**SHRP2 Project C03**
**Interactions between Transportation Capacity, Economic Systems and Land Use: Final Report**

# Highway Economic Impact Case Study Database and Analysis Findings


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# PREFACE

## P1. Project Products and Reports

**Report on Case Study Database and Analysis Findings.** This report describes research and findings from SHRP2 Project C03, entitled "Interactions between Transportation Capacity, Economic Systems and Land Use." It describes the development of a national database of highway project case studies that contains pre/post information to portray associated changes in economic growth and land development. It summarizes analysis findings from that database and lessons learned for future case study development.

**TPICS Data Base.** Another product produced by this study is a web-based tool called "TPICS" (Transportation Project Impact Case Studies). The database contains 100 case studies of the economic and development impacts of highway projects, along with analysis tools for screening, viewing and analyzing information pertaining to those cases. That web site can be accessed in two ways.

- via the SHRP2-sponsored web site: *Transportation for Communities - Advancing Projects through Partnerships (TCAPP)*, which can be found at www.transportationforcommunities.com (click on the TPICS link at the bottom of the page)
- or directly from the project web site: *Transportation Project Impact Case Studies*, which can be found at: www.tpics.us

**Other Technical Documents.** This project produced a series of additional technical reports, which can all be viewed and downloaded from the internet. They can also be accessed from the TPICS web page by selecting the tab on top labeled "More Info." These reports include:

TPICS Case Study

- TPICS Web Tool: Instructions for Use
- TPICS Data Dictionary (Database Documentation)

Research Methods

- Economic Impact Performance Metrics

# P2. Acknowledgements

**Contract.** This work was conducted as part of the second Strategic Highway Research Program (SHRP2), administered by the Transportation Research Board of the National Academies. It represents a product of the SHRP2 Capacity Program, Project C03.

**Supervision.** The project was managed by David Plazak and Stephen Andrle of the Strategic Highway Research Program.

**Contractors.** The research reported herein was conducted by a team comprised of Economic Development Research Group and subcontractors: Cambridge Systematics, Wilbur Smith Associates, Texas Transportation Institute, ICF International and Susan Jones Moses & Associates. The TPICS (Transportation Project Impact Case Studies) database and web tool were designed and developed by Economic Development Research Group, and implemented by ICF International.

**Authors.** The primary authors for this study were Glen Weisbrod, Steven Landau, Stephen Fitzroy, Margaret Collins and Adam Winston of Economic Development Research Group; Christopher Wornum of Cambridge Systematics; Paula Dowell and Eric McClellan of Wilbur Smith Associates; Sharada Vadali of the Texas Transportation Institute; Jeff Ang-Olson, Sergio Ostria, Anjali Mahendra and Stephen Ziegler of ICF International; and Susan Jones Moses of Susan Jones Moses and Associates.

# P3. Guide to this Document

This document is organized in terms of three parts that together contain 9 chapters. Part A describes the study design that underlies the data collection and database development processes. Part B presents findings from analysis of the dataset. Part C presents lessons learned for interpretation of existing case studies, development of future case studies and use of the web tool for planning and decision-making.

PART A: CASE STUDY DESIGN

- Chapter 1 presents an overview of the study objectives and design.
- Chapter 2 presents the classification of transportation project types and settings.
- Chapter 3 describes the process for selecting and conducting case studies.

PART B: ANALYSIS FINDINGS

- Chapter 4 presents findings from tabulations of case study data.
- Chapter 5 presents findings from statistical analysis of job impact factors.

PART C: GUIDELINES & LESSONS LEARNED

- Chapter 6 presents lessons learned for case study interpretation.
- Chapter 7 provides lessons for highway project planning.
- Chapter 8 discusses guidelines for conducting new case studies.
- Chapter 9 summarizes study conclusions.

## Executive Summary (SHRP2 Project C03)

# Highway Economic Impact Case Study Database & Analysis Findings

**Study Overview**

The US Strategic Highway Research Program (SHRP) funded development of 100 pre/post case studies of the economic development and land development impacts of highway and highway/intermodal projects, along with development of a database and web tool for viewing and using their findings.

The study developed standards for a national database of pre/post case studies that included requirements for: (a) pre/post impact comparison, (b) coverage of both local and regional level impacts, (c) a wide range of alternative perspectives for viewing and measuring impacts, (d) comparison of local changes over time relative to reference sources such as state trends, and (e) reliance on both quantitative data and qualitative observations regarding local economic conditions.

