would be added to the tax bases of the local jurisdictions and would increase the property tax revenue collected.

It is important to note that in order to be "new," the residential and commercial development must be in excess of the development that is already planned for the local area and would not have come, but for the transportation investment. Planned development generally includes any housing or employment growth that is captured in the local or MPO demographic forecasts—assuming these local forecasts do not include the impacts associated with the transportation investment. The planned development should match the assumptions used in other parts of the analysis, including travel demand and land use. New development does not include any development that results from existing businesses and residents in the defined region moving to the project area—because this gain is experienced at the direct expense of another part of the region.

Data Needs

To estimate the regional property tax impacts that result from the new residential and commercial development, the following data are needed:

1. *Value of the new development (in base year dollars)*: Since these properties do not currently exist, the assessed value of the new development should be equal to the construction cost of the development. This assumption is conservative because it is unlikely that a developer would pay to construct the new development if its value would be less than the cost. The construction value of this new development is addressed in the data needs for development construction (11.2.2).

2. *Assumptions regarding market absorption of new development*: The data needs for development construction (11.2.2), discuss the importance of developing assumptions regarding how quickly and over how many years the new development will be constructed and absorbed by the market. In addition, the analysis should assume that there is some delay in occupation of the new development.

3. *Tax rate for each jurisdiction*: The tax rate for each jurisdiction can be identified using the local assessor's website. Some areas have numerous local option taxes; so it is important to verify the tax rates for each jurisdiction. If there is an average or effective tax rate available for each jurisdiction in the analysis, this rate can be used. However, it is important to carefully document the source of the rate applied in the analysis.

Qualitative Analysis Options

If any of the data listed above are not available, the estimated increase in the property tax base and the resulting impact on property tax revenues cannot be calculated. If the data are not available to estimate the property tax impact, a qualitative analysis should acknowledge that the new residential and commercial development attracted by the transportation project or program would increase total assessed property value and property tax revenues for each jurisdiction.

If a detailed market analysis is not available, but the stakeholders and project team members believe that additional, new residential and commercial development would result due to the transportation investment, some additional research should be undertaken to help substantiate this claim as discussed in the qualitative analysis options for new development construction (11.2.2).

Involvement of Other Parts of the Planning Process

The estimation of the property tax impacts associated with the new development attracted by the transportation project or program requires inputs from one primary area within the project or programming process—the detailed market analysis. As a result, these property tax impacts cannot be finalized until the detailed market analysis is complete. ***If the property tax impacts from the new residential and commercial development have been developed and changes occur to the detailed market analysis, the EIA must be revisited to make sure that the impacts have not changed.***

11.3.3 Increase in Existing Property Values

Definition

Once the transportation project or program begins operation, the existing parcels located along the project corridor will enjoy greater mobility and access (and reduced travel times) to the broader region. Residents and commercial enterprises may be willing to pay a premium for these locations, where access is improved relative to other locations. As a result, this willingness to pay more for these existing properties represents an addition to the tax bases of the local jurisdictions and would increase the property tax revenue collected. This land premium impact is distinct from station area development because the impact here is to existing properties in close proximity to the project corridor, absent additional private development.

Data Needs

To estimate the regional property tax impacts that result from the increase in existing property values associated with the operation of the transportation project or program, the following data are needed:

1. *Identification of impacted parcels*: The planning and economics project team members must first determine whether existing properties would experience an increase in property value due to the transportation project or program. A detailed market analysis may address these potential impacts. Additionally, this can be accomplished by looking at actual impacts for similar projects or by interviewing local developers and economic development officials. If it is determined that there would be impacts, the area that would experience these impacts must be established. Generally, studies have found that impacts associated with transportation investment are experienced within a quarter- or half-mile radius of the project corridor or station areas. Once the appropriate radius is determined, the identification of impacted parcels can occur. This identification should include the following for each parcel:
    - Tax or Property Identification Number
    - Property address
    - Property type (e.g. residential or commercial)
    - Property tax jurisdiction.

2. *Assessed value of each parcel*: The assessed value for each parcel—including the total value, as well as the land and building improvement components—can be obtained through the local assessor's website or through GPS data files available from MPOs or other local agencies. Any homeowner exemptions that are not subject to property taxes also should be identified. It is important to make sure that the assessed values are for the most recent tax year available. If the assessed values are for a prior year, check the county or local assessor's office website for more up-to-date information. With the tax or property identification number of each parcel, it is relatively easy to update these values, using a local assessor's website, if necessary.

3. *Percentage increase in property values*: The appropriate percentage increase should be developed in coordination with planning and economics team members. It can be developed by looking at actual impacts for similar projects in the region or state, by examining outcomes reported in the literature for similar cities and transportation improvements, or by interviewing local developers and economic development officials. Studies have shown that an increase in property values near transit lines can range from 0 to over 30 percent—with select instances of significantly higher gains ***(18)***. This increase should be an assumption based on the best information available at the time of the analysis. It also should be conservative (in order to make it more defensible) and well-documented throughout the analysis.

4. *Tax rate for each parcel*: The tax rate for each property can be identified using the local assessor's website as discussed in the property required for construction and operation of the investment (11.3.1).

Qualitative Analysis Options

If any of the data listed above are not available, the estimated increase in the property tax base and the resulting impact on property tax revenues cannot be calculated. If the data are not available to estimate the property tax impact, a qualitative analysis should acknowledge that the increase in existing property values associated with the transportation project or program could increase total assessed property value and property tax revenues for each jurisdiction.

If a detailed market analysis that discusses the potential impacts on existing property values is not available, but the stakeholders and project team members believe that these values would increase due to the transportation investment, some additional research should be undertaken to substantiate this claim. This research should involve interviewing real estate developers and economic development officials in the region to identify the potential impact on existing property values, as well as examining actual existing property value impacts for similar projects in the region or state. Attempts should be made to use these findings cautiously and conservatively.

Land Premium Associated with Highway Projects

Research generally supports the idea that highway improvements positively impact nearby land values. However, the impacts vary in significance and often are dependent on the improvement type, proximity to highway, type of property (e.g. single family detached, multi-family, commercial), timing of construction and completion, environment (e.g. urban, rural, suburban), and extent of the highway network development. (*19*) These factors have been shown to result in:

- Highly localized but generally positive impacts on property values
- Gains that may occur at the expense of property value losses elsewhere in the region
- Potentially negative impacts associated with noise, emissions, vibrations, and additional traffic for properties immediately adjacent to improvements
- Impacts that are not statistically significant, particularly for improvements to existing highways
- More significant impacts for properties in the area around a new highway or in an area with a less developed highway network
- Impacts that vary by property type, including positive impacts on multi-family and commercial properties, but negative impacts on single family detached housing.

Given the variability of factors involved in highway improvements, it is difficult to compare the impacts from one region to another or to establish an appropriate range of highway impacts on property values. That being said, some important generalizations should be considered when evaluating the potential impacts of highway investments on property values: 1) the impacts on properties associated with highway investments tend to be smaller than those associated with transit investments and 2) the impacts from expansions or improvements to existing highway facilities in an area with a well developed highway network tend to be smaller than those associated with new facilities in an area with an underdeveloped highway network.

Involvement of Other Parts of the Planning Process

The estimation of the property tax impacts associated with the potential increase in existing property values in the project corridor requires inputs from one primary area within the project or programming process—the detailed market analysis. As a result, these property tax impacts cannot be finalized until the detailed market analysis is complete. ***If the property tax impacts from the increased value of existing properties have been developed and changes occur to the detailed market analysis, the EIA must be revisited to make sure that the impacts have not changed.***

11.4 Chapter Conclusion

This chapter discussed the potential economic measures for transportation projects and programs developing an economic impact analysis. An EIA examines what changes due to the construction and implementation of a project or program and who is affected by the change. It is used to estimate the impacts that result from the construction and implementation of the investment, regardless of whether they are a transfer or net change for a defined period of time. Economic impact analysis is not limited to direct impacts, and frequently includes multiplier effects that quantify the indirect and induced impacts.

The potential EIA measures addressed in this chapter include:

- *Jobs and earnings* associated with project or program construction and operation and new development construction and operation.
- *Property tax impacts* that result from project or program construction and operation, as well as from new development attributable to the project or program.

In addition to these benefits, an EIA also may include the economic benefits included in a BCA (i.e. user, non-user, community, and wider economic benefits). However, the impacts associated with an EIA may not be included in a BCA. Consequently, to distinguish the benefits that *would only be included in a BCA*, the measures associated with user, non-user, and wider economic benefits are discussed in Chapter 12.

All measures may not apply to all projects or programs; nor will all studies be able to quantify all measures. The planning and economics team members will need to assess whether each measure applies to the project or program, the importance of the measure, and whether the data are available to quantify the measure.

Table 11-1 summarizes the types of impacts and benefits discussed in this chapter and Chapter 12, whether they are included in EIA and/or BCA, and suggestions for quantifiable measures as appropriate. The selection of the economic impacts or benefits that are most important to report depends upon the objectives of the project or program and the economic analysis being performed. The appropriate impacts and their measures should be discussed and agreed upon by the project planning and economics team members. This mutual selection and identification of the appropriate impacts and measures will ensure that the economic analysis results reflect the impacts of greatest importance to the users and the region.

As Table 11-1 demonstrates, the elements that typically are included in an EIA, such as construction jobs created and sustained, operations and maintenance jobs created and sustained, and the value of ROW takings and associated tax revenues, are not included in BCA. This is because the two analyses have different purposes. The BCA is used to determine whether a project or program yields a positive return on investment and thus focuses on the net changes (i.e. those differences between an improvement case and a base case) attributable to the project or program. Since jobs represent both a cost to the employer (paying a wage) and a benefit to the employee (receiving a wage), it is a transfer payment, rather than a net benefit. Similarly, property tax is a benefit to the taxing authority while it is a cost to the taxpayer. In contrast, the environmental document assesses impacts, regardless of whether they are a transfer or net incremental change. It examines what changes due to the construction and implementation of a project or program and who is affected by the change.

It is important to note that the ability to quantify many of the measures often depends upon the data and planning phase of the transportation project or program. If the investment is relatively low-cost, or in the early stages of planning, the analysis detail may not be such that a quantifiable impact can be calculated. As a result, a simplified or qualitative approach may be acceptable for these situations. The difference between simplified and comprehensive assessments is primarily the level of effort and information that underpins the estimates, not the number of benefits or impacts considered. Each assessment type can consider all applicable benefits, using the best project or program information available at the time. This can include both quantifiable as well as qualitative descriptions of potential benefits.

Table 11-1: Summary of Benefit Types and Quantifiable Measures

Benefit/Impact Type	Included in Economic Impact Analysis	Included in Benefit Cost Analysis	Quantifiable Measures
User Benefits or Impacts			
Travel Time Savings	Y	Y	Time Saved; $
Travel Cost Savings	Y	Y	Reduced VMT; $
Value of Accidents Avoided	Y	Y	Reduced VMT; $
Non-User Benefits or Impacts			
Travel Time Savings	Y	Y	Time Saved; $
Value of Accidents Avoided	Y	Y	Reduced VMT; $
Community Benefits or Impacts			
Value of Emissions Avoided	Y	Y	Reduced short-tons and VMT; $
Environmental (e.g. air quality, water quality, noise)	Y	Y	dB/other unit; Qualitative
Walkability	Y	Y	Qualitative
Greater Access for Transportation Dependent Populations	Y	Y	Time Saved; Qualitative
Recreational Benefits	Y	Y	Qualitative
Jobs/Earnings Associated with Construction	Y	N	Number of Jobs and $ of Earnings
Jobs/Earnings Associated with Construction Activity to Build Net New Project Area Development	Y	N	Number of Jobs and $ of earnings
Jobs/Earnings Directly Associated with Operation	Y	N	Number of Jobs and $ of Earnings
Jobs/Earnings Project Area Development (net new; not transfers)	Y	N	Number of Jobs and $ of Earnings
Tax Base Impacts Associated with Acquisition of Private Land and Transfer to Non-taxed Public Use	Y	N	$ of Property Value Lost
Wider Economic Benefits or Impacts			
Land Premium	Y	Y	$
Labor Productivity	Y	Y	$
Option Value	Y	N	$ or Qualitative
Residual Value of the Improvement's Assets	Y	Y	$
Value of Investments Avoided	Y	Y	$

Source: AECOM

CHAPTER 12 BCA Measures and How Benefits Should be Quantified

After the economic analysis has established an appropriate framework and identified the appropriate methods and tools, the Planning Project Manager and the economics project team members must work together to identify the appropriate benefit measures for the transportation project or program. Economic measures are developed to assess the level of economic activity or benefits associated with the construction and operation of the transportation investment. These measures can come in a variety of forms, including both quantitative and qualitative. Regardless of their form, these measures should establish what the benefits are, the magnitude of the benefits, and who will experience the benefits.

Chapter 12 Summary

Chapter 12 discusses potential economic measures to use for Benefit Cost Analyses. Potential impacts to consider include user, non-user, community, and wider economic benefits. For each impact area, the chapter presents:

- Definitions of potential measures
- Their data needs
- Qualitative analysis options for the measures
- Involvement of other parts of the planning process.

This chapter focuses on identifying appropriate measures for the benefits that may be included in benefit cost analyses. It addresses specific measures, what they mean, what data are needed to quantify these measures, and how the measures relate to other parts of the transportation planning process.

All measures may not apply to all projects or programs; nor will all studies be able to quantify all measures. The planning and economics team members will need to assess whether each measure applies to the project or program, the importance of the measure, and whether the data are available to quantify the measure.

12.1 Overview

This chapter discusses the potential economic measures for transportation projects and programs developing a benefit cost analysis. A BCA is used to determine whether a project or program yields a positive return on investment by comparing the investment's quantifiable direct benefits to the direct costs for a defined period of time. As a result, it focuses on the net changes attributable to the project or program, i.e. those differences between an Improvement Case (with project or program) and Base Case (no build, or without project or program).
The potential economic benefit analysis measures addressed in this chapter include:

- User benefits—including travel time, travel cost, and accidents avoided savings
- Non-user benefits—including travel time and accidents avoided savings
- Community benefits—including environmental (e.g. reduced emission, noise, water quality, light), walkability, greater access for transit-dependent populations, and improved recreational benefits
- Wider economic benefits—including land premium, labor productivity, benefits to other modes, investment avoided, and residual value of the project or program.

The measures for a BCA generally are monetized so that a direct comparison of the project or program benefits and costs can be made. Additionally, the monetized benefits and costs are discounted to a present value (PV) in a BCA. Discounting accounts for the fact that a dollar today usually is greater than a dollar expected 10 years from now—because the dollar today could be invested and return more than a dollar in benefits 10 years from now (excluding inflationary impacts). By stating these economic benefits in present value it is possible to compare these benefits to the project or program costs in a BCA.

The economic benefits addressed in a BCA do not include the impacts included in an EIA because many of the latter impacts do not reflect net changes attributable to the transportation project or program. Since job impacts measured in an EIA represent both a cost to the employer (paying a wage) and a benefit to the employee (receiving a wage), it is a transfer payment, rather than a net benefit. Similarly, property tax revenues are a benefit to the taxing authority while they are a cost to the taxpayer. As a result, the net benefit from both jobs and tax revenues is zero.

> **Ability to Quantify Benefits**
>
> The ability to quantify many of the economic measures often depends upon the data and planning phase of the transportation project or program. If the project or program is relatively low-cost, or in the early stages of planning, the analysis detail may not be such that a quantifiable benefit can be calculated. As a result, a simplified or qualitative approach may be acceptable for these situations.
>
> The difference between simplified and comprehensive assessments is primarily the level of effort and information that underpins the estimates, not the number of benefits considered. Each assessment type can consider all applicable benefits—using the best project or program information available at the time. This can include both quantifiable as well as qualitative descriptions of potential benefits. However, only quantifiable and monetized benefits can be included in the development of a BCA measure, such as a BCA ratio or Net Present Value.

12.2 User Benefits

User benefits are those transportation benefits that are experienced directly by the users of the proposed transportation investment. These benefits include travel time, travel cost, as well as accidents avoided savings that are experienced as a result of using the new transportation investment.

12.2.1 Travel Time Savings

Definition

The investment in the new or improved transportation facility may allow travelers who use this facility to make their trips in less time. The time that they save has value. As travelers divert to the new/improved transportation investment, travel time savings likely accrue to users as the amount of time it takes for users to make their trips declines. Travel time savings are quantified in ***hours of time saved***, and sometimes are referred to as user benefits. These operations-related outcomes are long-term benefits that last as long as the project or program is operating.

Data Needs

To estimate the value of travel time savings associated with the transportation project or program, the following data are needed:

1. *Annual user travel time saved (in hours)*: This estimate is supplied by the travel demand or forecasting model. If the travel time saved is available by type of trip (e.g. home-based work or home-based other), ask for the data at this level of detail. The data often are provided for an average weekday, which requires an annualization factor to convert it to an annual value. The travel demand or forecasting analysis team can provide the appropriate annualization factor to apply.

2. *Distribution of leisure and business travel*: The travel demand or forecasting model should be able to provide the distribution of trips by purpose in the region. Measures of this distribution may include an estimate of travel time saved (in hours) for work trips (business) and all other trips (leisure) or an assumption based on the baseline travel data in the model.

3. *Assumption on annual travel growth in the region*: The travel demand or forecasting model generally provides results for only one year in the future (i.e. the forecast year). However, the BCA evaluates benefits for a multi-year analysis period, and as such, requires travel time savings for each year in that period. In general, assuming the forecast year travel time savings for each year in the analysis period is likely to over- or under-state the actual benefits—because travel gradually builds up to the forecast year and then may

continue to increase in each year after the forecast year (assuming population and employment levels in the region are increasing).

In order to account for this variance in annual benefits properly, the analysis should consider ramping up to the forecast year benefits and then, if appropriate, continue to grow the benefits in the years after the forecast year. Whether to assume an annual ramp up in the benefits, as well as the appropriate growth rate to apply, should be discussed with the travel demand or forecasting analysis team.

4. *Value of travelers' time*: In order to monetize travel time savings, an estimate of the regional value of time is needed. This estimate may be based on local wage rates if most trips are local. Using US DOT guidance, work-based trips are valued at the full average hourly wage—while leisure (non-work-based) trips are valued at 50 percent of the average hourly wage for local trips and 70 percent of the average hourly wage for intercity trips. *(20)* In addition, this US DOT guidance provides hourly values of time based on type of trip (e.g. work/leisure and local/ intercity) by mode—that may be used in place of local wage rates.

5. *Distribution (percentage) of local and intercity trips*: This data is required if the transportation project or program serves local, as well as intercity trips, because intercity travelers have a different value of time than local travelers. The travel demand or forecasting model may not be able to provide the time savings associated with local and/or intercity trips, but it should be able to provide a percentage for each of these trips that occur in the region.

6. *Identification of base year dollar and discount rate*: The BCA should establish a base year dollar (a historic year to report all dollar amounts in, such as 2010) as well as an appropriate discount rate to apply in the analysis. Make sure that the value of travel time is in base year dollars. If it is not, the analysis must escalate or deflate this value to the base year.

Qualitative Analysis Options

If any of the data listed above are not available, the actual user travel time benefits will be difficult to quantify. If the annual travel time saved is not available, an exact estimate of the user travel time savings cannot be calculated.

As long as the total amount of travel time saved is available, an estimate of the value of user travel time savings can be calculated—using the US DOT guidance on the value of time and conservative assumptions about the distribution of the time savings and trip types. If only the total travel time saved is known, the US DOT guidance on the use of travel times in economic analysis may be used for the hourly value of time—using the suggested value of time for all trip purposes (whether business or leisure). In addition, if there is uncertainty about the distribution of local and intercity trips, the analysis should assume all the trips are local. This assumption is conservative because the value of time for local trips generally is less than that of intercity trips.