The study sought to include all major project types, including intercity highways, urban beltways and local access roads, as well as bridges, highway interchanges and intermodal road/rail terminals. The projects spanned all regions of the continental US, both urban and rural settings and different economic distress levels. A small number of English language studies from Canada and abroad were also included in a format that would enable continuing expansion over time. Five categories of data were assembled for each case study:

(1) *Project characteristics* -- type of facility, years built, cost, size and level of use;

(2) *Project objectives* -- congestion reduction, access enhancement, etc.;

(3) *Impact metrics* – pre/post change in employment, income, business output, land values, building development, tax revenues;

(4) *Quantitative explanatory data* – location (region, metro /rural), topography, economic distress level, etc.

(5) *Qualitative explanatory data* –local interview findings on land use plans and policies, business climate and support programs, other factors affecting outcomes.

**Analysis Findings**

The case studies were analyzed through both statistical analysis of empirical data, and an effort to extract common themes from the qualitative interview reports. Key findings are listed below:

- Transportation projects lead to multi-faceted forms of economic development impact, which may include effects on employment, income, land use, property values or building construction. The form of impact varies by type of project and its setting.

- Impacts unfold over time, so no single project will necessarily show every type of impact at the same time. For that reason, multiple impact measures and an appropriate period of observation are needed to fully capture economic development impacts.
- Overall, 85% of the projects show evidence of positive economic impacts, while the rest show either no net impact or a small negative impact. However, the impacts were measured at different spatial scales depending on the size and breadth of the project -- which varied in length from two-mile short access roads to major interstate highways spanning several hundred miles.
- There are systematic differences in both project cost and job growth impacts that vary by project size, type and location.
- Project location matters. Larger numbers of jobs are being generated by project in metro settings than by projects in rural settings. Rural projects tend to have lower costs and take less time to build than those in metro settings, though job growth in rural areas also tends to take longer to unfold than in metro areas.
- The economy and business climate of the project impact area are critical factors affecting the magnitude of project impacts. Projects in economically vibrant areas with complementary infrastructure and zoning regulations tend to generate more long-term jobs than projects in areas where those factors are not yet in place.
- Motivations for developing projects differ, and projects with a coordinated economic development effort (involving complementary policies) generally facilitated more long-term job growth than projects that lack local supporting policies.

**<u>Practical Use</u>**

The TPICS web tool provides transportation planners with a way to search for relevant case studies by type of project and type of location setting. Details of the projects, their impacts, and factors affecting those outcomes are all provided in the case studies. The web tool also provides users with an option to specify a given type of proposed project, and then see the range of impacts that would be expected based on case study experience to date. These features have three important uses.

- First, they can have value for early stage policy or strategy development, in which it can be useful to initially identify the magnitude and types of impact tradeoffs to be considered.
- Second, they can be useful for early stage "sketch planning" processes, in which it can be useful to identify the types of local barrier and success factors that will need to be addressed in later, more detailed planning steps.
- And third, the case study findings can be useful in public hearings, as they provide a way of responding to the hopes of proponents and fears of opponents, with information on the range of impacts that have actually occurred in the real world.

# 1 STUDY ISSUES AND PROCESS

## 1.1 Project Background and Overview

**Project.** The Strategic Highway Research Program II (SHRP2), Capacity Project C03 was entitled: Interactions between Transportation Capacity, Economic Systems, and Land Use. The project included development of interviews, case studies, a database and web tool for assessing the economic and land development impacts of highway capacity investments. This document represents the final report of the project. It describes the data collection process, results of statistical analysis and study findings.

**Motivation.** The project was funded by SHRP2 to enhance the effectiveness of highway project planning, prioritization and selection processes, by providing more complete and accurate information on the nature of economic impacts typically occurring as a consequence of highway capacity expansion projects. The designs of the data collection process, the database tool and reporting on analysis findings were all focused on enhancing the effectiveness of local and state public meetings, policy discussions and planning processes.