Without travel demand or forecasting model results, it is difficult to discuss user travel time benefits—even qualitatively. It is the travel demand or forecasting model that provides the scale of the expected benefits with each project or program scenario.

Involvement of Other Parts of the Planning Process

The estimation of the user travel time benefits associated with the transportation project or program requires inputs from one primary area within the project or programming process—the travel demand or forecasting analysis model. As a result, these benefits cannot be finalized until the travel forecasting analysis is complete. ***If the travel time benefits have been developed and changes occur to the travel forecasting analysis results, the BCA must be revisited to make sure that the benefits have not changed.***

12.2.2 Travel Cost Savings

Definition

As travelers divert to the new/improved transportation investment (particularly transit or another non-auto mode), auto VMT are likely to be reduced in the region. This reduction in VMT reduces auto or truck operating costs in terms of fuel, maintenance, depreciation, and tires. Travel cost savings typically are quantified by changes in *VMT*. These operations-related outcomes are long-term benefits that last as long as the project or program is operating.

Some people may argue that certain investments may allow people to get rid of their cars altogether. If considering quantifying the number of cars sold or removed from the region, it is necessary to demonstrate that the particular project or program being evaluated is the reason for this switch. Typically, the decision to get rid of a car is based on location moves (i.e. from the suburbs to the urban core) rather than new services or facilities introduced (unless these are particularly large investments).

Data Needs

To estimate the value of travel cost savings associated with the transportation project or program, the following data are needed:

1. *Amount of annual VMT avoided (or reduced) for users*: This estimate is supplied by the travel demand or forecasting model. If the VMT avoided is available by type of trip (e.g. auto or truck), ask for the data at this level of detail. The data often are provided for an average weekday, which requires an annualization factor to convert it to an annual value. The travel demand or forecasting analysis team can provide the appropriate annualization factor to apply.

2. *Distribution of auto and truck VMT*: The travel demand or forecasting model should be able to provide an estimate of the distribution of trip types (auto or truck) in the region. Measures of this distribution may include an estimate of VMT avoided for autos and trucks—or an assumption based on the baseline travel data in the model.

3. *Assumption on annual travel growth in the region*: The travel demand or forecasting model generally provides results for only one year in the future (i.e. the forecast year). However, the BCA evaluates benefits for a multi-year analysis period, and as such, requires travel cost savings for each year in that period. In order to avoid over- or under-stating the actual benefits, the analysis should consider ramping up to the forecast year benefits and then, if appropriate, continue to grow the benefits in the years after the forecast year as described in the data needs for travel time savings (12.2.1).

4. *Value of vehicle operating costs per mile*: The value of the vehicle operating costs per mile should only include those costs that are impacted by miles traveled, such as fuel, maintenance, tires, and a portion of depreciation (as depreciation is influenced by both vehicle age and use). Other operating costs, such as insurance, are fixed ownership costs that are required regardless of whether the car or truck is driven. For autos, the per mile operating cost savings vary by the size of the car. However, one potential source for these costs is AAA's Annual Edition of *Your Driving Costs*. ***(21)*** This report separates out the per mile operating costs for an average sedan that can be applied in the travel cost analysis. It is updated annually.

   For trucks, the per mile operating cost savings vary by the type and size of the truck. Since these cost data are associated with for-profit private industries, they are more difficult to locate. One potential source is the American Transportation Research Institute's *An Analysis of the Operational Costs of Trucking* report. ***(22)*** In addition, it could be beneficial to perform an Internet search to identify any recent research that might summarize these trucking costs from other sources. Again, it is important to include only the costs that are impacted by the number of miles driven, not the fixed ownership costs.

5. *Number of annual new transit riders and cost of the transit trip*: If the reduction in VMT is due to the diversion of some auto users to transit, the cost of these new transit trips must be netted out of the cost savings, because these transit trips are new costs incurred by the travelers. The travel demand or

forecasting model should be able to provide a number for new transit trips (trips that previously used another mode). The data often are provided for an average weekday, which requires an annualization factor to convert it to an annual value. The travel demand or forecasting analysis team can provide the appropriate annualization factor to apply. Additionally, the travel demand or forecasting model should be able to supply the average transit trip cost applied in the model.

6. *Number of cars removed or sold in the region*: This number will be difficult to quantify as most travel demand or forecasting models do not estimate the number of cars removed. Rather, these models report the change in VMT. If taking this approach, it is important to work with the travel demand analysis team to develop a conservative, defensible number of cars removed.

7. *Annual cost of auto ownership*: There are several potential sources for this value. One is AAA's annual release of *Your Driving Costs*, which details annual expenses associated with various sized automobiles. *(23)* In addition, the *Consumer Expenditure Survey* produced by the Bureau of Labor Statistics estimates what percentage of American income is spent on transportation. *(24)* If the Consumer Expenditure Survey is used, it is important to not remove all the transportation expenses, unless the additional cost of the new transit trips is added separately in the analysis.

8. *Identification of base year dollar and discount rate*: The BCA should establish a base year dollar (a historic year to report all dollar amounts in, such as 2010) as well as an appropriate discount rate to apply in the analysis. Make sure that the operating costs and transit fares are in base year dollars. If they are not, the analysis must escalate or deflate these values to the base year.

Qualitative Analysis Options

If any of the data listed above are not available, the actual user travel cost benefits will be difficult to quantify. If the annual VMT avoided and/or average operating costs per mile are not available, an exact estimate of the user travel cost savings cannot be calculated.

As long as the total amount of VMT avoided (or reduced) is available, an estimate of the value of user travel cost savings can be calculated—using the operating costs per mile for gas, maintenance, a portion of the depreciation for an average sedan from AAA's *Your Driving Costs*, and conservative assumptions about the distribution of the VMT and trip types. If only the total VMT avoided is known, the analysis may assume that all trips are auto. This assumption is conservative because per mile costs for autos generally are less than those for trucks. If the reduction in VMT is due to the diversion of some auto users to transit, and the number of new transit trips is not known, estimate the cost savings associated with the reduced VMT and note that the benefits do not include the additional costs associated with the new transit trips. This and any other assumptions noted should be included in any discussion of the travel cost savings benefits—so that the results are not misleading to decision makers, stakeholders, and the general public.

Without travel demand or forecasting model results, it is difficult to discuss user travel cost benefits—even qualitatively. It is the travel demand or forecasting model that provides the scale of the expected benefits with each project or program scenario.

Involvement of Other Parts of the Planning Process

The estimation of the user travel cost benefits associated with the transportation project or program requires inputs from one primary area within the project or programming process—the travel demand or forecasting analysis model. As a result, these benefits cannot be finalized until the travel forecasting analysis is complete. ***If the travel cost benefits have been developed and changes occur to the travel forecasting analysis results, the BCA must be revisited to make sure that the benefits have not changed.***

12.2.3 Accidents Avoided

Definition

As travelers divert to the new/improved transportation facility (particularly transit or other safer modes of travel), VMT are likely to be avoided (or reduced), which reduces drivers' exposure to the hazard of being involved in a travel accident because travel is shifted from a more hazardous mode to a safer one. This hazard reduction has value. This reduction in VMT decreases the likelihood of auto crashes involving *fatalities*, *injuries*, *and property damage only*. These operations-related outcomes are long-term benefits that last as long as the project or program is operating.

Data Needs

To estimate the value of the accidents avoided for the transportation project or program, the following data are needed:

1. *Amount of annual VMT avoided (or reduced) for users*: This estimate is supplied by the travel demand or forecasting model results and is described in the data needs for travel cost savings (12.2.2).

2. *Assumption on annual travel growth in the region and typical occupancy rate*: The travel demand or forecasting model generally provides results for only one year in the future (i.e. the forecast year). However, the BCA evaluates benefits for a multi-year analysis period, and as such, requires travel cost savings for each year in that period. In order to avoid over- or under-stating the actual benefits, the analysis should consider ramping up to the forecast year benefits and then, if appropriate, continue to grow the benefits in the years after the forecast year as described in the data needs for travel time savings (12.2.1).

3. *Crash rates*: Crash rates provide estimates of the number of crashes by type (i.e. fatal, injury, or property damage only) per 100,000,000 VMT. Crash rates for the US as a whole are available from the Bureau of Transportation Statistics (BTS) Motor Vehicle Safety Data, which are updated annually. More detailed local or state crash rate data also may be available. *(25)*

4. *Value of accidents by type*: The value of fatal crashes may be based on the US DOT *Value of a Statistical Life guidance* *(26)*, which provides an estimate of the value of preventing the loss of one life. In addition to fatalities, accidents can involve injuries or property damage only. To estimate the value of avoiding these accidents, one potential source is *The Economic Cost of Motor Vehicle Crashes* (Blincoe et al). *(27)*

5. *Identification of base year dollar and discount rate*: The BCA should establish a base year dollar (a historic year to report all dollar amounts in, such as 2010) as well as an appropriate discount rate to apply in the analysis. Make sure that the values of accidents by type are in base year dollars. If they are not, the analysis must escalate or deflate these values to the base year.

Qualitative Analysis Options

If any of the data listed above are not available, the actual user accidents avoided benefits will be difficult to quantify. If the annual VMT avoided are not available, an exact estimate of the user accidents avoided savings cannot be calculated.

As long as the total amount of VMT avoided (or reduced) is available, an estimate of the value of the user accidents avoided savings can be calculated—using the BTS Motor Vehicle Safety Data crash rates, vehicle occupancy rates, the US DOT's *Value of a Statistical Life,* and *The Economic Cost of Motor Vehicle Crashes* (Blincoe, et. al., 2002).

Without travel demand or forecasting model results, it is difficult to discuss user accidents avoided benefits—even qualitatively. It is the travel demand or forecasting model that provides the scale of the expected benefits with each project or program scenario.

Involvement of Other Parts of the Planning Process

The estimation of the user accidents avoided benefits associated with the transportation project or program requires inputs from one primary area within the project or programming process—the travel demand or forecasting analysis model. As a result, these benefits cannot be finalized until the travel forecasting analysis is complete. *If the accidents avoided benefits have been developed and changes occur to the travel forecasting analysis results, the BCA must be revisited to make sure that the benefits have not changed.*

12.3 Non-User Benefits

Non-user benefits are those transportation benefits that are experienced by travelers who are not directly using the new transportation investment. For example, if the proposed project improves or adds additional transit service to the region, people who continue to use autos will experience travel benefits because the VMT on the roads will decline. These benefits include travel time and accidents avoided savings that are experienced by users of parallel facilities as more people divert to the new transportation investment. However, these benefits generally are more difficult to quantify than user benefits because not all travel demand or forecasting analyses can disaggregate non-user travel time and VMT.

It is important to note that sometimes the travel demand or forecasting model results may not be separated into users and non-users. In this instance, the travel demand impacts are combined for both users and non-users, and the non-user benefits described below should not be added to the user benefits in this instance.

12.3.1 Travel Time Savings

Definition

As travelers divert to the new/improved transportation investment, travel time savings are likely to accrue to non-users. As a result of this diversion, the amount of time it takes for non-users to make their trips may decline. Travel time savings is quantified in *hours of time saved*. These operations-related outcomes are long-term benefits that last as long as the project or program is operating.

Data Needs

To estimate the value of non-user travel time savings associated with the transportation project or program, the following data are needed:

1. *Annual non-user travel time saved (in hours)*: This estimate may be supplied by the travel demand or forecasting model. However, not all models will be able to disaggregate user benefits from non-user benefits. *If this disaggregation cannot be made, then the non-user benefits are already quantified in the user benefits and no additional non-user benefits can be estimated.* However, if the travel time saved for non-users is available by type of trip (e.g. home-based work or home-based other), ask for the data at this level of detail. The data often are provided for an average weekday, which requires an annualization factor to convert the value to an annual value. The travel demand or forecasting analysis team can provide the appropriate annualization factor to apply.

2. *Distribution of leisure and business travel*: The travel demand or forecasting model should be able to provide a distribution of trips by purpose in the region as described in the data needs for user travel time savings (12.2.1).

3. *Assumption on annual travel growth in the region*: This is described in detail in the data needs for user travel time savings (12.2.1).

4. *Value of travelers' time*: See data needs for user travel time savings for details (12.2.1).

5. *Distribution (percentage) of local and intercity trips*: See data needs for user travel time savings for details (12.2.1).

6. *Identification of base year dollar and discount rate*: The BCA should establish a base year dollar (a historic year to report all dollar amounts in, such as 2010) as well as an appropriate discount rate to apply in the analysis. Make sure that the value of travelers' time is in base year dollars. If it is not, the analysis must escalate or deflate this value to the base year.

Qualitative Analysis Options

If any of the data listed above are not available, the actual non-user travel time benefits will be difficult to quantify. If the annual travel time saved for non-users is not available, an exact estimate of this travel time savings cannot be calculated.

As long as the total amount of travel time saved for non-users is available, an estimate of the value of non-user travel time savings can be calculated—using the US DOT guidance on the value of time and conservative assumptions about the distribution of the time savings and trip types. If only the total travel time saved is known, the US DOT guidance on the use of travel times in economic analysis may be used for the hourly value of time—using the suggested value of time for all trip purposes (whether business or leisure). In addition, if there is uncertainty about the distribution of local and intercity trips, the analysis should assume all the non-user trips are local. This assumption is conservative, because the value of time for local trips generally is less than that of intercity trips.

Without travel demand or forecasting model results, it is difficult to discuss non-user travel time benefits—even qualitatively. It is the travel demand or forecasting model that provides the scale of the expected benefits with each project or program scenario.

Involvement of Other Parts of the Planning Process

The estimation of the non-user travel time benefits associated with the transportation project or program requires inputs from one primary area within the project or programming process—the travel demand or forecasting analysis model. As a result, these benefits cannot be finalized until the travel forecasting analysis is complete. ***If the non-user travel time benefits have been developed and changes occur to the travel forecasting analysis results, the BCA must be revisited to make sure that the benefits have not changed.***

12.3.2 Accidents Avoided Savings

Definition

As travelers divert to the new or improved transportation facility (particularly transit or other safer modes of travel), VMT are likely to be reduced, which reduces non-users' exposure to the hazard of being involved in a travel accident because more travel is shifted from a more hazardous mode to a safer one. This reduction in VMT decreases the likelihood of non-users involvement in auto crashes involving ***fatalities***, ***injuries***, *and property damage only*. These operations-related outcomes are long-term benefits that last as long as the project or program is operating.

Data Needs

To estimate the value of the non-user accidents avoided for the transportation project or program, the following data are needed:

1. *Annual VMT avoided (reduced) for non-users*: This estimate may be supplied by the travel demand or forecasting model. However, not all models will be able to disaggregate user VMT from non-user VMT (particularly for transit projects) as described in the data needs for non-user travel cost savings (12.2.2). ***If this disaggregation cannot be made, then the non-user accidents avoided savings are already quantified in the user benefits and no additional non-user benefits can be estimated.***

2. *Assumption on annual travel growth in the region and the occupancy rate*: This is described in detail in the data needs for user travel time savings (12.2.1).
3. *Crash rates*: See data needs for user accidents avoided savings for more details (12.2.3).
4. *Value of accidents by type*: See data needs for user accidents avoided savings for more details (12.2.3).
5. *Identification of base year dollar and discount rate*: The BCA should establish a base year dollar (a historic year to report all dollar amounts in, such as 2010) as well as an appropriate discount rate to apply in the analysis. Make sure that the accident values are in base year dollars. If they are not, the analysis must escalate or deflate these values to the base year.

Qualitative Analysis Options

If any of the data listed above are not available, the actual non-user accidents avoided benefits will be difficult to quantify. If the annual VMT avoided for non-users are not available, an exact estimate of the accidents avoided savings cannot be calculated.

As long as the total amount of non-user VMT avoided (or reduced) is available, an estimate of the value of the non-user accidents avoided savings can be calculated—using the BTS Motor Vehicle Safety Data crash rates, the US DOT's *Value of a Statistical Life,* and *The Economic Cost of Motor Vehicle Crashes* (Blincoe, et. al., 2002).

Without travel demand or forecasting model results, it is difficult to discuss non-user accidents avoided benefits—even qualitatively. It is the travel demand or forecasting model that provides the scale of the expected benefits with each project or program scenario.

Involvement of Other Parts of the Planning Process

The estimation of the non-user accidents avoided benefits associated with the transportation project or program requires inputs from one primary area within the project or programming process—the travel demand or forecasting analysis model. As a result, these benefits cannot be finalized until the travel forecasting analysis is complete. *If the accidents avoided benefits have been developed and changes occur to the travel forecasting analysis results, the BCA must be revisited to make sure that the benefits have not changed.*

12.4 Community Benefits

The construction and operation of the transportation project or program may generate benefits that are experienced by the entire community within the study area, not just users, and may include:

- Environmental (e.g. emissions, noise, water quality, and light)
- Walkability
- Access for transit-dependent populations
- Access to recreational activities and destinations.

Each of these benefits is measured differently, and these measures are often difficult to quantify and monetize. As a result, the sections below describe potential measures for each type of community benefit, as well as qualitative analysis options.

12.4.1 Emissions Avoided

Definition

As auto and truck travel diverts to the new/improved transportation facility (particularly transit or other cleaner modes of travel), VMT are likely to be reduced, resulting in reduced emissions. Emissions avoided savings are quantified by changes in *VMT*. This reduction in VMT decreases the occurrence of ***carbon monoxide (CO)***, ***nitrogen oxide (NOx)***, ***volatile organic compounds (VOC)***, ***particulate matter (PM-10)***, and ***carbon dioxide (CO2)*** in the atmosphere. These savings are netted against the emissions costs of the new (but cleaner) mode, yielding a net reduction in emissions. These operations-related outcomes are long-term benefits that last as long as the project or program is operating.

Data Needs

To estimate the value of emissions avoided savings associated with the transportation project or program, the following data are needed:

1. *Annual reduction in emissions*: If the transportation project or program is undergoing a more detailed environmental analysis, the reduction in emissions (in short tons) may be calculated during this process. If this is the case, data needs under items 2, 3, and 5 below are not necessary.

2. *Annual amount of VMT avoided (reduced or diverted to a cleaner mode) for all users*: This estimate is supplied by the results of the travel demand or forecasting model. If the VMT avoided is available by type of trip (e.g. auto or truck), ask for the data at this level of detail. Since the data often are provided for an average weekday, an annualization factor from the travel demand or forecasting analysis team may be required.

3. *Distribution of auto and truck VMT*: See data needs for user travel cost savings for more details (12.2.2).

4. *Assumption on annual travel growth in the region*: This is described in detail in the data needs for user travel time savings (12.2.1).

5. *Emission rates per VMT*: The emissions rates are specific to the defined region for the transportation project or program. These rates are based on factors such as fleet composition, travel time of day, and congestion in the region. As a result, the appropriate emissions rates will need to be provided by a regional agency, such as an MPO. If the region has an *Air Quality Conformity Determination Report*, this report may contain the appropriate emissions rate to apply in the analysis. These rates can be estimated through modeling tools developed by the US EPA's Office of Transportation and Air Quality, such as MOVES (Motor Vehicle Emissions Simulator). ***(28)*** This model estimates emissions from cars, trucks, and motorcycles. Additional research is typically needed to identify emission rates for other vehicles such as high-speed rail, buses, and rail transit. The factors are difficult to generalize because of differences in equipment and fuel type.

6. *Value of emissions*: One potential measure of the economic costs of air emissions is the National Highway Traffic Safety Administration's (NHTSA) *Final Regulatory Impact Analysis of the Rulemaking on Corporate Average Fuel Economy for MY 2011 Passenger Cars and Light Trucks*. ***(29)*** This is an area of study that is evolving constantly. So it is worth performing an Internet search to see if more recent values or analyses are available.