The research study therefore focused on assembling information for the range of highway projects that would be expected to generate economic impacts. These are classified as "capacity expansion projects" and typically they either (a) extend highway access to new areas, or (b) enhance the throughput (flow) of existing highway facilities to enable greater speed, reliability and volume of movement. For these types of highway projects, the research study assembled pre/post information to observe the facets of economic and land development impacts that occur in affected areas, and how those impacts tend to vary by type of project or local setting.

It should be noted that there are other types of highway investments that were not covered in this study because they do not typically lead to economic impacts. These include both (a) safety improvements and (b) facility reconstruction, rehabilitation and preservation investments. Both of these latter two types of highway projects do lead to notable user benefits, either in the form of reduced deaths and injuries (in the case of safety projects) or avoided facility performance degradation (or closure).

**Case Study Database.** The most notable accomplishment of this project was the development of 100 case studies of highway projects, which (a) compared pre-project and post-project changes in economic and land development conditions, (b) contrasted them with corresponding conditions for a base of comparison, and (c) included both quantitative impact measures and qualitative assessments based on local interviews.

This collection of case studies, completed in 2010, was compiled with the goal of representing the full range of highway-related project types, distributed across all regions of the US and urban/rural settings. An effort was also made to build upon work done in prior highway impact studies in the US and Canada, to the extent that earlier studies fit within the case study selection design, which is discussed further in Section 1.5.

**TPICS Web Tool.** The case studies were put into a web-based viewing and analysis system called "TPICS" – "Transportation Project Impact Case Studies." This system includes: (a) a *search function* that allows for user-defined screening and selection of relevant cases, (b) a *case study viewer* that provides user access to impact measures, discussion text, maps and related documents, and (c) an *impact estimation calculator* that shows the expected range of impact associated with any user-defined project profile.

The TPICS system was designed to assist transportation agencies in project planning and evaluation, by providing agency staff and interested stakeholders with a means for establishing the range of job, income and development impacts typically associated with various types of transportation projects in different settings.

# 1.2 Stakeholder Interview Process

**Motivation.** At the outset of this project, the study team held discussions with state and regional transportation planning officials to obtain additional information on their needs and concerns regarding current methods for assessing economic development impacts of highway projects, and the potential use of case study research. Key findings are summarized here.

**Topics.** The specific topics of conversation fell into four groups:

1) *Level of interest in economic impact analysis found among stakeholders:* levels of awareness of economic impact issues, and issues of major concern for impact measurement, assessment and forecasting;
2) *Uses made of economic impact analysis by stakeholders:* uses made of those impact estimates (for planning and decision-making), and types of impact metrics that they find most useful
3) *Situations where economic impact analysis is most relevant:* types of projects and situations where those impact measures are most needed, timing of when those impact measures are useful, and audiences for them
4) *Perception of needs for improvement*: perceived problems with the definition of currently available impact measures, gaps in their reliability and credibility, and weaknesses in how they are being used.

**Interviewees**. The discussion findings were compiled by staff of Economic Development Research Group, ICF International, Wilbur Smith Associates, Cambridge Systematics, Texas Transportation Institute and Susan Jones Moses & Associates. For this study, the team members assembled findings from their conversations with state and regional agency staff, including new interviews conducted for this study supplemented by recent conversations from other related projects.

Staff of the research team reported on discussions held with representatives from transportation planning agencies in the states of Iowa, Texas, California, North Carolina, New York, Wisconsin, Michigan, Oregon, Maine, Montana, New Mexico and the Appalachian Regional Commission. In addition, a focus group of consultants was held to determine the factors that they collectively felt were most critical for improvement to the state of practice.

# 1.3 Stakeholder Needs for Decision-Making

The stakeholder interviews and focus group led to the following findings:

1) **Importance of Economic Development Impacts.** Among state and regional transportation planning officials and staff, there is widespread recognition that economic development is a legitimate and important public policy goal, and that transportation investment can (at least sometimes) have an impact on it. However, there are many among them who are not sure how economic development impacts and opportunities can be reliably and legitimately measured. While a growing number of state and regional agencies do use economic impact models or tools, there is some remaining concern about the empirical basis of those tools. There is also uncertainty about how to interpret information on wider economic impacts and use it without double-counting transportation system benefits. Nearly all of the interviewees saw the project effort (to build a national database of case study research on economic impacts of highway projects) as providing a solid base of empirical information to help address those concerns.