7. *Identification of base year dollar and discount rate*: The BCA should establish a base year dollar (a historic year to report all dollar amounts in, such as 2010) as well as an appropriate discount rate to apply in the analysis. Make sure that the emissions values are in base year dollars. If they are not, the analysis must escalate or deflate these values to the base year.

Qualitative Analysis Options

If any of the data listed above are not available, the emissions avoided benefits will be difficult to quantify. If the annual VMT avoided and the emissions rates for the region are not available, an exact estimate of the emissions avoided savings cannot be calculated.

As long as the total amount of VMT avoided (or reduced or diverted to a cleaner mode) and emissions rates for the region are available—and/or the actual emissions reduced as estimated by the environmental analysis—an estimate of the value of the emissions avoided savings can be calculated. This calculation would require making the assumption that all avoided VMT are auto. This assumption is conservative because auto emissions rates generally are less than truck rates. In addition, the NHTSA values of emissions could be applied. As always, any assumptions made should be documented and noted in the analysis.

Without the environmental analysis on air quality or the travel demand or forecasting model results, it is difficult to discuss the emissions avoided benefits—even qualitatively. It is the environmental analysis or travel forecasting model that provides the scale of the expected benefits with each project or program scenario.

Involvement of Other Parts of the Planning Process

The estimation of the emissions avoided benefits associated with the transportation project or program requires inputs from at least one other area within the project or programming process: 1) detailed environmental analysis of air quality impacts or 2) the travel demand or forecasting analysis model. As a result, these benefits cannot be finalized until the air quality analysis or travel forecasting analysis is complete. ***If the emissions avoided benefits have been developed and changes occur to the air quality or travel forecasting analysis results, the BCA must be revisited to make sure that the benefits have not changed.***

12.4.2 Other Environmental

Definition

The construction and operation of a transportation project or program may affect the quality of the surrounding environment (e.g. noise levels, water quality, light) experienced in the defined region—which affects the quality of life experienced by people living and working in these areas. These operations-related outcomes are long-term benefits that last as long as the project or program is operating and any disbenefits are not mitigated.

Data Needs

The changes in environmental outcomes often are estimated during the environmental analysis of the transportation project or program, and therefore, already may be quantified.

However, how people value changes in environmental qualities varies significantly by person, location, and mode. As a result, it is often difficult to monetize (or place a dollar value on) these impacts. In the US, research on monetizing environmental changes associated with transportation projects or programs is rather limited but research is improving. Appropriate monetizing methodologies have been discussed ***(30)***, but limited research is available on specific values to apply. Good places to start identifying the most recent literature or potential unit values often include federal agencies, such as the US EPA.

Qualitative Analysis Options

Environmental benefits, or the lack thereof, are identified in the NEPA environmental process. However, if a non-NEPA environmental analysis has not identified a change in environmental levels associated with the transportation project or program, a qualitative discussion of the benefits may be included in the economic analysis. The qualitative discussion should include a description of:

- How the environmental quality would change as a result of the transportation project or program—including identifying the source or reason for the change.

- Who benefits—including the populations living and working in the area.
- Magnitude of the benefits—which could include a relative scale or ranking of the potential benefits of each project alternative or program scenario.

Involvement of Other Parts of the Planning Process

The results of the environmental analysis may provide insight into the potential changes in environmental quality associated with the transportation project or program and the resulting benefits on development in the defined region.

12.4.3 Walkability

Definition

The construction and operation of a transportation project or program (particularly transit) may encourage more dense, walkable development in the project or program corridor—which may result in fewer short-distance auto and transit trips within the study area. Conversely, a street widening or highway project may discourage dense, walkable development. These operations-related outcomes are long-term benefits that last as long as the project or program is operating.

Data Needs

This benefit often is difficult to quantify separately in an economic analysis. However, some of the reduced trips or travel times may be accounted for in the quantification of the travel forecasting model results.

For a measure of the current walkability of the project or program area, there is a website developed by Front Seat that calculates a Walk Score® for specific areas or addresses, www.walkscore.com. This Walk Score is the result of an algorithm based on such elements as development density, mix of land uses, density of intersections, and number of services within walking distance of a particular location. A location's Walk Score, may range from 0 ("car dependent") to 100 ("walker's paradise").

In addition, improved walkability may encourage health benefits in the local community. These benefits have been estimated to generate health cost savings as a result of regular physical activity. If the number of new walkers is known (remember that some portion of the walking trips would be repeat walkers), an annual health cost savings may be estimating using the per capita cost savings. One potential source for the estimate of the annual cost savings of health benefits is available from *NCHRP Report 552: Guidelines for Analysis of Investments in Bicycle Facilities*. (*31*)

Qualitative Analysis Options

Due to the difficulty in quantifying these benefits, walkability generally is discussed qualitatively. The qualitative discussion should include a description of:

- How the transportation project or program impacts development and improves walkability—including greater density and/or greater mix of uses
- Who benefits—including the populations served and residential and commercial development attracted to the region
- Magnitude of the improved walkability—which could include a relative scale or ranking of the potential benefits of each project alternative or program scenario.

Involvement of Other Parts of the Planning Process

The results of the travel forecasting analysis and the detailed market or land use analysis may provide insight into the potential connectivity and access improvements and their resulting benefits on development in the defined region.

12.4.4 Greater Access for Transit-Dependent Populations

Definition

The implementation of a transit project or program may improve transportation options and access for populations that rely on transit services to access jobs, services, education, health facilities, and other activities. Transit-dependent populations typically include zero-car households, low-income households, and populations under 18 and over 65. These operations-related outcomes are long-term benefits that last as long as the project or program is operating.

Data Needs

The improvements in access for transit-dependent populations often are quantified (at least partially) by the travel forecasting model and included in the ***user travel time savings***. Some travel forecasting models may be able to estimate the travel time savings accrued to transit-dependent populations (or at least a portion of this population, such as zero-car households) separately. See the user travel time savings discussion earlier in this chapter for more details. ***It is important to note that if the transit-dependent benefits are quantified and monetized separately, they should not be included in the user travel time savings reported in the user benefits section.***

Qualitative Analysis Options

Due to difficulty in quantifying these benefits, providing greater access for transit-dependent populations often is discussed qualitatively. The qualitative discussion should include a description of:

- How the transportation project or program improves access for transportation-dependent populations—including a summary of the new areas now accessible or improvement in number of stations/stops, headways, and/or quality of services provided.
- Who benefits—including summary of transit dependent populations in the region and portion of the populations within a mile or half-mile of the corridor.
- Magnitude of the improved access—which could include a relative scale or ranking of the potential benefits of each project alternative or program scenario.

Involvement of Other Parts of the Planning Process

The results of the travel forecasting analysis and the detailed market or land use analysis may provide insight into the potential connectivity and access improvements and their resulting benefits on transit-dependent populations in the corridor and region.

12.4.5 Recreation

Definition

The implementation of a transportation project or program may improve transportation access to recreational activities—ranging from arts, entertainment, and restaurants to parks and cultural amenities. The transportation project or program may make the trip to these destinations faster, cheaper, and/or less congested or stressful—making people more likely to make the trip to these recreational destinations. These operations-related outcomes are long-term benefits that last as long as the project or program is operating.

Data Needs

The improvements in access for recreational destinations often are quantified (at least partially) by the travel forecasting model and included in ***ridership*** or ***VMT*** results for these areas. The total ridership (for all modes) or VMT results for recreational areas with the transportation project or program may be compared to ridership or VMT without the project or program. Any difference in these results may be used to help support the improved access and use of the recreational destinations offered by the transportation project or program.

Qualitative Analysis Options

Due to difficulty in quantifying these benefits, providing greater access to recreational activities and destinations often is discussed qualitatively. The qualitative discussion should include a description of:

- How the transportation project or program improves access to recreational activities and destinations—including a summary of the recreational areas now accessible or improvements in number of stations/stops, headways, and/or quality of services provided.
- Who benefits—including populations served and recreational areas and their owners, if applicable.
- Magnitude of the improved access—which could include a relative scale or ranking of the potential benefits of each project alternative or program scenario.

Involvement of Other Parts of the Planning Process

The results of the travel forecasting analysis and the detailed market or land use analysis can provide insight into the potential connectivity and access improvements to recreational activities and destinations and their resulting benefits on the corridor and region.

12.5 Wider Economic Benefits

Wider economic benefits reflect the expansion of economic outcomes considered and the scope of project or program evaluation in transportation assessments. These benefit types fall under the umbrella-term "wider economic benefits" and include economic productivity (for both land and labor), options to use an alternative/improved means to travel, investments avoided, and the residual value of the transportation project or program.

12.5.1 Land Premium

Definition

Once the transportation project or program begins operation, parcels located along the corridor may enjoy greater access to the broader region. As a result, residents and commercial enterprises may be willing to pay a premium for these locations where access is improved relative to other locations without good transportation access. ***The benefit here is only to existing properties in close proximity to the project or program—absent additional private development.*** These operations-related outcomes are long-term benefits that last as long as the project or program is operating.

Data Needs

To estimate the land premium benefits that result from the improved access offered by the transportation project or program, the following data are needed:

1. *Identification of impacted parcels*: The planning and economics project team members must first determine whether existing properties will experience an increase in property value due to the transportation project or program. A detailed market analysis may address these potential impacts. Additionally, this can be accomplished by looking at actual impacts for similar projects or by interviewing local real estate developers and economic development officials. If it is determined that there will be impacts, the area that will experience these impacts needs to be established. Generally, studies have found that impacts associated with transportation investments are experienced within a quarter- or half-mile radius of the project corridor or station areas. Once the appropriate radius is determined, the identification of impacted parcels can occur. This identification should include the following for each parcel:
    - Tax or Property Identification Number
    - Property address
    - Property type (e.g. residential or commercial)
    - Property tax jurisdiction.

2. *Assessed value of each parcel required*: The assessed value for each parcel—including the total value, as well as the land and building improvement components—can be obtained through the local assessor's website or through GPS data files available from MPOs or other local agencies. Any homeowner exemptions that are not subject to property taxes also should be identified. It is important to make sure that the assessed values are for the most recent tax year available. If the assessed values are for a prior year, check the county or local assessor's office website for more-up-to-date information. With the tax or property identification number of each parcel, it is relatively easy to update these values using a local assessor's website, if necessary.

3. *Percentage increase in property values*: The appropriate percentage increase should be developed in coordination with planning and economics team members. It can be developed by looking at actual impacts for similar projects in the region or state, by examining case studies of peer communities with similar projects, or by interviewing local real estate developers and economic development officials. Studies have shown that an increase in property values near transit lines can range from 0 to over 30 percent—with select instances of significantly higher gains. *(32)* This increase should be an assumption based on the best information available at the time of the analysis. Therefore, it should be conservative (in order to make it more defensible) and well documented throughout the analysis.

4. *Identification of base year dollar and discount rate*: The BCA should establish a base year dollar (a historic year to report all dollar amounts in, such as 2010) as well as an appropriate discount rate to apply in the analysis. Verify that the assessed values of the identified properties are in the base year dollar. If they are not, the analysis must escalate or deflate these values to the base year.

5. *Subtract user travel time savings benefits*: Since the user benefits associated with the transportation project or program already are calculated as a benefit, it is important to note that any projected travel time savings associated with the project or program would have to be netted against the land premium value. This reduction is necessary because the land premium benefit is a capitalization of the time savings. Only the land premium value that would be in excess of the travel time savings should be considered as an additional benefit.

Qualitative Analysis Options

If any of the data listed above are not available, the estimated land premium benefit cannot be calculated. If a detailed market analysis that discusses the potential impacts on existing property values in the defined region is not available, but the stakeholders and project team members believe that these values would increase due to the transportation investments, some additional research should be undertaken to substantiate this claim. This research should involve interviewing real estate developers and economic development agencies in the region to identify the potential impact on existing property values, as well as examining actual existing property value impacts for similar projects in the region or state. However, as mentioned in previous chapters, it is important to use these findings cautiously and conservatively and to benchmark the predictions against historical experience as a check.

Involvement of Other Parts of the Planning Process

The estimation of the land premium benefits associated with the improved access provided by the transportation project or program requires inputs from one primary area within the project or programming process—the detailed market analysis. As a result, these land premium benefits cannot be finalized until the detailed market analysis is complete or an independent analysis of actual land premium impacts for similar projects or programs in the region or state has been conducted. ***If the land premium benefits have been developed and changes occur to the detailed market analysis, the BCA must be revisited to make sure that the benefits have not changed.***

12.5.2 Labor Productivity

Definition

Urban areas and megaregions are the focal points for commercial transactions in the economy. Transportation investment that significantly reduces travel time between cities or increases the ability to move large numbers of people in and out of an urban market improves accessibility—increasing the number of workers and suppliers of other goods and services accessible to a firm. As a result, the range of choice expands, and firms are able to select those workers and suppliers that represent the best "match" for their needs. When the match between workers and firms—or between suppliers and producers—improves, the productivity of the market increases because firms are using workers with the best skill set for their needs and suppliers are using specialized expertise that best fits their needs. This is the agglomeration benefit. Past theoretical and empirical evidence has confirmed that the level of agglomeration affects the productivity of firms and workers in an area, even after controlling for characteristics specific to firms and workers in that area, such as the mix of industries.

Recent economic studies have begun to consider these wider economic benefits associated with transportation investment, including labor productivity or agglomeration. The idea behind the transportation agglomeration benefit is that a metropolitan area or megaregion has one potential size and density without the transportation investment but a larger one with it—due to the ability to move larger numbers of people in and out of the metropolitan area on a daily basis. Absent the availability of the transportation investment, the diseconomies of large urban areas, such as higher living and business costs and traffic congestion, could begin to outweigh the advantages of its urban size. As a result, the region would begin to lose productivity and be less competitive. These operations-related outcomes are long-term benefits that last as long as the project or program is operating.

Data Needs

Once user and non-user benefits have been established, the project planning and economics team members can consider the potential labor productivity (or agglomeration) benefits. If the travel time savings benefits are significant, they could generate additional agglomeration benefits. The labor productivity benefits are more difficult to quantify and will require special considerations by the project team members, particularly the economic consultant. The data that will be helpful in estimating these benefits include:

1. *Travel time savings for users and non-users*: This estimate is supplied by the travel demand or forecasting model. If the travel time saved is available by type of trip (e.g. home-based work or home-based other), ask for the data at this level of detail. The data often are provided for an average weekday, which requires an annualization factor to convert it to an annual value. The travel demand or forecasting analysis team can provide the appropriate annualization factor to apply. It is important to make sure that the planned future land use assumptions in the agglomeration base case match the land use assumptions applied in the travel demand or forecasting model.

2. *Land use analysis of properties located within the corridor*: This will require an inventory of planned land uses within a quarter- or half-mile of the project corridor, including the number and density of jobs and households.

3. *Market analysis of the corridor*: This market analysis should identify opportunities for the attraction of additional residential and commercial development to the corridor due to the implementation of the transportation project or program.

4. *Purchase of an econometric model (optional)*: Several econometric models available for purchase can aid the project team in quantifying these agglomeration or labor productivity benefits. The models are widely accepted and provide additional credibility to a benefit that is often difficult to measure and justify. However, these models are fairly expensive.

5. *Identification of base year dollar and discount rate*: The BCA should establish a base year dollar (a historic year to report all dollar amounts in, such as 2010) as well as an appropriate discount rate to apply in the analysis. Verify that the values of the labor productivity benefits are in the base year dollar. If they are not, the analysis must escalate or deflate these values to the base year.

Qualitative Analysis Options
If any of the data listed above are not available, the estimated labor productivity (or agglomeration) benefits cannot be calculated. If a detailed market analysis or land use analysis is not available that discusses the potential effects of the project or program on future residential and commercial development in the corridor, the impacts can still be discussed qualitatively in the context of changes observed in other communities.

Involvement of Other Parts of the Planning Process
The estimation of the labor productivity (or agglomeration) benefits associated with the improved access provided by the transportation project or program requires inputs from three primary areas within the project or programming process: 1) the travel demand or forecasting analysis model, 2) an evaluation of the change in land use density or additional access to employees and firms associated with project implementation, and 3) detailed information on labor productivity (output per worker) in the market. As a result, these labor productivity benefits cannot be finalized until the travel demand or forecasting analysis and detailed market and/or land use analysis are complete. ***If the labor productivity benefits have been developed and changes occur to the travel demand or forecasting model results or the detailed market and/or land use analysis, the BCA must be revisited to make sure that the benefits have not changed.***

12.5.3 Option Value

Definition
Residents and travelers prefer to have more numerous travel options available to them, even if they do not plan to use all of the options. The option value attempts to place a dollar value on having this travel option for the non-user—whether in terms of adding additional transportation service or taking it away. This is a less traditional benefit and difficult to quantify.

Data Needs
The travel demand or forecasting model measures who will shift to the new mode or service, but it does not provide any insight into how non-users may value having the option to use the new mode or service—should their preferred mode of travel be unavailable or impossible due to various circumstances (e.g. congestion and unreliability of travel times on existing modes, weather, maintenance/repair of vehicle, or parking costs). Determining the value of having this option is difficult because it varies significantly among travelers, regions, and modes. Since the travel demand or forecasting analysis cannot quantify the option values, additional sources of data—including qualitative information—will need to be developed.

Qualitative Analysis Options
Due to the difficulty in quantifying these benefits, option value benefits are often discussed qualitatively. The qualitative discussion should:

- Evaluate whether time and budget exist to undertake an additional travel survey or develop additional questions for an existing travel survey planned for the project or program. These questions could be designed to have respondents place a value on a transportation option—whether through multiple choice or write-in responses.
- Discuss how non-users can benefit by having the option to use this new transportation project or program service—should their preferred mode of travel be unavailable or impossible for a trip due to various circumstances (e.g. weather, maintenance/repair of vehicle, parking costs).

- Magnitude of the improved access—which could include a relative scale or ranking of the potential benefits of each project alternative or program scenario.

Involvement of Other Parts of the Planning Process
The estimation of the option value benefits associated with the transportation project or program requires insight from one primary area within the project or programming process—the travel demand or forecasting analysis model. As a result, the option value benefits cannot be finalized until the travel forecasting analysis is complete. ***If the option value benefits have been developed and changes occur to the travel demand or forecasting model results, the BCA must be revisited to make sure that the benefits have not changed.***

12.5.4 Investments Avoided

Definition
As travelers divert to the new/improved transportation investment, VMT are likely to be reduced, resulting in the decline on the wear and tear of other parallel transportation assets. As a result of this reduced wear and tear, transportation investments necessary to improve or repair these parallel facilities may be avoided or deferred. The ***value of these investment savings*** may be discounted and included as a benefit.

Data Needs:
To identify the other transportation investments that could be avoided as a result of the implementation of the project or program being evaluated, the following data are needed:

1. *LRTPs for every locality or region included in the defined study area*: These long range plans should be examined closely by the project planning and economics team members to identify any projects that potentially could be deferred or removed as a result of the implementation of the proposed project or program. Ideally, these investments would be included in a cost-feasible or financially-constrained LRTP and would include preliminary cost estimates for these projects.

2. *Identification of base year dollar and discount rate*: The BCA should establish a base year dollar (a historic year to report all dollar amounts in, such as 2010) as well as an appropriate discount rate to apply in the analysis. Verify that the capital costs of the identified projects are in the base year dollar. If they are not, the analysis must escalate or deflate these values to the base year.

Qualitative Analysis Options
If the LRTPs do not contain preliminary cost estimates or rankings for the projects identified as having the potential to be deferred or removed as a result of the implementation of the transportation project or program, a qualitative discussion of the projects should be included in the BCA. The qualitative discussion should identify:

- Which projects could be deferred or removed
- Why these projects will no longer be needed or needed as early as planned
- Relative priority of these projects in the LRTP(s).