2) **Types of Information Needed in Decision-Making**. Much of the disagreement about measuring economic development impacts, and much of the concern about their use can be traced back to confusion about the *intended purpose* of economic impact analysis. For DOT staff and other decision-makers, there are distinctly different types of information and communication needed at different stages in the planning and decision-making process. Yet there is no simple way to match economic impact tools or results to those stages in the decision-making process. With better guidance and case study examples, though, such problems can be addressed and the mis-application of evaluation tools can be reduced.

3) **Differing Analysis Needs at Planning and Decision Stages.** The interviews identified at least six distinct stages in the planning process at which economic development impacts become a consideration. At each stage, the issues concerning economic development and the necessary form of input information are different. These stages conform roughly to key decision points in the separate SHRP2 study of the collaborative decision-making process, and are summarized below.

**Key Phases in Transportation Planning and Decision-Making**

1. Policy/Funding Allocation Stage
2. Planning Strategy Stage
3. Programming (including funding) Stage
4. Prioritization Stage
5. Project Development/EIS Stage
6. Preservation, Operations and Maintenance Stage

There was wide divergence among interviewees as to which of these stages most needed economic development impact analysis. Actually, that is not surprising; given that they had different positions and played different roles in planning and decision-making. For instance, several interviewees noted that some projects are motivated by economic development (rather than merely congestion reduction or safety), and that can play a major role in their stated "purpose and need." Others noted that analysis of economic development impacts is particularly useful for public information and public participation purposes. Yet others noted that there can be value in examining economic development impacts as a way to gain insight into cost recovery opportunities, or to give recognition to long-term mobility and capacity needs at a regional level (that goes beyond impacts of individual projects). Clearly, the form of analysis needed to address each of these issues can vary widely, and no single method or tool can be equally applicable for all of them.

4) **Consideration of Wider Economic Benefits.** Consultants and academics (rather than planners or officials) tended to be most aware of the recent European advances in formally recognizing what they call WEBs -- "wider economic benefits" -- in decision-making. Whereas economic impacts have often been seen in the US as a way of justifying projects that would otherwise not pass the traditional user benefit/cost test, the WEB approach shows how economic development assessment can also encompass land use and development considerations and serve to either increase or decrease estimates of the payback from transportation investments. By recognizing the broader range of impacts occurring in case study examples, this study can help development of a more systematic and appropriate set of economic benefit metrics for investment decision-making in the US.

# 1.4 Refining Economic Impact Concepts

The interviews with practitioners identified, from a practitioner's perspective, key needs to enhance available analysis methods for assessing economic development impacts of transportation investments. They are:

**(1) Need for Case Studies of Economic Development Impacts.** There is a hunger and need for establishing realistic expectations about economic impacts of transportation projects at the earliest possible point in the sequence of planning and decision steps. Staff of state DOTs continually experience unrealistically high expectations of positive job creation benefits from proponents, and also unrealistically high alarm about loss of land values and uses from opponents. These situations can increase the resources required and the time period involved in overall planning, analysis and public discussion processes. They drive demand for analysis of potential economic development impacts, though they also "raise the bar" in need for transparency in defining impact measures and estimating their values. Case study examples, selected from a national database, can help provide a more realistic range of likely impact expectations for projects being considered in early stage planning discussions.

(2) **Defining and Measuring Economic Development Impact**. More than one interviewee noted that the definition of economic development impacts is not a simple matter. The most common forms of economic development impact analysis focus on measuring economic activity expansion – through measures of jobs, income, GDP (value added) and/or business sales. However, public groups sometimes broaden it to encompass a wider range of societal goals for economic development, which can encompass economic standards (e.g., unemployment rate, average wage, standard of living and job skill level), and business factors (productivity and competitiveness). They may also be combined into broader measures of social quality of life (including safety/security, air quality and carbon footprint). The most common economic impact concepts can include:

- Jobs
- Income (or Gross Regional Product)
- Productivity
- Property Values
- Competitiveness (relative costs)
- Quality of Life (air quality, safety, etc.)

Most agencies now focus on jobs because they are most easily understood by the public and do not require potentially confusing inflation adjustments. However, a number of interviewees from different agencies noted the importance of tax base and property values for public sector decision-making, while another set of interviewees expressed interest in the competitiveness and productivity to enable better economic evaluation. Case studies can potentially examine all of these impact elements.