Involvement of Other Parts of the Planning Process
The estimation of the potential transportation investments that could be avoided as a result of the implementation of the project or program and their value should involve other project team members, particularly the travel demand or forecasting analysis team. These other team members have a unique understanding of how the LRTPs improve mobility and access in the region, particularly as they relate to the travel demand or forecasting model.

12.5.5 Residual Value

Definition

Many transportation project or program assets will have a useful life that extends beyond the analysis period specified in the BCA. US DOT guidance indicates that this asset value is a benefit as long as the expectation is that it will be in service for its full useful life. (*33*) Residual value also may be referred to as salvage value, as it can include the salvage cost, if demolition would be required. Salvage values generally are positive—however, they may be negative if the cost of demolition exceeds the value of the materials and equipment being salvaged.

The capital investment should be depreciated (e.g. straight-line) over the full length of its asset life. The years included in the BCA or EIA must be excluded from the residual estimation as these years are the basis for the other benefits estimated. For a BCA, this residual value should be discounted back to a present value and included as a benefit in the analysis.

Data Needs

In order to estimate the residual value of the transportation project or program being evaluated, the following data are needed:

1. *Total capital cost of the transportation project or program (in base year dollars)*: These costs must be disaggregated by type of expense, including guideway (with roads and bridges distinguished) and/or track elements; stations, stops, terminals, or intermodal facilities; support facilities (e.g. yards, shops, and administrative buildings); systems; and vehicles.

2. *Useful life of the assets by type*: These asset types should match the categories of capital costs. The capital cost team members should be able to help identify the appropriate useful life of these assets. In addition, FTA, FHWA, and asset management materials provide guidance on useful life. *(34)*

3. *Identification of base year dollar and discount rate*: The BCA should establish a base year dollar (a historic year to report all dollar amounts in, such as 2010) as well as an appropriate discount rate to apply in the analysis. Verify that the capital costs are in the base year dollar. If they are not, the analysis must escalate or deflate these values to the base year.

Qualitative Analysis Options

If any of the data listed above are not available, the estimated residual value cannot be calculated. Without the capital cost estimates, it is difficult to discuss the residual value benefits qualitatively because the capital cost estimate provides the scale of the expected benefits with each project or program scenario.

Involvement of Other Parts of the Planning Process

The estimation of the residual value benefits requires inputs from one primary area within the project or programming process—capital cost estimates. As a result, the residual value benefits cannot be finalized until the capital costs are complete. *If the residual value benefits have been developed and changes occur to these costs, the BCA must be revisited to make sure that the benefits have not changed.*

12.6 Chapter Conclusion

This chapter discussed the potential economic measures for transportation projects and programs developing a benefit cost analysis. A BCA is used to determine whether a project or program yields a positive return on investment by comparing the quantifiable direct benefits to the direct costs for a defined period of time. As a result, it focuses on the net changes attributable to the project or programs, i.e. those differences between an Improvement Case (with project or program) and Base Case (no build, or without project or program). In addition, since the BCA should only consider direct benefits it should not include any multiplier effects (i.e. indirect and induced impacts).

The potential economic benefit analysis measures addressed in this chapter include:

- User benefits—including travel time, travel cost, and accidents avoided savings.
- Non-user benefits—including travel time and accidents avoided savings .
- Community benefits—including environmental (e.g. reduced emission, noise, water quality, light) walkability, greater access for transit-dependent populations, and improved recreational benefits.
- Wider economic benefits—including land premium, labor productivity, benefits to other modes, investment avoided, and residual value of the project or program.

The measures for a BCA generally are monetized, so that a direct comparison of the project or program benefits and costs can be made. In addition, since a dollar 10 years from now is not worth the same as a dollar today—the dollar today could be invested and return more than a dollar 10 years from now (excluding inflationary impacts), these monetized costs and benefits must be discounted. Discounting is the process by which benefits and costs are stated in present value (PV), assuming a specific discount rate (or time value of money). By stating these economic benefits in present value it is possible to compare these benefits to the project or program costs in a BCA.

All measures may not apply to all projects or programs; nor will all studies be able to quantify all measures. The planning and economics team members will need to assess whether each measure applies to the project or program, the importance of the measure, and whether the data are available to quantify the measure.

Table 12-1 summarizes the types of impacts and benefits discussed in this chapter and Chapter 11—whether they are included in EIA and/or BCA—and suggestions for quantifiable measures as appropriate. The selection of the economic impacts or benefits that are most important to report depends upon the objectives of the project or program and the economic analysis being performed. The appropriate benefits and their measures should be discussed and agreed upon by the project planning and economics team members. This mutual selection and identification of the appropriate benefits and measures will ensure that the economic analysis results reflect the impacts of greatest importance to the users and the region.

As Table 12-1 demonstrates, the elements that typically are included in an EIA—such as construction jobs created and sustained, operations and maintenance jobs created and sustained, and the value of ROW takings or purchases and associated tax revenues—are not included in BCA. This is because the two analyses have different purposes. The BCA is used to determine whether a project or program yields a positive return on investment and thus focuses on the net changes attributable to the project or program (i.e. the differences between an improvement case and a base case). Since jobs represent both a cost to the employer (paying a wage) and a benefit to the employee (receiving a wage), it is a transfer payment, rather than a net benefit. Similarly, property tax is a benefit to the taxing authority while it is a cost to the taxpayer. In contrast, the environmental document (e.g. EA or EIS) assesses impacts, regardless of whether they are a transfer or net incremental change. It examines what changes due to the construction and implementation of a project or program and who is affected by the change.

It is important to note that the ability to quantify many of the economic measures often depends upon the data and planning phase of the transportation project or program. If the investment is relatively low-cost, or in the early stages of planning, the analysis detail may not be such that a quantifiable benefit can be calculated. As a result, a simplified or qualitative approach may be acceptable for these situations. The difference between simplified and comprehensive assessments is primarily the level of effort and information that underpins the estimates, not the number of benefits or impacts considered. Each assessment type can consider all applicable benefits—using the best project or program information available at the time. This can include both quantifiable as well as qualitative descriptions of potential benefits.

Table 12-1: Summary of Benefit Types and Quantifiable Measures

Benefit/Impact Type	Included in Benefit Cost Analysis	Included in Economic Impact Analysis	Quantifiable Measures
User Benefits or Impacts			
Travel Time Savings	Y	Y	Time Saved; $
Travel Cost Savings	Y	Y	Reduced VMT; $
Value of Accidents Avoided	Y	Y	Reduced VMT; $
Non-User Benefits or Impacts			
Travel Time Savings	Y	Y	Time Saved; $
Value of Accidents Avoided	Y	Y	Reduced VMT; $
Community Benefits or Impacts			
Value of Emissions Avoided	Y	Y	Reduced short-tons and VMT; $
Environmental (e.g. air quality, water quality, noise)	Y	Y	dB/other unit; Qualitative
Walkability	Y	Y	Qualitative
Greater Access for Transportation Dependent Populations	Y	Y	Time Saved; Qualitative
Recreational Benefits	Y	Y	Qualitative
Jobs/Earnings Associated with Construction	N	Y	Number of Jobs and $ of Earnings
Jobs/Earnings Associated with Construction Activity to Build Net New Project Area Development	N	Y	Number of Jobs and $ of earnings
Jobs/Earnings Directly Associated with Operation	N	Y	Number of Jobs and $ of Earnings
Jobs/Earnings Project Area Development (net new; not transfers)	N	Y	Number of Jobs and $ of Earnings
Tax Base Impacts Associated with Acquisition of Private Land and Transfer to Non-taxed Public Use	N	Y	$ of Property Value Lost
Wider Economic Benefits or Impacts			
Land Premium	Y	Y	$
Labor Productivity	Y	Y	$
Option Value	N	Y	$ or Qualitative
Residual Value of the Improvement's Assets	Y	Y	$
Value of Investments Avoided	Y	Y	$

Source: AECOM

CHAPTER 13 Key Considerations in Selecting and Managing Economic Consultants

Successfully selecting and managing an economic consultant is one of the keys to ensuring that the project or program is evaluated appropriately and comparably. When selecting a consultant, it is important to find an organization that is not only technically competent, but that also listens and responds to your analysis needs—including effectively communicating the analysis findings, particularly to non-technical audiences. There must be a level of comfort in working with the consultant selected, because as the project manager or participant in the evaluation process, you will share in the responsibility of developing an economic analysis that meets the objectives of the study and successfully evaluating the appropriate benefits.

Chapter 13 Summary

Chapter 13 suggests:

- Key considerations for hiring an economic consultant
- Questions to ask during the economic analysis process
- Ways to assess the reasonableness of a forecast
- Common mistakes to look for in an economic analysis.

This chapter discusses the key considerations in selecting and managing an economic consultant and the economic analysis process. It is designed to assist transportation planners and professionals by highlighting the types of questions to ask during an economic analysis, ways to assess the reasonableness of economic results, and how to identify common mistakes made during an economic analysis.

13.1 Key Considerations in Hiring an Economic Consultant

One of the keys to getting the information needed to make a decision about which economic consultant to hire is making sure that the hiring agency and decision makers provide specific information about the project, project needs and goals, and selection process and criteria as clearly and early as possible. This will allow the consultants to develop strong, focused proposal responses and interview materials. If the economist is left unsure about what the agency needs, the responses will tend to be vague and less directed towards the project's needs. As a result, the consultants may not provide the decision makers with all of the information necessary to make an informed selection.

To help determine which economic consultant best meets the evaluation criteria established, it is important to interview the economists about how they would approach the project and present results. Make sure that the consultant responses provide specific examples of what they have done in the past and how it would relate to this project. Naturally, questions should cover project team members, their qualifications, and the project schedule. Depending on the budget and nature of the project, interview questions also could include: *(35)*

- How do you propose to include other groups, including decision makers, stakeholders, other professionals, and the general public in the analysis process for this project?
- How have you done this in other projects?
- How do you foster a collaborative approach?
- How would you present the economic analyses results to decision makers, stakeholders, and the general public? Would there be differences in your approach to these groups?
- How have you presented results for similar projects?

13.2 Managing the Economic Analysis Process

You must be comfortable working with the consultant selected, because as the project manager or participant in the evaluation process, you will share in the responsibility of developing an economic analysis that meets the objectives of the study and successfully evaluates the appropriate benefits. Therefore, it is important to participate actively in the economic analysis process by asking questions throughout the process, assessing the reasonableness of the economic results or forecasts, and looking for common mistakes.

13.2.1 Questions to Ask During the Economic Analysis Process

As the project manager or participant in the economic analysis process, it is important to participate actively throughout the process by asking questions that not only frame the analysis but examine the impacts of the assumptions used throughout. *NCHRP Report 342* (Lewis, 1991) effectively identified and addressed seven important areas to focus your questions; these areas are summarized below. ***(36)***

1) *Analysis objectives*: Define the analysis objectives early and make sure that they are measurable. The focus primarily should be on productivity objectives because these emphasize the larger importance of transportation investments but can still influence jobs, earnings, and quality of life in the study area. If the primary objectives are jobs and earnings, it is likely that many of these jobs and earnings move from somewhere else in the region, state, or nation and could be considered transfers rather than new jobs and earnings.
2) *Analysis methodology*: Make sure that the methodology emphasizes rates of return (net present value or benefit cost ratios) so that appropriate comparisons can be made between project alternatives or program scenarios.
3) *Establishing the base case*: Question what is and what is not included in the base case to make sure that it is a reasonable picture of what the future would look like without the project or program. The base case likely will require some minimal level of investment and operating expenses to keep the assets/facilities in a state of good repair.
4) *Identifying benefits*: Make sure that all benefits are identified, even those that are not quantifiable. Make sure you have considered impacts on all localities and modes of transportation.
5) *Identifying costs*: Make sure that all costs are identified, including capital, operating, maintenance, mitigation expenses, financing, and environmental. If any costs are excluded from the analysis, make sure that there is a logical reason for the exclusion. Additionally, different categories of costs may have different short-term impacts. For example, in an EIA, it is common for the costs of land, vehicles, and financing to be excluded from the economic impacts associated with construction expenses because these purchases generally do not create jobs or earnings in the local economy. However, for the same project or program, these expenses should be included in the costs utilized to create a benefit cost ratio for a BCA because they are still expenses associated with the project or program.
6) *Discounting*: If you are discounting for a BCA, make sure that a discount rate you are comfortable with is being applied. The selection of the discount rate greatly impacts the results of the BCA. A discount rate that is too high results in later-year benefits being reduced, and a discount rate that is too low generates benefits that are overvalued. All project planning and economics team members should be involved in the selection of the discount rate to be applied in the analysis to make sure that it is an accurate reflection of the costs associated with delaying project or program benefits. If the project or program is to receive federal money, note that the US Office of Management and Budget (OMB) requires that you include a 7.0 percent discount rate. However, you also may chose to include a discount rate that better reflects the opportunity costs associated with investments in the region.

7) ***Risk analysis***: The very nature of economic analysis involves using forecasts of various components, such as costs, demographics, travel demand, and people's willingness to pay. These forecasts require judgments and assumptions by individuals or agencies that are very likely to be wrong. As a result, it is important to question the use of these forecasts and assumptions, to ask how likely these forecasts are to be wrong and what the resulting impacts on the economic analysis would be. Depending on available resources, request that a risk analysis of a few critical assumptions and variables be performed. This will provide decision makers with some confidence in the results, as well as any plans established to address instances where these forecasts and assumptions do not happen as planned.

13.2.2 Assessing the Reasonableness of the Forecast

In addition to asking questions throughout the economic analysis process, it is important to be able to evaluate the analysis results and/or forecasts of factors (such as population, employment, and travel demand or forecasting model results) that are applied in the economic analysis to make sure that they are reasonable. Evaluating a forecast can often seem daunting—as they usually are generated by experts. However, it is essential to understand what the forecast is saying and to be able to explain any differences in comparison to historical data.

One of the best indicators of reasonableness is graphing the forecast with any historical data available. Some questions to ask when looking at the graph include: Does it have jump offs? Does it veer off? Does it look like history? If the forecast does look different from history, it is necessary to be able to explain what is changing to make the future different from the past, or to decide whether the forecast needs revision.

It is often helpful to find several benchmark ratios to compare how the benefits (or other forecasted factors) are growing over time. Benchmarking involves looking at the growth of the benefits or forecasted factors per person or per household throughout the analysis period. This growth per person or per household should be fairly steady throughout the forecast. If it is not, then the person or group who developed the forecast needs to provide additional explanation. Another variation on the benchmarking approach, is to graph the flow of costs estimated for the project (capital and operating and maintenance) relative to the stream of benefits to assess the reasonableness of the forecast.

13.2.3 Common Mistakes to Look for in an Economic Analysis

As the project manager or participant in the economic analysis process, it also is important to search for potential issues or mistakes in the economic analysis performed for your project or programs. As with any analysis, these mistakes often can mislead decision makers by providing an incorrect or incomplete picture of the impacts of the project or program on the region. This section explores some of the more common mistakes that may occur during an economic analysis.

13.2.3.1 Choosing an Unrealistic Base Case

The base case should include transportation investments needed to keep the existing facilities or services in a state of good repair as well as any other investments that already are planned or funded in the region. It is rare to identify a base case with no investment or capital expenditure.

If the base case does not reflect future conditions without the project or program accurately, then the results of the economic analysis will be skewed and could result in misleading information being delivered to decision makers. Since benefits for the project or program alternatives represent the benefits over and above those offered by the base case, the benefits associated with the alternatives could be overstated if the base case does not include investments needed to keep the existing transportation facilities in a state of good repair. Similarly, if the base case includes too many investments in the existing facilities, the benefits of the project may be under-estimated and the base case could be identified as the best transportation solution.

13.2.3.2 Definition of the Project Alternative is Actually Comprised of Two or More Independent Projects

Often projects can be divided into several component projects that have independent utility (i.e. could be built independently and create benefits on their own). If this is the case, then the "project" actually should be divided into multiple projects so as not to mask costs or benefits of these individual components. If the components are combined into one project, it is possible that the benefits associated with one segment may mask costs associated with the other. For example, it is possible that, when combined, the travel time savings for the project would be positive. However, when looked at independently, one segment may have travel time savings large enough to mask the increased travel time of the other segment. In this example, the combination of the segments could result in both segments being built when only one should or both being built when only one should.

13.2.3.3 Failure to Include All Project Costs in the Analysis

Particularly when performing a BCA, it is essential to include the full project costs, including design, construction, mitigation, operation, and maintenance/rehabilitation costs that are experienced during the project analysis period. Another common mistake in applying costs in the BCA is to include only the portion of the costs funded by local agencies, rather than the full cost funded by all sources.

The confusion over which costs to include in the BCA often stems from some of the cost presentations used in EIA. For an EIA, often only the impacts from capital or operating costs that will be funded with federal or state revenues should be estimated because these are new funds to the locality. Any local revenues used for the project would be spent in the region, whether on the project being evaluated or another similar project—generating similar impacts. Therefore in an EIA, these impacts are not considered new to the region. Additionally, land, financing, and vehicle purchases often are excluded from the costs in an EIA as these costs do not generate jobs and earnings in the region.

13.2.3.4 Failure to Include All Benefits (Including Disbenefits) in the Analysis

Another common mistake when performing an economic analysis is to focus only on benefits (and disbenefits) in the local area and ignore any that may accrue outside the local jurisdiction. The key to preventing this is to make sure the appropriate study area for the economic impacts has been defined and agreed upon by the project planning and economics teams. When defining the study area for economic analyses, it is important to select an area large enough to measure the place where the local impacts will be felt, but not so large that it would overstate the benefits of the project. Many impacts experienced in a local area may be new impacts (jobs, earnings, new development) for that local area, but it is possible that these impacts are moving from one part of the larger area (state, region, or nation) to the locality. As a result, these local gains would not be considered new impacts for the larger region because they are shifting from one part of the region to another.

13.2.3.5 Double Counting Benefits or Impacts in the Analysis

Double counting can take different forms, and dealing with issues or allegations of double counting can be quite difficult. One form of double counting is including benefits that are actually an economic transfer or a shift in benefits from one location or population group in a region to another location or population group in the same region. As a result, the benefits experienced by one group or area in the study area due to the project or program should be netted out due to the resulting costs experienced by another group or area. For example, in a BCA, jobs and earnings generally are not included as benefits because jobs represent both a cost to the employer (paying a wage) and a benefit to the employee (receiving a wage); as a result, it is a transfer payment rather than a net benefit. In terms of economic development, if development shifts from one area of the region to another, it is a transfer of benefits rather than the result of attracting new development (from outside the region) to the study area.

Another common form of double counting in an economic analysis is to include the same benefit in two separate measures inadvertently. For example, new private station area development (including jobs and earnings associated with the development) that occurs along a transit project corridor should not be included in a BCA because the development is attracted to the region in response to the user benefits associated with the project. These user benefits that have been quantified already in the form of travel time and travel cost savings. However, these station area impacts may be included in an EIA, as long as the impacts are not summed at the end of the analysis process.

13.2.3.6 Summing Benefits for Multiple Regions

When performing an economic analysis, it also may be appropriate to include results for multiple areas—depending upon who the project stakeholders are. While a county may be the primary funding source for a project, the state also may want to know the larger economic impacts to the MSA or the state—especially if it is a partner (or potential partner) in the project. In this instance, economic impacts could be reported at both the county and MSA or state level. However, it is important to note that when multiple study areas are defined for similar regions (i.e. the county is within the MSA or state), the economic results are not additive—because the county impacts are already included in the larger MSA or state results.

13.2.3.7 Job-years vs. Jobs

When presenting employment impacts for a project or program in an EIA, the results often are presented in terms of jobs-years, particularly if the impacts are estimated with multipliers. Job-years allows short-term job and long-term job creation to be valued differently so that long-term (or recurring jobs) are valued at a higher level than jobs that only last for a year or two, such as construction jobs. A job-year is equal to a full-time equivalent job that lasts for one year. So if the construction of a project creates 100 jobs for two years, the project generates employment equivalent to 200 job-years (100 jobs x 2 years). Similarly, if the operation of the project results in the hiring of 50 new people for as long as the project is in operation, then the job-year estimate is equal to the number of annual new jobs (50) multiplied by the analysis period (e.g. 20 years), resulting in employment equivalent to 1,000 job-years. This distinction must be clear in the analysis so that there is no misunderstanding among stakeholders and decision makers. Often it is best to include job-years as well as total jobs. In the construction example above, the results should report employment equivalent to 200 job-years, which represents the creation of 100 jobs for two years.

13.3 Chapter Conclusion

This chapter discussed the key considerations in selecting and managing an economic consultant and the economic analysis process. It is designed to assist transportation planners and professionals by highlighting the types of questions to ask during an economic analysis, ways to assess the reasonableness of economic analysis results, and identifying common mistakes made during an economic analysis.

- *Questions to ask during an economic analysis*: As the project manager or participant in the economic analysis process, it is important to participate actively throughout the process by asking questions that not only frame the analysis but examine the impacts of the assumptions used throughout. *NCHRP Report 342* (Lewis, 1991) effectively identified and addressed seven important areas to focus your questions: 1) analysis objectives, 2) analysis methodology, 3) establishing the base case, 4) identifying benefits, 5) identifying costs, 6) discounting, and 7) risk analysis.
- *Assessing the reasonableness of the forecast*: It is important to be able to evaluate the analysis results and/or forecasts of factors (such as population, employment, and travel demand or forecasting model results) that are applied in the economic analysis to make sure that they are reasonable. One of the best indicators of reasonableness is graphing the forecast with any historical data available. If the forecast does look different from history, it is necessary to be able to explain what is changing to make the future different from the past, or to decide whether the forecast needs revision.

- *Common mistakes in an economic analysis*: It is important to search for potential issues or mistakes in the economic analysis performed for your project or programs. As with any analysis, these mistakes often can mislead decision makers by providing an incorrect or incomplete picture of the impacts of the project or program on the region. Some of the more common mistakes that may occur during and economic analysis, include: choosing an unrealistic base case, defining two independent projects as one project, failing to include all project costs, failing to include all impacts (including negative impacts), double counting impacts, summing impacts for multiple regions, and reporting job-years as jobs.

CHAPTER 14 Communicating Economic Findings for Non-Technical Audiences

Chapter 14 Summary

Chapter 14 presents general strategies for:

- Communicating technical information effectively to wide audiences
- Visual presentation of data.

There are a variety of audiences and applications for economic information. The information must be structured to address the needs of technical users but also presented in a way that is accessible to a non-technical stakeholder audience. This balance is achieved by using technically rigorous analytical methods, making all assumptions and methods transparent, and presenting findings both graphically and in text or tabular form. Potential audiences and applications for this information include:

- Providing support for agencies in developing a project or program and prioritizing projects or segments
- Articulating project or program impacts on the environmental process
- Describing project or program impacts on the long-term outlook for the regional or state economy to decision makers in all levels of government who must decide whether and how to support the project or program
- Positioning selected alternatives for a variety of federal/state funding programs—should the sponsor choose to advance the project or program. Increasingly, many funding and grant programs are emphasizing economic considerations in their decision to select and fund projects or programs.

To meet the needs of these diverse audiences and applications, the economic analysis results must be presented and explained in a clear, accessible way. This chapter offers suggestions on how to communicate economic findings effectively to non-technical audiences using general strategies and graphics.

14.1 General Strategies

Research exists that identifies strategies for communicating technical information effectively to wide audiences. Some of the strategies identified include: *(37) (38)*

- *Understand the perspective of the audience:* Without understanding the perspective of the audience, it is difficult to persuade them that results meet their needs. The results must address not only the project goals and objectives, but the goals of the audience as well. Whether decision makers, policy makers, stakeholders, or the general public, the audience has a set of objectives for the economic results being presented. Make sure that the results are presented in such a way that it is clear that the audiences' objectives or issues are understood. Present the results in a manner that indicates potential, realistic solutions to these issues. Clearly identify the short- and long-term impacts of various actions. If the audience includes people who are skeptical of the project or the issues at hand, make sure that the economic results and message directly address these concerns.
- *Present the results in multiple formats or environments:* With the vast array of intended audiences for economic results, it is often best to present the results or findings in different ways to ensure that they are understood by as many people as possible. This may include providing different graphics or examples that vary how the results are presented or summarized. Be sure to include graphs and tables as some people learn more by looking at numbers, while others gain understanding through visual displays. In addition, provide comparisons with similar projects or situations to help provide real-life context to the results. Often it takes more than one delivery for people to grasp fully what the economic results are saying. Many of the issues are complicated, and the more explanation provided by different approaches, the more likely you are to reach your audience.

- *Quantify as many of the results as possible:* When making an economic argument, it is best to provide supportive data or quantitative measures of impacts that support what is being argued. Often it is easier for the audience to understand numbers – i.e., they can relate to a dollar amount or a number of gallons of fuel saved. Often just stating what the benefit is does not convey the significance of the benefit the same way a number does. It is also important to make sure that what the number represents is reflected accurately in the materials, including appropriate labels such as dollars, present value, jobs, job-years, vehicle miles travel saved, and hours saved.
- *Craft an argument for non-quantifiable results:* Non-quantifiable benefits often are harder for a non-technical audience to understand or compare because they cannot be expressed in an easily understood number such as a dollar amount. Therefore, it is important to provide context to these non-quantifiable benefits in such a way that the audience can relate to their significance. When describing benefits qualitatively, it is important to articulate clearly what the benefits are, who receives them, how long they will be experienced, and the relative magnitude of the benefits. The importance or magnitude can be conveyed in ways other than through numbers, including a descriptive scale, such as rating the significance as high, medium, or low. This same descriptive scale also can be applied to all impacts (even those that are quantifiable) in order to provide context to the relative importance of the non-quantifiable impacts.
- *Make sure the results are presented accurately:* While quantifying the results is important, these numbers must be presented accurately and understood by the audience. This includes making sure that trusted methodologies are used to estimate impacts, data inputs are appropriate and accurate, assumptions made are identified and described clearly, benchmarks are provided to demonstrate that the results are realistic and potentially conservative, and sensitivity analyses are performed to determine how sensitive the results are to changes in assumptions or data inputs used. These steps will help make the audience comfortable with the results being presented and increase their confidence in the quality of the work performed.

14.2 Using Graphics

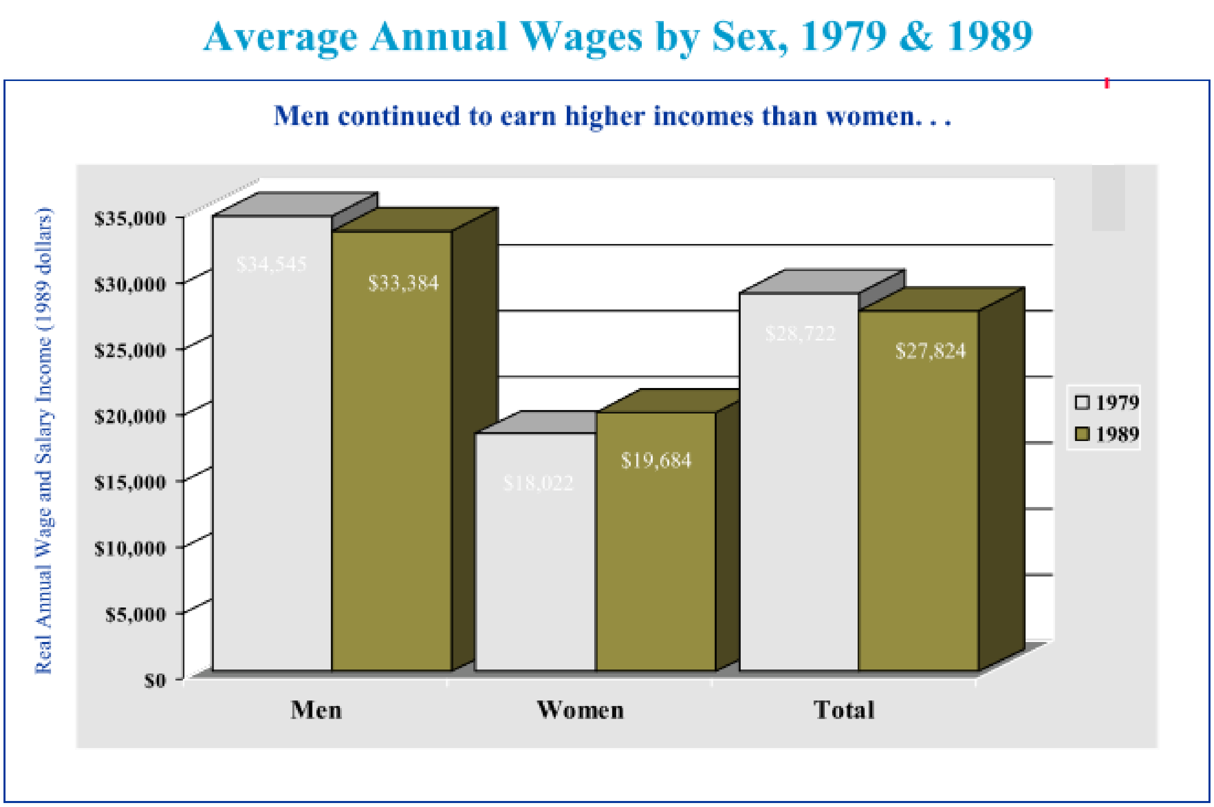
Many times the best way to convey the economic results of a project or program is through the use of graphs, charts, and tables. However, it is important to make sure that these graphics accurately portray the data being presented, while still presenting sufficient data to draw appropriate conclusions. If the graphics are not clear, they only will hinder the acceptance of the economic analysis results. Edward Tufte has produced several books on the best practices for visually presenting data, and has identified several principles on how to make graphics effective, including: *(39)*

- *Remove "chartjunk" (40):* Make sure that what is included in the graphic is useful data. Know what you are trying to convey with the graphics and do not include extra visual designs that distract from the data being presented. These can include such things as gridlines, too many data series differentiated by different line formats, or unnecessarily bold (in color or format) trend lines that diminish the impact of the real data being presented.
- *Emphasize the useful data:* Make sure that most of the graphic emphasizes the presentation of the useful data, including simple presentation of data points and trend lines so that the audience can see the actual changes in data over time. This can include narrowing the axis of the graphic to the pertinent value range instead of having the axis start at zero—and using lines instead of bars, which can be overly bold or distracting.
- *Focus on "high density data":* Make sure that the size of the graphic is proportional to the data being presented. Often graphics are created when in reality only a few data points exist, and as a result, the picture does not add much value. If this is the case, consider presenting the data in tabular form.

Applying many of these principles, the WSDOT Strategic Assessment Office uses a *performance journalism* approach—the use of quantitative charts, tables, and data in combination with narrative reporting that tells the story and makes the quantitative easy to follow—to publish its quarterly *The Gray Notebook* and other performance reports. Over the 10 year history of *The Gray Notebook*, the Strategic Assessment Office has found that this approach has improved public credibility and helped contribute support for funding increases because it clearly and concisely depicts WSDOT's programs and projects in a manner that is easily understood by policy makers and the public alike.

Daniela Bremmer, the Director of Strategic Assessment, has published a TRB paper and delivered presentations on the use of performance journalism at WSDOT. As part of these efforts, she has developed a series of graphics that depict how to edit and improve graphics to ensure that the message is clear, concise, and can be understood even without supporting narrative. With Ms. Bremmer's permission, two of these graphics have been reprinted below to demonstrate how to apply the graphing principles to improve their quality. *(41) (42)* Figure 14-1 depicts the original graph comparing average annual wages of men and women in 1979 and 1989.

Figure 14-1: Graphic BEFORE Applying Principles



Source: WSDOT, "Effective Communication of Performance Measures: Performance Journalism in Practice at WSDOT," Presented by Daniela Bremmer, September 9, 2007.

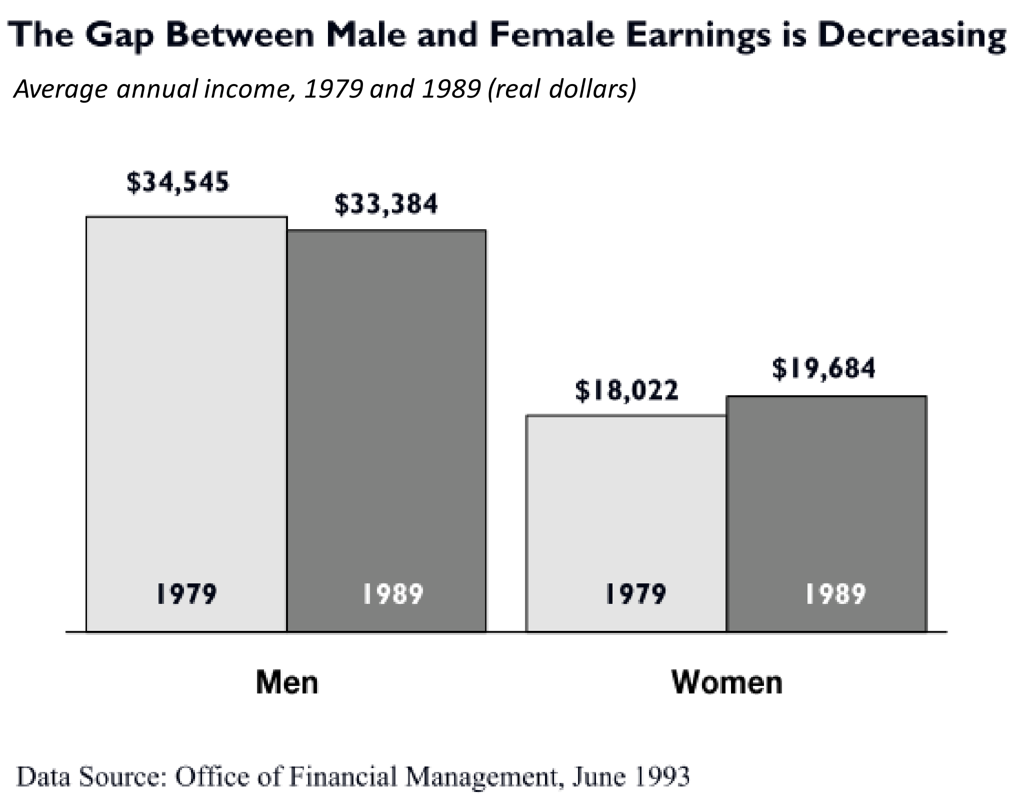
The graphic contained in Figure 14-1 is a lot for the eye to take in at one time. Many of the formats are distracting to the reader. However, there are several quick fixes that can be applied to improve the quality and readability of the graphic, including:

(1) Remove the "Figure VI-1" label.
(2) Remove the gray background shading.
(3) Remove the outside box.
(4) Remove the 3-D effect from the chart bars.
(5) Refine the Y-axis so that scale includes fewer number labels.

(6) Remove the gridlines.
(7) Remove the legend and add appropriate labels (1979 and 1989) to the base of the chart bars.
(8) Remove the Total chart bars.
(9) Move data labels for the bar values above each bar.
(10) Improve the use of color—use black, bold font for data labels, increase the contrast between the 1979 and 1989 bars, use white font for any labels that lie against a dark background.
(11) Match bar labels "men" and "women" to chart title "male" and "female."
(12) Make the fonts more readable and decrease the emphasis on subheadings and references.
(13) Change the chart title and description to reflect the message the graphic is trying to convey.
(14) Remove the Subheading "Men continued to earn higher incomes than women…"
(15) Move Y-axis label to a sub heading.
(16) Add data source.

After the above steps have been taken, the graphic looks more like the one shown in Figure 14-2. This figure contains the same information, but it is much more succinct and easier to read.

Figure 14-2: Graphic AFTER Applying Principles



Source: WSDOT, "Effective Communication of Performance Measures: Performance Journalism in Practice at WSDOT," Presented by Daniela Bremmer, September 9, 2007.

14.3 Chapter Conclusion

This chapter provided suggestions for effectively communicating economic findings to non-technical audiences. There are a variety of audiences and applications for economic information. Consequently, the information must be structured to address the needs of technical users but also presented in a way that is accessible to a non-technical stakeholder audience. This balance is achieved by using technically rigorous analytical methods, making all assumptions and methods transparent, and presenting findings both graphically and in text or tabular form. Research exists that identifies strategies for communicating technical information effectively to wide audiences. Some of the strategies identified include:

- Understand the perspective of the audience
- Present the results in multiple formats or environments
- Quantify as many of the results as possible
- Craft an argument for non-quantifiable results
- Make sure the results are presented accurately
- Use graphs, charts, and tables.

LIST OF ACRONYMS

AAA	American Automobile Association
ADA	Americans with Disabilities Act of 1990
APS	Accident Prediction Severity Model
BCA	Benefit Cost Analysis
BEA	United States Bureau of Economic Analysis
BTS	United States Bureau of Transportation Statistics
C&P	Conditions and Performance Report
CE	Categorical Exclusion
CO	Carbon Monoxide
CO2	Carbon Dioxide
dB	Decibels
DOE	Department of Energy
DOT	Department of Transportation
EA	Environmental Assessment
EDR	Economic Development Research Group, Inc.
EIA	Economic Impact Analysis
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
EUAB	Equivalent Uniform Annual Benefit
EUAC	Equivalent Uniform Annual Cost
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
FONSI	Finding of No Significant Impact
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GIS	Geographic Information Systems
GPS	Global Positioning System
HERS	Highway Economic Requirements System
HERS-ST	Highway Economic Requirements System – State Version
HPMS	Highway Performance Monitoring System
HRTPO	Hampton Roads Transportation Planning Organization
HUD	United States Department of Housing and Urban Development
I-O	Input-Output
ITS	Intelligent Transportation Systems
LEAP	Local Economic Assessment Package
LRTP	Long Range Transportation Plan

MARAD	Maritime Administration
MOVES	Motor Vehicle Emissions Simulator
MPO	Metropolitan Planning Organization
MSA	Metropolitan Statistical Area
NAFTA	North American Free Trade Agreement
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act (1969)
NHTSA	National Highway Traffic Safety Administration
NOI	Notice of Intent
NOx	Nitrogen Oxide
NPV	Net Present Value
NTIS	National Technical Information Service
O&M	Operations and Maintenance
OMB	United States Office of Management and Budget
PDO	Property Damage Only
PM-10	Particulate Matter-10
PSC	Partnership for Sustainable Communities
PV	Present Value
REMI	Regional Economic Models, Inc.
RIMS II	Regional Input-output Modeling System II
ROD	Record of Decision
ROI	Return on Investment
ROW	Right of Way
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TAZ	Transportation Analysis Zone
TEA-21	Transportation Equity Act for the 21st Century (1998)
TIGER	Transportation Investment Generating Economic Recovery grant program
TIP	Transportation Improvement Program
TOD	Transportation Oriented Development
TREDIS	Transportation Economic Development Impact System
TSM	Transportation Systems Management
UM	University of Michigan
US	United States
US DOT	United States Department of Transportation
VOC	Volatile Organic Compounds
VHT	Vehicle Hours Traveled
VMT	Vehicle Miles Traveled
WSDOT	Washington State Department of Transportation

GLOSSARY OF COMMON TERMS

This appendix is designed to provide an extended glossary of basic economic terms as they are applied in transportation planning analyses. The definitions and examples provide an introduction to economic concepts and terms from the transportation planners' point of view. The Glossary is not intended to be a detailed discussion of the issues and analysis involved in each topic area; rather it provides an introduction into the concepts necessary to understand the issues and analysis that are explored more fully throughout the Guidebook.