(3) **Time and Space Aspects of Economic Development Impacts**. Urban planners have noted that economic development impacts can unfold over time and over space in a sequence. The most common sequence of impacts has the following order:

- Change in land prices/valuation (as demand grows for some locations)
- Change in property sales volume and prices (as land is purchased for new or more intensive uses)

- Change in amount of construction spending (as building investment is made for new or more intensive uses)
- Change in employment, and associated wages and total business sales (as buildings are occupied)
- Change in public sector tax revenues (as business activity occurs in the new buildings).

This sequence leads to a wide set of potentially relevant indicators of economic development impacts, and a wide set of potential spatial areas for measuring those impacts. However, error can be introduced when post-project studies attempt to measure some of the later forms of impact prematurely, or when they focus on too narrow of a spatial area. Error can also be introduced when pre-project forecasts focus on an overly narrow indicator or they are defined for an overly narrow or wide study area.

(4) **Errors Caused by Multiple Indicators**. The proliferation of multiple ways of measuring economic impacts also leads to confusion among analysts and users of this information. There is clearly confusion over pre-project impact forecasting methods that attempt to focus on just one impact indicator (e.g., jobs) without acknowledging the potential for other forms of impact (e.g., land use). There is also concern about double counting of impacts by combining overlapping impact measures.

# 1.5 Study Design

Following completion of the initial stakeholder interviews and focus group (as described in the preceding sections 1.2 – 1.4), the project team developed 100 case studies of highway impacts on local and regional economic development. The cases were carefully selected within a study design that ensured a wide range of different project types in different settings (as described in Chapters 2 – 5). The case studies, and accompanying database and TPICS (Transportation Project Impact Case Studies) web tool, were designed with the specific intent of addressing issues raised by stakeholder interviews. This included the following key elements:

(1) **Coverage of Projects, Contexts and Impact Measures.** The stakeholder interviews underscored the need to distinguish impacts among a wide range of different types of transportation projects and settings. The SHRP2 program is required to focus specifically on highways, but within that class, case studies were carefully selected to cover ten types of highway-related capacity projects, representing essentially the entire range of project types. These spanned all regions of the US and a wide range of urban/rural settings and economic conditions. These characteristics of the projects and their settings are represented in the case study database.

Economic impacts of the case study projects were then defined to include both quantitative data and qualitative observations on how economic conditions changed before and after completion of each highway project. Case studies sought to cover the full range of impacts on jobs, income, land values, building investment. Effort was also made to distinguish the extent to which impacts occurred at a localized or regional level. In this way, the case studies highlighted the multi-faceted ways in which economic development impacts can occur, depending on the type of project and its setting. The TPICS web tool can provide tables of quantitative impact metrics as well as detailed discussion text to describe the different forms of economic development impact that have occurred. The only major limitation in terms of data coverage is that it was not possible to assemble information on how traffic conditions have changed over time. In nearly all cases, that was because pre-project data was not available.

(2) **Explanation of Factors Affecting Observed Economic Results.** The stakeholder interviews and focus group underscored a need to recognize (and to the extent possible) control for outside factors that also affected observed changes in economic development. Accordingly, the case studies included not only a comparison of pre- and post-changes in economic conditions, but they also included comparison of changes to reference areas to control for external business cycles, and interviews with local planners and business representatives to assess the extent to which observed changes were due to the highway project vs. other factors.

This has value in two ways. First, it provides a basis for distinguishing the extent to which the highway project was actually responsible for observed economic development impacts. Second, it serves to highlight the ways in which local economic and institutional factors served to either mute (reduce) or amplify (expand) the magnitude of observed economic development impacts. Thus, the case studies serve to establish the extent of causal connection between highway-related improvements and resulting economic impacts. However, the case study database cannot relate observed economic impacts to the magnitude of pre/post change in transportation conditions. Those relationships require more data (currently unavailable) on how transportation conditions have changed, and a more sophisticated economic model that can establish costs and benefits for various elements of the economy.