The terms presented below are divided into topic areas, so that similar terms and concepts are grouped together. These topic areas are arranged alphabetically. In addition, many areas refer the reader to other topic areas for more details or provide additional, related terms that may be encountered as part of the topic area.

As in the main sections of the Guidebook, the related terms that have definitions located in other sections of the Glossary are presented in blue, underlined font and are hyperlinked to the appropriate section. When your mouse is placed over one of these terms, a text box with a brief definition of the term and a link to click on for a more detailed discussion are provided. ***To return to your previous location (where you clicked the hyperlink) press ALT-Left Arrow***.

Area 1: Base and Build Alternatives

The base case represents the existing conditions in the project area and is used to compare the impacts of the project or program of projects (improvement/build alternative) being studied as part of the economic analysis. The base case may be either the No Build or Transportation Systems Management (TSM) alternative.

- *No build alternative*: Generally represents existing conditions in the project area including transportation projects currently under construction or funded for construction and operation.
- *TSM alternative*: In addition to the No Build, the TSM generally includes lower cost capital and operational improvements than the Build Alternatives.
- *Improvement/build alternative*: Represents the project or program of projects being evaluated.

Area 2: Benefit Cost Analysis vs. Economic Impact Analysis

Benefit Cost Analysis (BCA) and Economic Impact Analysis (EIA) are two of the most common economic analyses performed as part of the transportation planning process. However, there are common misunderstandings about what is included in each type of analysis, as well as about the intent of each. The definitions of each analysis type, as well as the differences between the two, are summarized below.

Benefit Cost Analysis (BCA)

Benefit Cost Analysis is used to determine whether a project yields a positive return on investment (ROI) by comparing the quantifiable benefits to the project costs for a defined period of time (usually the useful life of the project or program of projects). As a result, it focuses on the net changes attributable to the project or programs of projects, i.e. those differences between an Improvement Case (project) and Base Case (no build).

These net changes focus on quantifiable impacts that can be broadly classified as follows:

- Direct transportation and operational benefits (user benefits, see Area 4)
- Potential benefits to other modes (including non-user benefits, see Area 4)

- Community benefits (see Area 4)
- Residual value of the project assets (see Area 14)
- Agglomeration benefits that occur as the market responds to the improved level of service and accessibility (see Area 4)
- Investments avoided (see Area 4).

As part of a BCA, benefits and costs (both capital and operating) are monetized (expressed as a dollar amount), discounted, and then compared to each other to develop a benefit-cost ratio. Given the reliance on net changes attributable to the project, the BCA typically is performed near the end of a planning process phase (e.g. Environmental Assessment [EA], Environmental Impact Statement [EIS]) and is used to help make decisions on which project or projects should move forward into later stages of planning or into construction.

Additional, related terms:

- *Return on investment*: Whether the investment or project generates benefits that are greater than the project costs. Also see benefit cost ratio (Area 3).
- *Cost benefit analysis*: Same as benefit cost analysis.
- *Net present value:* The net present value (NPV) of a project is estimated by subtracting the total discounted project costs from the total discounted benefits for a defined period to help determine if the project is economically viable. A NPV that is greater than zero (0) indicates that the benefits exceed the costs and is therefore, economically viable. Projects then can be compared and ranked against their NPV. The larger the NPV, the greater the benefits and the more downside risk the project can absorb.
- *Rate of return:* The rate of return (sometimes referred to as the internal rate of return) is the discount rate required so that the discounted total benefits equal the discounted total costs (i.e. NPV = 0). The higher the rate of return, the more economically viable the project is. When the rate of return is used in an analysis, a minimum rate of return is usually established by stakeholders so that decision makers will only consider those projects that exceed this threshold.

Economic Impact Analyses (EIA)

Economic Impact Analysis is used to estimate the benefits or impacts that result from a project or program of projects' construction and implementation, regardless of whether they are a transfer or net incremental change. Additionally, these impacts may consist of both quantifiable and non-quantifiable impacts, including those incorporated in a BCA, as well as construction jobs created and sustained, operations and maintenance jobs created and sustained, and the value of any Right-of-Way (ROW) takings or purchases and associated tax revenues. EIA generally is performed near the end of a planning process phase (e.g. Environmental Assessment [EA], Environmental Impact Statement [EIS]) to help determine changes due to a project's construction and implementation and who is affected by the change.

Differences between Economic Impact Analysis and Benefit Cost Analysis

The elements that are typically included in an environmental document, such as construction jobs created and sustained, operations and maintenance jobs created and sustained, and the value of ROW takings or purchases and associated tax revenues, are not included in benefit cost analyses. This is because the two analyses have different purposes. The benefit cost is used to determine whether a project yields a positive return on investment and thus focuses on the net changes attributable to the project. Since jobs represent both a cost to the employer (paying a wage) and a benefit to the employee (receiving a wage), it is a transfer payment, rather than a net benefit. Similarly, property tax is a benefit to the taxing authority, while it is a cost to the taxpayer. By contrast, the environmental document assesses impacts, regardless of whether they are a transfer or net incremental change. It examines what changes because of a project's construction and implementation and who is affected by the change. The following table summarizes the types of impacts/benefits included in economic impact and benefits cost analyses.

Table A-1: Summary of Benefits and Impacts by Analysis Type

Benefit/Impact Type	Included in Benefit Cost Analysis	Included in Economic Impact Analysis
Transportation and Operational Benefits and Impacts		
Travel Time Savings	Y	Y
Travel Cost Savings	Y	Y
Value of Accidents Avoided	Y	Y
Jobs/Earnings Directly Associated with Operation	N	Y
Non-Quantifiable Benefits Associated with Operation (Community Benefits)	N	Y
Jobs/Earnings Project Area Development (net new/not transfers)	N	Y
Community Benefits and Impacts		
Value of Emissions Avoided	Y	Y
Gallons of Fuel Saved (already valued in travel cost savings)	N	Y
Wider Economic Benefits and Impacts		
Land Premium	Y	Y
Labor Productivity	Y	Y
Residual Value		
Residual Value of the Improvement's Assets	Y	Y
Investments Avoided		
Value of Investments Avoided	Y	Y
Construction Impacts		
Jobs/Earnings Associated with Construction	N	Y
Jobs/Earnings Associated with Construction Activity to Build Net New Project Area Development	N	Y
Fiscal Impacts		
Tax Base Impacts Associated with Acquisition of Private Land and Transfer to Non-taxed Public Use	N	Y

Source: AECOM

Area 3: BCA Ratio

The benefit cost ratio is equal to the sum of the discounted benefits, divided by the sum of the discounted costs (both capital and operating) for a defined analysis period, such as 20 years or the useful life of the asset. A benefit cost ratio of one (1) implies that benefits equal the costs. A ratio greater than one (1) implies that the benefits are greater than the costs, and a ratio less than one (1) implies that the costs exceed the benefits. Given the risks associated with forecasting costs and benefits (see Area 15), a successful project generally has a BCA ratio well over 1.0. The greater the ratio is over one (1), the more downside risk the project can absorb.

Other return on investment measures or methods may be used. These may include:

- *Net present value:* The net present value (NPV) of a project is estimated by subtracting the total discounted project costs from the total discounted benefits for a defined period to help determine if the project is economically viable. A NPV that is greater than zero (0) indicates that the benefits exceed the costs and is therefore, economically viable. Projects then can be compared and ranked against each other utilizing their NPV. The larger the NPV, the greater the benefits and the more downside risk the project can absorb.

- *Rate of return:* The rate of return (sometimes referred to as the internal rate of return) is the discount rate required so that the discounted total benefits equal the discounted total costs (i.e. NPV = 0). The higher the rate of return, the more economically viable the project is. When the rate of return is used in an analysis, a minimum rate of return is usually established by stakeholders so that decision makers will only consider those projects that exceed this threshold.
- *Pay-back period:* The pay-back period is the number of years of operation required for the present value of the total benefits to equal the present value of the total costs. This measure helps quantify the ability of the project to absorb risk. A shorter pay-back period indicates that there is less risk that the project's return on investment will be adversely impacted by uncertain forecasts and assumptions used in the economic analysis.
- *Equivalent Uniform Annual Cost:* The equivalent uniform annual cost (EUAC) represents the capital recovery cost of a project and can be used to identify the most cost-efficient project alternative, assuming the benefits from the project are the same. By annualizing the full costs (capital, operating, and any salvage value associate with the project or program), it allows projects with varying useful lives to be compared.
- *Equivalent Uniform Annual Benefit:* The equivalent uniform annual benefit (EUAB) annualizes the value of a project or program's benefits and can be used to identify the most beneficial project alternative, assuming the costs of the project are the same. By annualizing the full benefits, it allows different projects or programs with the same costs) to be compared.

Area 4: Benefit Types

Benefits of transportation investments can be broadly classified as community, user, and non-user benefits. The following sections describe the most common transportation benefits and classify them in these categories.

User Benefits: User benefits are those transportation benefits that are experienced directly by the users of the proposed transportation investment. These benefits include travel time, travel cost, as well as accidents avoided savings that are experienced as a result of using the new transportation investment.

- *Travel time savings*: The investment in the new/improved transportation facility may allow travelers who use the new or improved facility to make their trips in less time. The time that they save has value. The total value of this benefit is based on the amount of time saved (measured in hours) and the value of travelers' time (measured in dollars per hour). The quantity of travel time saved (in hours) is estimated by the travel demand or forecasting model. The value of travelers' time is based on local wage rates, the quantity of local and intercity travel, and the distribution of personal (leisure) and business travel.
- *Travel cost savings*: As travelers divert to the new/improved transportation investment (usually auto travelers switching to transit or another non-auto mode), the cost per passenger mile traveled may be reduced or total vehicle miles traveled (VMT) may be reduced—both resulting in a travel cost savings for users. The amount of VMT diverted or avoided altogether is estimated by the travel demand or forecasting model. The value of vehicle operating costs per mile can be applied to VMT diverted or avoided to obtain the estimate of costs saved. In addition, if these users are now using transit, the cost of the transit trip must be netted out of the cost savings, as these transit trip expenses are new costs incurred by the travelers.
- *Accidents avoided*: As auto travelers divert to the new/improved transportation facility (particularly transit or other safer modes of travel), their exposure to the hazard of being involved in a travel accident is reduced. This hazard reduction has value. The value is based on the degree to which travelers' exposure to risk is reduced and the potential cost if that risk materializes. The change in exposure to travel accident risk is based on the predicted amount of travel (VMT) and the comparative likelihood of a fatal, injury, or property damage only accident occurring when using the existing transportation facilities and the

new/improved transportation facilities. The amount of VMT is estimated using the travel demand or forecasting model. Crash rates and average accident costs can be applied to VMT avoided to estimate the number of accidents avoided and the avoided costs associated with these accidents.

Non-User Benefits: Non-user benefits are those transportation benefits experienced by people who are not directly using the new transportation investment. For example, if the proposed project improves or adds additional transit service to the region, people who continue to use autos will experience travel time, travel cost, and accidents avoided benefits because the VMT on the roads will decline as more people divert to the new or improved transit service. It is important to note that sometimes the travel demand model results may not be divided into users and non-users. As a result, the travel demand impacts are combined for both users and non-users and the non-user benefits described below should not be added to the user benefits in this instance.

- *Travel time savings*: The investment in the new/improved transportation facility may allow travelers who use parallel facilities to make their trips in less time—as more people divert to the new transportation investment. The time that they save has value. The total value of this benefit is based on the amount of time saved (measured in hours) and the value of travelers' time (measured in dollars per hour). The quantity of travel time saved (in hours) for non-users may be estimated by the travel demand or forecasting model. The value of travelers' time is based on local wage rates, the quantity of local and intercity travel, and the distribution of personal (leisure) and business travel.
- *Accidents avoided*: As auto travelers divert to the new/improved transportation facility (particularly transit or other safer modes of travel), exposure to the hazard of being involved in a travel accident is reduced for travelers who remain on the existing facilities. This hazard reduction has value. The value is based on the degree to which travelers' exposure to risk is reduced and the potential cost if that risk materializes. The change in exposure to travel accident risk is based on the predicted amount of travel (VMT) and the comparative likelihood of a fatal, injury, or property damage only accident occurring using the existing transportation facilities and the new/improved transportation facilities. The amount of VMT is estimated using the travel demand or forecasting model. If the disaggregated data are available, crash rates and average accident costs can be applied to non-user VMT avoided to estimate the number of accidents avoided and the avoided costs associated with these accidents.

Community Benefits (also Public or Social Benefits): Community benefits are one of a number of benefit types. They are benefits that are experienced by the entire community within the study area, not just users. These benefits, frequently called social or public benefits, include reduced emissions or environmental impacts, economic competitiveness, noise reductions, greater walkability, greater access for transit dependent populations, greater access to jobs from existing housing locations, and recreational benefits. Many of these impacts are not quantifiable and must be discussed qualitatively, stating what the benefits are and who the beneficiary groups are. Some of these impacts that are quantifiable include:

- *Emissions avoided*: As travelers divert to the new/improved transportation investment (particularly transit or other cleaner modes of travel), VMT are likely to be reduced, resulting in a reduction of emissions. The amount of VMT avoided is estimated by the travel demand model. The value of these emissions can be estimated by applying the economic cost of air emissions to the reduction of CO, NOx, VOC, PM-10, and CO2.
- Greater access for transit dependent populations. This estimate can be generated through GIS analysis of the data that underpins the environmental justice analysis of an environmental document and the travel demand modeling. Typically, as part of the project's development, planners have evaluated the difference in travel times with and without the project. Using this same metric, a GIS analysis can calculate the difference in the spatial area accessed within a 30 or 45 minute travel time and the job opportunities associated with that greater access.

- *Livability impacts*: Of all the wider economic impacts, livability impacts are the newest and thus least defined methodologically. Livability, which is a major new focus at US DOT, currently does not have a common and agreed-upon set of performance metrics that analysts can use to quantify and/or monetize its impact. The effort to incorporate livability into economic analysis is being accomplished under the Interagency Partnership for Sustainable Communities (PSC) that was established in June 2009. Complicating the inclusion of livability in a project assessment is the variety of ways that it can be defined and how it would vary from an urban setting to a rural one. The Six Livability Guiding Principles for the PSC are:
    1. Provide more transportation choices;
    2. Promote equitable, affordable housing;
    3. Enhance economic competitiveness;
    4. Support existing communities;
    5. Coordinate policies and leverage investment; and
    6. Value communities and neighborhoods.
- Fiscal impacts. This estimate quantifies the change (increase or decrease) in tax revenues available to a jurisdiction for providing community services associated with the change in underlying property value. It is a straightforward application of the community's tax rate for each property type applied to the value of the land for parcels affected by the project. The parcel values are acquired from the assessors' records.
- *Investments avoided*: As travelers divert to the new/improved transportation investment, VMT are likely to be reduced, resulting in the decline of the wear and tear on other assets. As a result of this reduced wear and tear, other transportation investments to improve or repair these assets may be avoided or delayed. The value of these investment savings can be discounted and included as a benefit.

Wider Economic Benefits: Recognizing the value of a complete—and to the degree possible—uniformly quantifiable assessment, transportation economists have begun to expand the range of impacts estimated in their analyses. Reflecting the expansion of economic outcomes considered and the scope of project evaluation, these impact types fall under the umbrella term "wider economic impacts." While this is an evolving field within transportation project assessment, the main types of wider economic impacts that are more commonly used in empirical project analyses are described below.

- *Agglomeration economy*: The term agglomeration refers to the concentration of economic activity within a region. Transportation investment that significantly reduces travel time between cities or increases the ability to move large numbers of people in and out of an urban market improves accessibility—increasing the number of workers and suppliers of other goods and services accessible to a firm. As a result, the range of choice expands, and firms are able to select those workers and suppliers that represent the best "match" for their needs. When the match between workers and firms—or between suppliers and producers— improves, the productivity of the market increases because firms are using workers with the best skill set for their needs and suppliers are using specialized expertise that best fits their needs. This is the agglomeration impact. Past theoretical and empirical evidence has confirmed that the level of agglomeration affects the productivity of firms and workers in an area, even after controlling for characteristics specific to firms and workers in that area, such as the mix of industries.
- *Land premium*: Just as labor markets become more productive when accessibility improves, the value of land improves as well. Residents and commercial enterprises will be willing to pay a premium for locations where access is improved relative to other locations without good transportation access. Studies have shown that an increase in property values near transit lines can range from 0 to over 30 percent—with selectively higher amounts possible. This land premium impact is distinct from station-area development because the impact here is to existing properties in close proximity to the station areas, absent additional private development.
- *Option value*: Option value analysis captures the value non-users place on having an alternative means to travel. For example, in a highly congested highway corridor, where travel times are variable and unreliable,

auto travelers may place value on having the option of using a different mode (such as transit, intercity rail, or perhaps a variable toll lane) that guarantees a trip within a known and reliable travel time. In this way, option value is like a mobility insurance premium. While the concept of an option value is comparatively new to transportation project assessment, it is widely used in environmental economics. For example, in an environmental context, people are willing to pay a premium to ensure that natural environments or wildlife species exist so that they can view them in the future.

Additional, related terms:

- *Economic competitiveness*: Ability of one area or region to attract new development or businesses (from outside the region). Competitiveness can be improved through reliable and timely access to employment centers, educational opportunities, services and other basic needs by workers as well as expanded business access to markets.

Area 5: Direct, Indirect, and Induced Impacts

Direct, indirect, and induced impacts are estimated by I-O models (see Area 12). These impact types are described as follows:

- *Direct impacts*: The first-level impacts occur as a result of the project (e.g. construction purchases, construction hiring, operating purchases, and operating hiring)
- *Indirect impacts*: The second-level impacts occur as the increase in construction requires purchases from supporting industries, such as higher steel production, which in turn requires more chemicals, iron, ore, and limestone. Input-output tables trace these input chains back through the economy to arrive at the total requirements needed to support a given increase in the final demand for construction.
- *Induced impacts*: The third-level impacts occur as resident workers associated with the direct and indirect impacts of the project spend a portion of their increased earnings on additional goods and services. These consumer demands generate further multiplier effects in the same way that the increase in construction does.

Area 6: Discounting

Discounting is the process by which benefits and costs can be stated in present value (PV), assuming a specific discount rate (or time value of money). A dollar 10 years from now is not worth the same as a dollar today because the dollar today could be invested and return more than a dollar 10 years from now (excluding inflationary impacts; see Area 11). As a result, benefits that are experienced today are more valuable than the benefits expected in 10 years.

By stating the economic impact measures in present value it is possible to compare these benefits to the project costs in a BCA. Since EIA results are not specifically compared to project costs, the results generally are not discounted.

PV = Value of Cost or Benefit in Year t * [(1+discount rate)^(forecast year t – base year)]

Additional, related terms:

- *Discount Rate*: The discount rate reflects the time value of money (or opportunity cost) associated with delaying a project's cost and/or benefit.
- *Opportunity cost*: The cost associated with delaying an investment, also sometimes referred to as the time value of money. In the example above (a dollar 10 years from now), the amount of money gained from investment of the dollar today would be the opportunity cost associated with receiving the dollar 10 years from now.

- *Nominal dollars*: Includes inflationary impacts in forecasts of future dollar amounts. The discount rates for nominal dollars are greater than those for real dollars in order to account for the inflationary impacts.
- *Real dollars*: Removes the inflationary impacts from forecasts of future dollar amounts. Generally, real dollars are used in benefit cost and economic impact analyses; therefore, a base year dollar amount must be defined for each project (i.e. 2010, 2011) so that all costs and benefits are shown in the same year dollar.

Area 7: Econometric Models

This is a structured quantitative analysis often used as part of an economic analysis. It uses the past relationship between economic variables (e.g. population, employment, income) to predict the future values of another economic variable (e.g. housing stock, retail sales tax revenues), frequently involving regression analyses. If, for example, we run a regression and find that a community adds one house for every six new residents (some new residents are children who are born and "move" to existing houses), and we know something about future population growth, we can make a prediction about housing growth too.

The econometric model's prediction is only good to the extent that past relationships hold into the future. This is why econometric models are sometimes paired with leading indicators. No econometric model would predict a recession—the leading indicators, however, do signal a slowdown. This provides forecasters with some warning that the econometric model might not be performing as well as it had in the past.

Examples and a brief description of econometric models frequently used in transportation planning include RIMS II, IMPLAN, REMI, and TREDIS which are shown below. Please note that this is not an inclusive list, but a list of some of the more commonly used econometric models.

- *Regional Input-Output Modeling System (RIMS II):* Developed by the US Bureau of Economic Analysis (BEA), RIMS II is an I-O model that produces economic multipliers so that the user can estimate the direct, indirect, and induced jobs and earnings produced given a change in final demand or a direct change in employment or earnings for a particularly industry (i.e. construction). The RIMS II multipliers are developed in accordance with the specific industry structure of the user defined region in terms of inter-industry purchasing patterns.

- *IMPLAN:* Developed by MIG, Inc., IMPLAN is an I-O model that produces economic multipliers to estimate the direct, indirect, and induced jobs and earnings produced by a given change in final demand or direct change in employment or earnings. However, unlike RIMS II, IMPLAN is a software package that estimates these direct, indirect, and induced impacts as well as provides the multipliers used to develop the impacts.

- *REMI:* Developed by Regional Economic Models, Inc. (REMI), the structure of the REMI model incorporates inter-industry transactions (I-O model), as well as behavioral equations from economic theory that allow the model to respond to changes in an area's economy resulting from strategic investments. The REMI model distinguishes itself from a traditional I-O model in that it allows for substitution among production factors (e.g. wages, labor markets, migration) in response to changes in relative production factor costs over time and accounts for agglomeration impacts.

- *TREDIS:* Developed by Economic Development Research Group, Inc. (EDR), the Transportation Economic Development Impact System (TREDIS) is specifically designed to develop economic impact and benefit cost analyses for transportation investments of all modes (highway, bus, rail, aviation, maritime, and multi-modal) as well as freight and passenger transportation. The sophistication of the web-based model also can vary depending on the users' needs from a sketch planning/early assessment tool to a comprehensive analysis tool. It also accounts for agglomeration impacts using the Local Economic Assessment Package (LEAP), which draws on a database of local economic conditions and research to estimate how quantified changes in access improve the competitiveness of the study area to attract business.

Additional, related terms:

- *Leading indicators*: An economic variable or factor that typically changes before economy begins a change in business cycle (i.e. recession, recovery). Tracking these variables may help predict changes in the business cycle.
- *Hedonic estimation model*: A model that uses revealed preferences to estimate a value or demand for an asset or good. It requires the asset or good being modeled to be separated into its defining characteristics and then assembly of estimates of the contributing value of each characteristic. These characteristics must have a market value in order for the asset or good to be modeled hedonically.

Area 8: Economic Development

Economic development is defined locally because the objectives or goals of economic development can vary from place to place. Economic development can mean greater industrial diversity, new job and income creation, higher-wage jobs, land use changes, cost savings to businesses or households. As a result of this significant variation, the metrics used to define economic development vary depending on the specific goals of the locality.

However, with all economic development impacts, it is important to carefully consider whether or not the resulting impacts can be included in a BCA or whether they are more appropriate for an EIA (see Area 2). As mentioned previously, job creation should not be included in a BCA since jobs represent a transfer payment, a cost to the employer (paying a wage) and a benefit to the employee (receiving a wage). Similarly, new station area development or TOD is not included in a BCA because the increase in property values generally equals the cost of the investment or results in the creation of jobs. However, an increase in labor productivity or agglomeration economies (see Area 4) can be included in a BCA.

Area 9: Economic Multiplier

Economic multipliers are produced by I-O models for the defined study or benefit area. With the purchase of materials and labor to construct a transportation project, a chain of transactions result, which is how the multipliers are calculated for a defined region. The defined region for the multipliers should reflect the areas where benefits are generated; however, most multipliers are defined at the county or state level, which means that the smallest area of measurement generally is one county or a region made up of several counties.

The specification of the region influences the values of the multiplier coefficients; generally, the larger, more economically diverse the region, the higher the value for the coefficients since more inputs, e.g. labor, materials, intermediate goods, would be sourced to the region as opposed to being purchased from outside the region. The multipliers reflect the supplier linkages for the each industry, and thus account for any leakage from the local economy (i.e. those goods and services that are not available locally and must be purchased from outside the defined region).

For example, multipliers can be used to estimate economic impacts from transportation infrastructure investments and operations in the following forms for a defined region or regions:

- ***Final demand* multipliers for *output***, which estimate the total dollar change in output for all industries for each additional dollar of output delivered to final demand by the industry specified (i.e. the construction industry)
- ***Final demand multipliers for value added***, which estimate the total dollar change in value added for all industries for each additional dollar of output delivered to final demand by the industry specified

- *Final demand multipliers for earnings*, which estimate the total dollar change in earnings of households employed by all industries for each additional dollar of output delivered to final demand by the industry specified (e.g. the construction industry)
- *Final demand multipliers for employment*, which estimate the total change in the number of jobs that occurs in all industries for each additional 1 million dollars of output delivered to final demand by the industry specified (e.g. the construction industry)
- *Direct effect multipliers for earnings*, which estimate the total dollar change in earnings of households employed by all industries for each additional dollar of earnings paid directly to households employed by the industry specified (e.g. transit and ground passenger transportation)
- *Direct effect multipliers for employment*, which estimate the total change in the number of jobs in all industries for each additional job in the industry specified (e.g. transit and ground passenger transportation)

Additional, related terms:

- *Final demand*: The purchases of goods and services by final or end users in the economy. These multipliers generally are used to estimate total impacts (direct + indirect + induced) when only the total cost of a project is known.
- *Direct effect*: Reflects the impacts (job, earnings, etc.) that are the direct result of the project, i.e. those hired for the project by industry type. These multipliers are used to estimate total impacts (direct + indirect + induced) when the direct change in the number of jobs or earnings for the project by industry is known (i.e. number of employees hired to operate the project and/or the total earnings of these employees, including benefits.

Area 10: Economic Transfer

Economic transfer is the shift of benefits from one location or population group in a region to another location or population group in the same region. As a result, the benefits experienced by one group or area due to the project are netted out due to the resulting costs experienced by another group or area.

For example, in a BCA, jobs and earnings generally are not included as benefits because jobs represent both a cost to the employer (paying a wage) and a benefit to the employee (receiving a wage); as a result, it is a transfer payment rather than a net benefit. Similarly, property tax is a benefit to the taxing authority, while it is a cost to the taxpayer. In terms of economic development, if development shifts from one area of the region to another, it is a transfer of benefits rather than the result of attracting new development (from outside the region) to project area.

Area 11: Escalation and Deflation

Escalation is the means by which real values are adjusted for inflation. Deflation is the means by which nominal values are adjusted to a common real value. A dollar will buy less retail output today than it did 20 years ago. Just looking at data, a $20 purchase gets reported in the same manner today as it did 20 years ago, even though it represents a very different quantity of goods. By accounting for the price effect, economists have a clearer picture of the true economic impact during any time period.

Area 12: Input-Output Models

Input-Output (I-O) models are a type of econometric model that predicts, for each year in the future, the number and distribution of output, value added, earnings, and employment in a defined region for each industry sector based on the specific industry structure of the region. These predictions are based on the defined region's inter-industry purchasing patterns (who buys what from whom). These inter-industry purchasing patterns come from I-O accounting tables that trace the extent to which each industry sector generates demand for inputs from other sectors. Since these tables are based on history, these models can be used as long as the structure of the economy (i.e. industries and companies located within the region, productivity levels, labor force, wages, etc.) does not change as a result of the project or programs of projects.

The major advantage of using I-O techniques is that they allow estimation of both the direct and indirect economic effects of changes in demand for particular goods and services. For example, the construction of a highway project requires an increase in the output of the construction industry. This increase in construction requires, among other things, higher steel production, which in turn requires more chemicals, iron, ore, and limestone. Input-output tables trace these input chains back through the economy to arrive at the total local requirements (materials, supplies, services, labor, etc.) needed to support a given increase in highway construction.

The use of I-O models also allows for the estimation of induced economic impacts that result from changes in demand for particular goods and services. The direct and indirect effects are stated in terms of employment and earnings that accrue to the benefit of workers who reside in the defined region. These workers will spend a portion of their increased earnings on additional goods and services in the region, and these consumer demands will generate further multiplier effects in the same way that the increase in highway construction did.

Examples of I-O models frequently used in transportation planning include RIMS II and IMPLAN. However, please note that this is not an inclusive list of I-O models.

Additional, related terms:

- *Output:* Reflects the purchase of goods and services—that are used in the production of other goods and services (and that are not sold in final demand markets)—and value added.
- *Value added:* Includes the compensation of employees, taxes on production and imports (less subsidies), and the gross operating surplus for a particular industry. As a result, it also reflects the contribution of a particular industry to the gross domestic product (GDP).
- *Gross Domestic Product (GDP):* Reflects the market value of goods and services produced by all industries in the US.
- *Earnings:* Reflects the sum of wages and salaries, income of sole proprietors or partnerships, and employer contributions for health insurance (excluding contributions for social insurance, such as Social Security)
- *Employment:* Includes full- and part-time jobs. Often reported as job-years, or one job that lasts for one year.

Area 13: Location Efficiency

Housing is typically the largest expense a household incurs. Households select their residential locations based on a number of factors—seeking to maximize the size, quality, amenities and services offered by neighborhood locations—subject to their budgets. In short, they try to maximize the bundle of housing and neighborhood services given the affordability of the location. Location efficiency, adds transportation cost to the assessment. It considers the cost and affordability of housing by including both the housing cost and the transportation costs associated with living in that location.

Area 14: Residual Value

Many transportation project assets will have a useful life that extends beyond the analysis period specified for the federal and state grant programs that are likely to use the information developed in the benefit cost analysis. US DOT guidance indicates that this project value is a benefit as long as the expectation is that the asset will be in service for its full useful life. In order to estimate the residual value of the project, the capital investment should be depreciated (e.g. straight-line) over the full length of its asset life. The years included in the benefit cost or economic impact analysis must be excluded from the residual estimation—as these years are the basis of the other benefits estimation. For a BCA, this residual value should be discounted back to a present value and included as a benefit in the analysis.

Additional, related terms:

- *Depreciation*: Depreciation is a means to allocate the cost of an asset over its useful life. Straight-line depreciation assumes the costs are allocated equally over each year of the asset's useful life. The term also can be used to describe the decline in the value of assets over time due to wear and tear and technological advances or changes.
- *Salvage value*: Same as residual value. It implies that investment has value even if the project should stop operating because the components of the project could be sold (i.e. vehicles, equipment, steel, etc.) There also could be demolition costs associated with a salvage value if the asset is to be removed at the end of its service life.

Area 15: Sensitivity Analysis and Risk

Risk is associated with any forecast including population, employment, travel demand results, costs, and revenue—all forecasts frequently involved in economic analyses. The risk stems from the fact that forecasts are predictions of the future based on available information at the time the forecast was developed (usually historic data, professional judgment, and forecasts of other variables provided by local, state, or federal governments or experts). Even with the most rigorous forecast, it is almost guaranteed that the actual data in the future will be different from the forecast. However, it is a matter of how different (e.g. 0.5% vs. 20%)—and how dependent the results of the economic analyses are on these forecasts being close to the actual future result.

A sensitivity analysis is a means to measure how sensitive the results of the economic analysis are to changes in the input forecasts of population, employment, travel demand, etc., either separately or combined. There are two general types of sensitivity analysis that can be performed on the results of an economic analysis: uni-dimensional stress test and a more dynamic risk analysis that uses Monte Carlo simulation. Each sensitivity analysis has a role with certain advantages and disadvantages:

- *Uni-dimensional stress test*: With a stress test, one or more uncertainty variables (e.g. inflation, population, ridership) are selected, and the analysis is run with alternative values of these variables that typically represent baseline, high, and low scenarios. This approach can define the upper and lower extremes, answering the important question: How bad could it get? This type of sensitivity analysis is the most common and simplest to perform. It is also the easiest for the general public to understand. However, it does not recognize that all uncertainty variables likely change simultaneously, not just the ones selected in the "stress test." Nor does it recognize that there is a lower probability of outcomes that are farther away from the most likely value. While "How bad it could get" is clearly important information, it does not address the likelihood of the pessimistic outcome.
- *Risk analysis with Monte Carlo simulation*: Risk analysis with Monte Carlo simulation addresses some of the concerns associated with the uni-dimensional stress test, particularly the ability to change multiple variables at the same time and the likelihood of a pessimistic outcome. Risk analysis examines the probability of failure by replacing point values of uncertainty variables with a pessimistic, likely, and optimistic range, permitting all uncertainty variables to vary simultaneously and summarizing the results over

a large number of iterations (model runs). Risk analysis quantifies the “down-side” risk and provides decision makers with some comfort or confidence in the economic analysis results. Running a risk analysis with Monte Carlo simulation is more complex than a stress test and requires the purchase and application of software.

Area 16: Study Area

The study area for the economic analysis can be the same as that defined for the project (also sometimes called the project or corridor area). However, in most cases the economic impacts are also felt outside the immediate project or corridor area, i.e. jobs in the project corridor may be filled by people residing outside the immediate corridor, in neighboring towns or counties. As a result, the economic benefits or impacts are frequently reported for a slightly larger study area, such as the metropolitan statistical area (MSA), county, groups of counties, megapolitan region, or the state. The study area selected should include those areas that will provide a large percentage of the labor, supplies, materials, services, etc. for the project.

When defining the study area for economic analyses it is important to make the area large enough to accurately measure the place where the local impacts will be felt, but not so large that it would overstate the benefits of the project. For example, a transit investment in a large city is a project with a local focus; therefore, a county-level or MSA-defined study area is most appropriate. However, if the economic analysis is looking at a state program of transportation projects, the appropriate study may be the entire state, rather than the localities of each project. Similarly, if the economic analysis study is too narrowly defined (e.g. one county in a large, seven-county MSA) the economic impacts could be understated.

When performing an economic analysis, it also may be appropriate to include results for multiple study areas depending upon who the project stakeholders are. While a county may be the primary funding source for a project, the state may also want to know the larger economic impacts for the MSA or the state if it also a partner in the project. In this instance, economic impacts could be reported at both the county and MSA or state level. However, it is important to note that when multiple study areas are defined for similar regions (i.e. the county is included in the MSA), the economic results are not additive because the county impacts are already included in the larger MSA.

ALPHABETICAL GLOSSARY OF TERMS

Accidents Avoided: A benefit that is the same for users and non-users of a new-improved transportation investment. As travelers divert to the investment (particularly transit or other safer modes of travel), their exposure to the hazard of being involved in a travel accident is reduced. This hazard reduction has value. The value is based on the degree to which travelers' exposure to risk is reduced and the potential cost if that risk materializes.

The change in exposure to travel accident risk is based on the predicted amount of travel (VMT) and the comparative likelihood of a fatal, injury, or property-damage-only accident occurring, using the existing transportation facilities and the new/improved transportation facilities. The amount of VMT is estimated using the travel demand model. Crash rates and average accident costs can be applied to VMT-avoided to estimate the number of accidents avoided and the avoided costs associated with these accidents. (See Area 4, Benefit Types, in Topical Glossary)

Agglomeration Benefits or Economy: By collecting producers, suppliers, and consumers in urban centers, communication, transport, distribution, and production activities are less costly. These so-called agglomeration economies diminish the cost of transactions and make the urban area's firms more productive. Thus they are considered wider economic benefits. (See Area 4, Benefit Types, in Topical Glossary)

Base Case: The base case represents the existing conditions in the project area. It is used to compare the impacts of the project or program of projects (improvement/build alternative) being studied as part of the economic analysis. The base case may be either the No Build or Transportation Systems Management (TSM) alternative. (See Area 1, Base Case, in Topical Glossary)

Benefit Cost Analysis (BCA): A form of economic analysis that is used to determine whether a project yields a positive return on investment (ROI) by comparing the quantifiable benefits to the project costs for a defined period of time (usually the useful life of the project or program of projects). (See Area 2, Benefit Cost Analysis vs. Economic Impact Analysis, in Topical Glossary)

Benefit Cost Ratio: The benefit cost ratio is equal to the sum of the discounted benefits, divided by the sum of the discounted costs (both capital and operating) for a defined analysis period, such as 20 years or the useful life of the asset. A benefit cost ratio of one (1) implies that benefits equal the costs. A ratio greater than one (1) implies that the benefits are greater than the costs, and a ratio less than one (1) implies that the costs exceed the benefits. (See Area 3, BCA Ratio, in Topical Glossary)

Community Benefits (also known as Social or Public Benefits): These are benefits that are experienced by the entire community within the study area, not just users. These benefits include reduced emissions or environmental impacts, noise reductions, greater walkability, greater access for transit dependent populations, greater access to jobs from existing housing locations, recreational benefits, and the option to have an alternative/improved means to travel. Many of these impacts are not quantifiable and must be discussed qualitatively, stating what the benefits are and who the beneficiary groups are. (See Area 4, Benefit Types, in Topical Glossary)

Competitiveness: See Economic Competitiveness

Cost Benefit Analysis: Same as Benefit Cost Analysis

Deflation: The means by which nominal values are adjusted to a common real value. (See Area 11, Escalation and Deflation, in Topical Glossary)

Depreciation: Depreciation is a means to allocate the cost of an asset over its useful life. Straight-line depreciation assumes the costs are allocated equally over each year of the asset's useful life. The term also can be used to describe the decline in the value of assets over time due to wear and tear and technological advances or changes. (See Area 14, Residual Value, in Topical Glosary)

Direct Effect: The impacts (e.g. jobs, earnings) that are the direct result of a project—i.e. those hired for the project by industry type. These multipliers are used to estimate total impacts (direct + indirect + induced) when the direct change in the number of jobs or earnings for the project by industry is known (i.e. number of employees hired to operate the project and/or the total earnings of these employees, including benefits). (See Area 9, Economic Multiplier, in Topical Glossary)

Direct Effect Multipliers for Earnings: Estimate the total dollar change in earnings of households employed by all industries for each additional dollar of earnings paid directly to households employed by the industry specified (e.g. transit and ground passenger transportation). (See Area 9, Economic Multiplier, in Topical Glossary)

Direct Effect Multipliers for Employment: Estimate the total change in the number of jobs in all industries for each additional job in the industry specified (e.g. transit and ground passenger transportation). (See Area 9, Economic Multiplier, in Topical Glossary)

Direct Impacts: First-level impacts that occur as a result of a project (e.g. construction purchases, construction hiring, operating purchases, and operating hiring). Estimated by Input-Output models. (See Area 5, Direct, Indirect, and Induced Impacts, in Topical Glossary)

Discounting: Discounting is the process by which benefits and costs can be stated in present value (PV), assuming a specific discount rate (or time value of money). (See Area 6, Discounting, in Topical Glossary)

Discount Rate: The discount rate reflects the time value of money (or opportunity cost) associated with delaying a project's cost and/or benefit. If the project is receiving federal money, the US Office of Management and Budget (OMB) requires that you include a 7% real discount rate. However, this rate is rather steep given the recent history of interest rates, and decision makers and project team member may also want to evaluate the impacts of a lower discount rate on the results of their project or program analysis results. (See Area 6, Discounting, in Topical Glossary)

Earnings: The sum of wages and salaries, income of sole proprietors or partnerships, and employer contributions for health insurance (excluding contributions for social insurance, such as Social Security). (See Area 12, Input-Output Models, in Topical Glossary)

Econometric Models: A structured quantitative analysis often used as part of an economic analysis. It uses the past relationship between economic variables (e.g. population, employment, income) to predict the future values of another economic variable (e.g. housing stock, retail sales tax revenues). It frequently involves the use of regression analyses. (See Area 7, Econometric Models, in Topical Glossary)

Economic Competitiveness: Ability of one area or region to attract new development or businesses (from outside the region). Competitiveness can be improved through reliable and timely access to employment centers, educational opportunities, services and other basic needs by workers, as well as expanded business access to markets. (See Area 4, Benefit Types, in Topical Glossary)

Economic Development: Economic development is defined locally because its objectives or goals can vary from place to place. It can mean greater industrial diversity, new job and income creation, higher-wage jobs, land use changes, or cost savings to businesses or households. As a result of this significant variation, the metrics used to define economic development vary depending on the specific goals of the locality. (See Area 8, Economic Development, in Topical Glossary)

Economic Impact Analysis (EIA): A form of economic analysis that is used to estimate the benefits or impacts that result from a project or program of projects' construction and implementation, regardless of whether they are a transfer or net incremental change. Additionally, these impacts may consist of both quantifiable and non-quantifiable impacts, including those incorporated in a benefit cost analysis. (See Area 2, Benefit Cost Analysis vs. Economic Impact Analysis, in Topical Glossary)

Economic Multipliers: These are factors that estimate how changes in final demand for a particular industry impact employment, earnings, value added, and output for all industries in a study or benefit area. Multipliers are produced by I-O models for a specified area. With the purchase of materials and labor to construct a transportation project, a chain of transactions result. This chain of transactions is captured by the I-O table or model and is used to calculate the multipliers for a specified region.