(3) **Basis for Sketch Planning.** The TPICS web tool provides transportation planners with a way to search for relevant types of projects in specific types of setting (region location, urban/rural population density, etc.). It also allows users an option to specify a given type of proposed project, and then see the range of impacts that have been actually observed in case studies to date. These features have three important uses. First, they can have value for early stage policy or strategy development, in which it can be useful to initially identify the magnitude and types of impact tradeoffs to be considered. Second, they can be useful for early stage "sketch planning" processes, in which it can be useful to identify the types of local barrier and success factors that will need to be addressed in later, more detailed planning steps. And third, the case study findings can be useful in public hearings, as they provide a way of responding to the sometimes outrageous hopes of proponents or fears of opponents, with information on the range of impacts that have actually occurred in the real world.

(4) **Complementarity with Economic Development Impact Models.** The case study results provide empirical evidence of the range of economic development impacts that have actually occurred as a result of past highway system improvement projects. Besides being directly useful for initial strategy development and public hearings, benchmarks of economic impact from past case studies (now available from this study) can also be used to help validate the reasonableness of predictions made by economic impact forecasting models for proposed future projects. Until now, there has been a paucity of such data available for validating predictive models.

However, it should also be clear that the case study database and TPICS web tool cannot serve as a substitute for predictive economic impact models. For, while predictive economic impact models forecast shifts in economic growth resulting from changes in transportation conditions (traffic levels, travel times, distances, access, reliability, etc.), the case studies lack such detailed information. That was unavoidable given the long time span of the economic impact case studies (often ten to twenty years) and the fact that data on pre-project transportation conditions was either never collected or is no longer available.

As a result, the case studies are useful for portraying the range of impacts observed from specific types of projects (e.g., bridge widening in urban areas or town bypass projects in rural areas). But they have neither the transportation data nor the statistical controls to show how variation in travel characteristics (travel times, costs and access features) affect economic impact outcomes. For this reason, the case study database is designed for use as a sketch planning tool that is most useful for initial policy or strategy development, while economic impact models are designed for to be most useful in later stages of planning and prioritization, where more details are available on the nature of proposed projects and their expected transportation system impacts.

# 2 CLASSIFICATION OF PROJECT TYPES AND SETTINGS

## 2.1 Types of Projects

Project types are the single greatest differentiator among case studies, for different project types can have very different attributes in terms of (a) cost, (b) spatial footprint, (c) volume of activity and (d) performance characteristics. The most obvious differences are between small area projects such as interchanges and bridges, and large area projects such as major interstate highways. In between, there are various classes of beltways, town bypasses and connector routes.

For this study, projects were classified into ten types representing different functions, spatial footprints and magnitudes of investment cost. The definitions adopted for purposes of this study are presented below. Case studies were selected to ensure a roughly even distribution of project types, dispersed among different settings and parts of the US. The number of case studies completed for each project type is shown in FIGURE 2-1 which follows.

1) **Major Highways** are multi-lane roadways designed to handle high vehicle volumes traveling at high-speeds. Travel lanes in either direction are separated by distance or crash barriers. Limited access highways are typically free of traffic lights and stop signs, and accessible only via periodic on/off ramps and interchanges with other Limited Access highways. Because they are designed to handle high volumes of traffic, limited access highways typically built to provide access to metropolitan markets from outlying areas, or access across metropolitan areas. Where they pass through rural areas, they do so primarily to connect metropolitan areas and/or to connect rural agricultural areas with metropolitan markets and intermodal terminals (such as airports, marine ports or rail terminals) often located in metropolitan areas.

2) **Beltways** are circumferential highways (typically freeways) typically built around the fringe of major cities. They often are designed to link satellite activity centers – which can include housing, retail, and major employers – that spring up outside the center of cities.

3) **Connectors** provide highway access between two major highways, or between a highway and an attraction such as an airport or employment center.

4) **Bypasses** are highway realignments that divert traffic flow around built-up towns or other urbanized areas to allow long-distance through traffic to avoid mixing with slower local traffic. Typically an option to drive through the town center is maintained. Bypasses are designed to improve efficient traffic flow for long distance travel by keeping it away from areas with stop-and-go traffic, and to increase safety by reducing the mixing of long distance trucks with local pedestrians.

5) **Bridges** span natural environmental features, such as bodies of water and canyons as well as manmade features including train tracks and other roadways.

6) **Interchanges** provide a connection between a limited access highway and another road that intersects with it. Interchanges are essentially a single point, or points in each direction of connection, with no length at all.

7) **Industrial Access Roads** are built for the specific purpose of providing access to new development sites, typically for industrial use. Some access roads support the development of a mix of employment-related uses, such as light industrial, office and commercial activity. Some are built to support the development of new industrial or business parks, and others are built to allow for the expansion of existing parks by providing access from a new direction.

8) **Highway Widening Projects** typically increase highway capacity by adding lanes. Widenings tend to be expensive, in part because they typically involve extensive right of way acquisition.

9) **Intermodal Freight Terminals** enable freight to be transferred between modes. The cases in this study all transfer freight between truck and rail modes.

10) **Intermodal Passenger Terminals** enable passengers to transfer between modes. The cases in this study all transfer passengers between car and rail transit modes.

**TABLE 2-1 Number of Cases by Project Type**

| Project Type | Total Cases |
|---|---|
| Beltway | 8 |
| Bridge | 10 |
| Bypass | 13 |
| Connector | 8 |
| Interchange | 12 |
| Industrial Access Road | 7 |
| Major Highway (Limited Access Route) | 14 |
| Widening | 9 |
| Freight Intermodal Terminal | 10 |
| Passenger Intermodal Terminal | 9 |
| **Total** | **100** |

# 2.2 Types of Project Setting

Project setting is defined as the geographic, social and economic context in which a project is developed, which can have a major influence on the economic development outcomes of a project. Accordingly, the case study database has been structured to allow users to search projects with comparable settings to their local area. Elements of project setting include:

- *Geographical Setting* – projects built in different regions of the country may be influenced by regional differences in climate, topography, highway network density and distances between cities.

- *Social Setting* – impacts may vary with the density and socio-economic composition of an area, regardless of geographic setting.
- *Economic Setting* – impacts of highway projects may also vary with difference in underlying patterns of unemployment and economic growth/decline that are in effect at the time of project construction.

For this study, quantitative information was collected for eight aspects of project setting, which are listed in TABLE 2-2. An effort was then made to ensure that the selected case studies were representative of the full range of potential settings. To accomplish this, one key metric was selected for as the primarily indicator each of the three major dimensions of project setting, and that metric was used in the screening and selection process. Other metrics were designated as secondary elements and they are also available for use as further case study descriptors and search criteria.

**TABLE 2-2 Project Settings**

| Setting Factor | Primary | Secondary |
|---|---|---|
| *Geographical Setting* | | |
| - Region | X | |
| - Topography | | X |
| *Social Setting* | | |
| - Urban/Rural class | X | |
| - Population density | | X |
| - Transportation access | | X |
| *Economic Setting* | | |
| - Economic distress | X | |
| - Economic growth | | X |
| - Local Conditions | | X |

Note: The identification of primary and secondary factors and ways that they can affect economic impact were drawn from prior research studies developed by the Appalachian Regional Commission and its contractors. (See *Sources of Regional Growth in Non-Metro Appalachia*, three volumes, by Economic Development Research Group, Massachusetts Institute of Technology and Regional Technology Strategies, for the Appalachian Regional Commission, Washington, D.C., 2007.)

## Primary Setting Indicators

**Region.** An important consideration in determining the comparability of projects is the regional location. The region can affect the observed impact of a project due to differences in climate, topography, land-use patterns, highway network density and travel distances in different parts of the US. This factor can thus help users compare cases in similar areas or those with similar characteristics to their own. The regions are defined on the basis of the US Dept of Commerce's Bureau of Economic Analysis (BEA) regions -- which classifies the US into eight regions. The number of regions used for this study was reduced to five, as three pairs of regions were combined together (Far West & Rocky Mountain, Great Lakes & Plains, Mideast & New England). These regions are shown in

FIGURE 2-1. Effort was also made to ensure a reasonable representation of all project types in each region; that distribution is shown in TABLE 2-3.