The specification of the region influences the values of the multiplier coefficients. Generally, the larger, more economically diverse the region, the higher the value for the coefficients since more inputs, e.g. labor, materials, intermediate goods, would be sourced to the region as opposed to being purchased from outside the region. The multipliers reflect the supplier linkages for each industry, and thus account for any leakage from the local economy (i.e. those goods and services that are not available locally and must be purchased from outside the defined region). (See Area 9, Economic Multiplier, in Topical Glossary)

Economic Transfer (or Transfer or Transfer Payment): A shift of benefits from one location or population group in a region to another location or population group in the same region. As a result, the benefits experienced by one group or area due to the project are netted out due to the resulting costs experienced by another group or area. (See Area 10, Economic Transfer, in Topical Glossary)

Emissions Avoided: As travelers divert to a new/improved transportation investment (particularly transit or other cleaner modes of travel), VMT are likely to be reduced, resulting in a reduction of emissions. The amount of VMT avoided is estimated by the travel demand model. (See Area 4, Benefit Types, in Topical Glossary)

Employment: Includes full- and part-time jobs. Often reported as job-years—or one job that lasts for one year. (See Area 12, Input-Output Models, in Topical Glossary)

Equivalent Uniform Annual Benefit (EUAB): The equivalent uniform annual benefit (EUAB) annualizes the value of a project or program's benefits and can be used to identify the most beneficial project alternative, assuming the costs of the project are the same. By annualizing the full benefits, it allows different projects or programs with the same costs) to be compared. (See Area 3, BCA Ratio, in Topical Glossary)

Equivalent Uniform Annual Cost (EUAC): Represents the capital recovery cost of a project and can be used to identify the most cost-efficient project alternative, assuming the benefits from the project are the same. By annualizing the full costs (capital, operating, and any salvage value associate with the project or program), it allows projects with varying useful lives to be compared. (See Area 3, BCA Ratio, in Topical Glossary)

Escalation: The means by which real values are adjusted for inflation. (See Area 11, Escalation and Deflation, in Topical Glossary)

Final Demand: The purchases of goods and services by final or end users in the economy. These are multipliers generally used to estimate total impacts (direct + indirect + induced) when only the total cost of a project is known. (See Area 9, Economic Multiplier, in Topical Glossary)

Final Demand Multipliers for Earnings: Estimate the total dollar change in earnings of households employed by all industries for each additional dollar of output delivered to final demand by the industry specified (e.g. the construction industry). (See Area 9, Economic Multiplier, in Topical Glossary)

Final Demand Multipliers for Employment: Estimate the total change in the number of jobs that occurs in all industries for each additional 1 million dollars of output delivered to final demand by the industry specified (e.g. the construction industry). (See Area 9, Economic Multiplier, in Topical Glossary)

Final Demand Multipliers for Output: Estimate the total dollar change in output for all industries for each additional dollar of output delivered to final demand by the industry specified (e.g. the construction industry). (See Area 9, Economic Multiplier, in Topical Glossary)

Final Demand Multipliers for Value-Added: Estimate the total dollar change in value added for all industries for each additional dollar of output delivered to final demand by the industry specified (e.g. the construction industry). (See Area 9, Economic Multiplier, in Topical Glossary)

Fiscal Impacts: Quantifies the change (increase or decrease) in tax revenues available to a jurisdiction for providing community services associated with the transportation investments. May include, but is not limited to, property, sales, and income taxes. (See Area 4, Benefit Types, in Topical Glossary)

Gross Domestic Product (GDP): The market value of goods and services produced by all industries in the US. (See Area 12, Input-Output Models, in Topical Glossary)

Hedonic Estimation Model: A model that uses revealed preferences to estimate a value or demand for an asset or good. It requires the asset or good being modeled to be separated into its defining characteristics and then assembly of estimates of the contributing value of each characteristic. These characteristics must have a market value in order for the asset or good to be modeled hedonically. (See Area 7, Econometric Models, in Topical Glossary)

IMPLAN: An Input-Output model developed by MIG, Inc. that produces economic multipliers so that the user can estimate the direct, indirect, and induced jobs and earnings produced by a given change in final demand or a direct change in employment or earnings. IMPLAN is a software package that estimates these direct, indirect, and induced impacts, as well as providing the multipliers used to develop the impacts. (See Area 7, Econometric Models, in Topical Glossary)

Improvement/Build Alternative: The project or program of projects being evaluated. (See Area 1, Base Case, in Topical Glossary)

Indirect Impacts: Second-level impacts that occur as the increase in construction requires purchases from supporting industries, such as higher steel production, which in turn requires more chemicals, iron, ore, and limestone. Input-output tables trace these input chains back through the economy to arrive at the total requirements needed to support a given increase in the final demand for construction. (See Area 5, Direct, Indirect, and Induced Impacts, in Topical Glossary)

Induced Impacts: Third-level impacts that occur as resident workers associated with the direct and indirect impacts of the project spend a portion of their increased earnings on additional goods and services. These consumer demands generate further multiplier effects in the same way that the increase in construction does. Estimated by Input-Output models. (See Area 5, Direct, Indirect, and Induced Impacts, in Topical Glossary)

Input-Output (I-O) Models: A type of economic model that predicts, for each year in the future, the number and distribution of output, value-added, earnings, and employment in a defined region for each industry sector based on the specific industry structure of the region. These predictions are based on the defined region's inter-industry purchasing patterns (who buy what from whom). These inter-industry purchasing patterns come from I-O accounting tables that trace the extent to which each industry sector generates demand for inputs from other sectors. (See Area 12, Input-Output Models, in Topical Glossary)
Internal Rate of Return: See Rate of Return.

Investments Avoided: As travelers divert to a new/improved transportation investment, Vehicle Miles Traveled (VMT) are likely to be reduced, resulting in the decline of the wear and tear on other assets. As a result of this reduced wear and tear, other transportation investments to improve or repair these assets may be avoided or delayed. The value of these investment savings can be discounted and included as a wider economic benefit. (See Area 4, Benefit Types, in Topical Glossary)

Job-Years: One job that lasts for one year. (See Area 12, Input-Output Models, in Topical Glossary)

Land Premium: Once a transportation project begins operation, parcels located along the corridor may enjoy greater access to the broader metropolitan region. Residents and commercial enterprises may be willing to pay a premium for the locations where access is improved relative to other locations without good transportation access. (See Area 4, Benefit Types, in Topical Glossary)

Leading Indicators: An economic variable or factor that typically changes before the economy begins a change in business cycle (e.g. recession, recovery). Tracking these variables may help predict changes in the business cycle. Examples of leading indicators include unemployment rates, Consumer Price Index (inflation measure), manufacturing indices, housing starts, and stock market prices or indices. (See Area 7, Econometric Models, in Topical Glossary)

Life-Cycle Cost Analysis: A process for evaluating the total economic worth of a usable project segment by analyzing initial costs and discounted future costs, such as user, maintenance, reconstruction, rehabilitation, restoring, and resurfacing costs, over the life of the project segment. (Source: TEA-21)

Location Efficiency: Location efficiency adds transportation cost to the assessment of housing and neighborhood locations by households. It considers the cost and affordability of housing by including both the housing cost and the transportation costs associated with living in that location. (See Area 13, Location Efficiency, in Topical Glossary)

Multipliers: See Economic Multipliers.

Net Present Value: The net present value (NPV) of a project is estimated by subtracting the total discounted project costs from the total discounted benefits for a defined period to help determine if the project is economically viable. A NPV that is greater than zero (0) indicates that the benefits exceed the costs and is therefore, economically viable. (See Area 2, Benefit Cost Analysis vs. Economic Impact Analysis, in Topical Glossary)

No Build Alternative: Generally represents existing conditions in the project area including transportation projects currently under construction or funded for construction and operation. (See Area 1, Base Case, in Topical Glossary)

Nominal Dollars or Value: Forecasts of future dollar amounts that include inflationary impacts. The discount rates for nominal dollars are greater than those for real dollars in order to account for the inflationary impacts. (See Area 6, Discounting, in Topical Glossary)

Non-user Benefits: Non-user benefits are those transportation benefits (travel time, travel cost, and accidents avoided savings) experienced by people who are not directly using the new transportation investment. (See Area 4, Benefit Types, in Topical Glossary)

North American Industry Classification System (NAICS): NAICS is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. The NAICS system allows for a high level of comparability in business statistics among the North American countries. (Source: NAICS Main Page, http://www.census.gov/eos/www/naics/)

Opportunity Cost: The cost associated with delaying an investment, also sometimes referred to as the time value of money. The amount of money gained from investment of a dollar today would be the opportunity cost associated with receiving the dollar 10 years from now. (See Area 6, Discounting, in Topical Glossary)

Option Value: Residents and travelers prefer to have more numerous travel options available to them, even if they do not plan to use all of the options. The option value attempts to place a dollar value on having this option for the non-user – whether in terms of adding additional transportation service or taking it away. This is a less traditional benefit and often difficult to quantify. (See Area 4, Benefit Types, in Topical Glossary)

Output: Consists of the purchase of goods and services that are used in the production of other goods and services (and not sold in final demand markets)—and value added. (See Area 12, Input-Output Models, in Topical Glossary)

Pay-back Period: The number of years of operation required for the present value of the total benefits to equal the present value of the total costs. This measure helps quantify the ability of the project to absorb risk. (See Area 3, BCA Ratio, in Topical Glossary)

Present Value (PV): Current value of future costs and/or benefits. These costs and/or benefits are discounted to account for the time value of money (or opportunity cost) associated with delaying the cost and/or benefit. For example, a dollar 10 years from now is not the same as a dollar today because the dollar today could be invested and return more than a dollar 10 years from now (excluding inflationary impacts). By stating the benefits and/or costs in present value, these values are comparable across transportation projects that occur at different times. (See Area 6, Discounting, in Topical Glossary)

Public or Social Benefits: See Community Benefits

Rate of Return (or Internal Rate of Return): The discount rate required so that the discounted total benefits equal the discounted total costs (i.e. NPV = 0). The higher the rate of return, the more economically viable the project is. (see Area 3, BCA Ratio, in Topical Glossary)

Real Dollars or Value: Forecasts of future dollar amounts without inflationary impacts. Generally, real dollars are used in benefit cost and economic impact analyses. Therefore, a base year dollar amount (e.g. 2011, 2012) must be defined for each project, so that all costs and benefits are shown in the same year dollar. (See Area 6, Discounting, in Topical Glossary)

Regional Input-Output Modeling System (RIMS II): Developed by the US Bureau of Economic Analysis (BEA), RIMS II is an Input-Output model that produces economic multipliers so that the user can estimate the direct, indirect, and induced jobs and earnings produced by a given a change in final demand or a direct change in employment or earnings for a particularly industry (e.g. construction). The RIMS II multipliers are developed in accordance with the specific industry structure of the user-defined region in terms of inter-industry purchasing patterns. (See Area 7, Econometric Models, in Topical Glossary)

REMI: Developed by Regional Economic Models, Inc. (REMI), this econometric model incorporates inter-industry transactions (I-O model), as well as behavioral equations from economic theory that allow the model to respond to changes in an area's economy resulting from strategic investments. The REMI model distinguishes itself from a traditional I-O model in that it allows for substitution among production factors (e.g. wages, labor markets, migration) in response to changes in relative production factor costs over time, and accounts for agglomeration impacts. (See Area 7, Econometric Models, in Topical Glossary)

Residual Value: Many transportation project assets will have a useful life that extends beyond the analysis period specified for the federal and state grant programs that are likely to use the information developed in the benefit cost analysis. US DOT guidance indicates that this project value is a benefit as long as the expectation is that the asset will be in service for its full useful life. (See Area 14, Residual Value, in Topical Glossary)

Return on Investment (ROI): Whether the investment or project generates benefits that are greater than the project costs. (See Area 3, BCA Ratio, in Topical Glossary)

Risk: Risk is associated with any forecast—including population, employment, travel demand results, costs, and revenue—all forecasts frequently involved in economic analyses. The risk stems from the fact that forecasts are predictions of the future based on available information at the time the forecast was developed (usually historic data, professional judgment, and forecasts of other variables provided by local, state, or federal governments or experts). Even with the most rigorous forecast, it is almost guaranteed that the actual data in the future will be different from the forecast. However, it is a matter of how different (e.g. 0.5% vs. 20%), and how dependent the results of the economic analyses are on these forecasts being close to the actual future result. (See Area 15, Sensitivity Analysis and Risk, in Topical Glossary)

Risk Analysis with Monte Carlo Simulation: A sensitivity analysis that examines the probability of failure by replacing point values of uncertainty variables with a pessimistic/likely/optimistic range, permitting all uncertainty variables to vary simultaneously, and summarizing the results over a large number of iterations (model runs). Risk analysis quantifies the “down-side” risk and provides decision makers with some comfort/confidence in the economic analysis results. It addresses some of the concerns associated with the uni-dimensional stress test, particularly the ability to change multiple variables at the same time and the likelihood of a pessimistic outcome. To run a risk analysis with Monte Carlo simulation requires the purchase and application of software. (See Area 15, Sensitivity Analysis and Risk, in Topical Glossary)

Salvage value: Same as residual value. It implies that investment has value even if the project should stop operating—because the components of the project could be sold (e.g. vehicles, equipment, and steel). (See Area 14, Residual Value, in Topical Glossary)

Sensitivity Analysis: A means to measure how sensitive the results of the economic analysis are to changes in the input forecasts of such elements as population, employment, and travel demand, either separately or combined. There are two general types of sensitivity analysis that can be performed on the results of an economic analysis: uni-dimensional stress test and Monte Carlo simulation. (See Area 15, Sensitivity Analysis and Risk, in Topical Glossary)

Social or Public Benefits: See Community Benefits

Study or Benefit Area or Defined Region: The study area for the economic analysis can be the same as that defined for the project (also sometimes called the project or corridor area). However, in most cases the economic impacts are also felt outside the immediate project or corridor area. For example, jobs in the project corridor may be filled by people residing outside the immediate corridor, in neighboring towns or counties. As a result, the economic benefits or impacts are frequently reported for a slightly larger study area, such as the metropolitan statistical area (MSA), county, groups of counties, megapolitan region, or the state. The study area selected should include those areas that will provide a large percentage of such items as the labor, supplies, materials, and services for the project. (See Area 16, Study Area, in Topical Glossary)

Time Value of Money: The cost associated with delaying an investment, also sometimes referred to as the opportunity cost. (See Area 6, Discounting, in Topical Glossary)

Transfer: See Economic Transfer.

Transfer Payment: See Economic Transfer.

Transportation System Management (TSM) Alternative: In addition to the No Build Alternative, the TSM generally includes lower cost capital and operational improvements than the Build Alternatives. (See Area 1, Base Case, in Topical Glossary)

Travel Cost Savings: As travelers divert to a new/improved transportation investment (particularly transit or another non-auto mode), VMT are likely to be reduced, resulting in

- A travel cost savings for users. The amount of VMT avoided is estimated by the travel demand model. The value of vehicle operating costs per mile can be applied to VMT avoided to obtain the estimate of costs avoided.

(See Area 4, Benefit Types, in Topical Glossary)

Travel Time Savings: As travelers divert to a new/improved transportation investment, travel time savings are likely accrue

- For users, as the amount of time it takes for users to make their trips declines.
- For non-users, as fewer autos are using other roads in the area.

The estimation of travel time savings requires the amount of travel time saved (in hours) that is estimated by the travel demand model. The value of travelers' time relies on local wage rates, the quantity of local and intercity travel, and the distribution of personal and business travel. (See Area 4, Benefit Types, in Topical Glossary)

TREDIS: Developed by Economic Development Research Group, Inc. (EDR), the Transportation Economic Development Impact System (TREDIS) is specifically designed to develop economic impact and benefit cost analyses for transportation investments of all modes (highway, bus, rail, aviation, maritime, and multi-modal), as well as freight and passenger transportation. The sophistication of this web-based model also can vary depending on the users' needs—from a sketch planning/early assessment tool to a comprehensive analysis tool. It also accounts for agglomeration impacts using the Local Economic Assessment Package (LEAP), which draws on a database of local economic conditions and research to estimate how quantified changes in access improve the competitiveness of the study area to attract business. (See Area 7, Econometric Models, in Topical Glossary)

Uni-dimensional Stress Test: With a stress test, one or more uncertainty variables (e.g., inflation, population, and ridership) are selected, and the analysis is run with alternative values of these variables— typically baseline, high, and low. This approach can define the upper and lower extremes, answering the important question: "How bad could it get?" This type of sensitivity analysis is the most common and easiest to perform. It is also the easiest for the general public to understand. However, it does not recognize that all uncertainty variables likely change simultaneously—not just the ones selected in the "stress test"—or that there is a lower probability of outcomes further away from the most likely value. While "How bad could it get?" is clearly an important question, it does not address the issue of the likelihood of the pessimistic outcome. (See Area 15, Sensitivity Analysis and Risk, in Topical Glossary)

User Benefits: User benefits are those transportation benefits that are experienced directly by the users of the proposed transportation investment. These benefits include travel time, travel cost, and accidents avoided savings that are experienced as a result of using the new transportation investment. (See Area 4, Benefit Types, in Topical Glossary)

Value Added: Consists of the compensation of employees, taxes on production and imports (less subsidies), and the gross operating surplus for a particular industry. As a result, it also reflects the contribution of a particular industry to the gross domestic product (GDP). (See Area 12, Input-Output Models, in Topical Glossary)

Wider Economic Benefits: An expansion of the economic outcomes considered for a proposed transportation project or program of projects. It is an emerging area for economic analysis of transportation planning. (See Area 4, Benefit Types, in Topical Glossary)

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