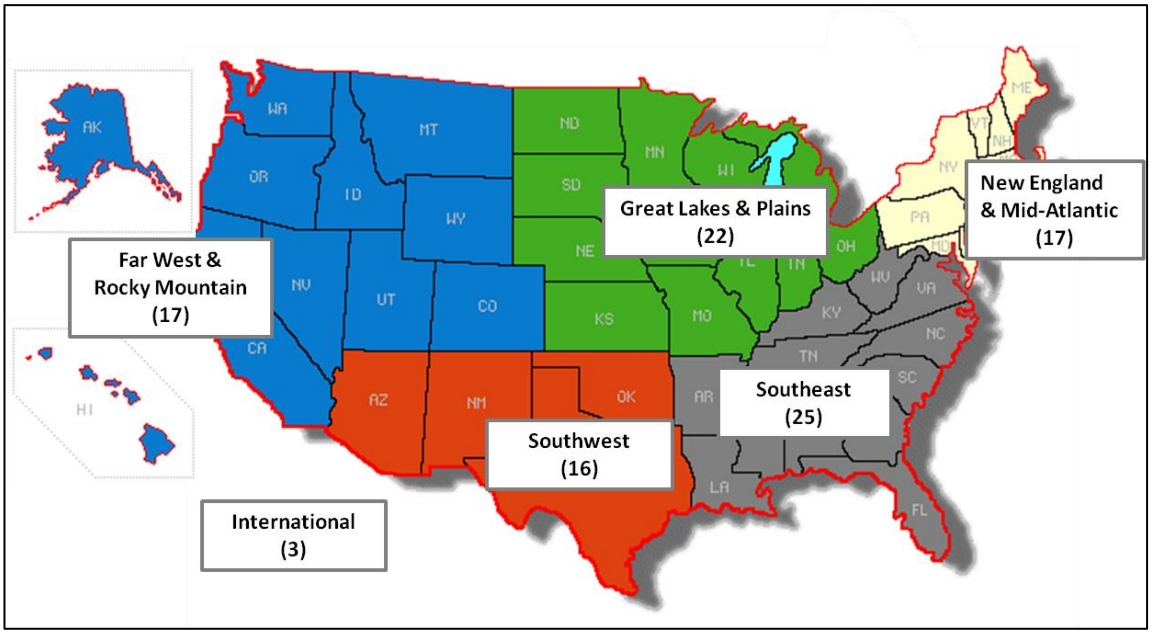


**FIGURE 2-1 Number of Cases by Geographic Region (total 100)**

**TABLE 2-3 Distribution of Project Types Among Regions**

| Project Type | Great Lakes & Plains | New Engl. & Mid-Atlantic | Far West & Rocky Mtn | South - east | South-west | Inter-national | Total by type |
|---|---|---|---|---|---|---|---|
| Access Road | 2 | 2 | 0 | 2 | 1 | 0 | **7** |
| Beltway | 2 | 1 | 1 | 2 | 2 | 0 | **8** |
| Bridge | 1 | 2 | 3 | 2 | 1 | 1 | **10** |
| Bypass | 4 | 1 | 3 | 2 | 1 | 2 | **13** |
| Connector | 1 | 1 | 2 | 3 | 1 | 0 | **8** |
| Freight Intermodal | 2 | 2 | 1 | 3 | 2 | 0 | **10** |
| Interchange | 4 | 2 | 1 | 2 | 3 | 0 | **12** |
| Highway | 3 | 4 | 1 | 4 | 2 | 0 | **14** |
| Passenger Intermodal | 2 | 1 | 3 | 2 | 1 | 0 | **9** |
| Widening | 1 | 1 | 2 | 3 | 2 | 0 | **9** |
| **Total** | **22** | **17** | **17** | **25** | **16** | **3** | **100** |

**Economic Market.** The economic market context of a project's location can be an important impact factor because the size of the market served by a given project would be expected to influence the magnitude of its economic impact. Market size is reflected in the metropolitan area concept as defined by the US Office of Management and Budget, and adopted by the US Census. Every county that is part of an urban area with 50,000 or more inhabitants is classified as part of a "metropolitan area." For this study. each highway-related project setting was classified by the county or group of counties in which the project was located. (Many of the highways covered in the case studies run through multiple counties.) If the project counties were all classified as metropolitan then the project setting was classified as "Metro." If the project counties included both metropolitan and non-metropolitan counties, then the project setting was classified as "Mixed." And if all project counties were non-metropolitan, then the project setting was classified as "Rural." An effort was made to ensure a mix of most project types represented in each county setting class. (In some cases, it was not possible; for instance, urban beltways do not exist in rural areas.) The distribution is shown in Table 2-4.

**Economic Distress.** This measure can affect the timing and magnitude of economic impacts associated with a transportation project. Various agencies define economic distress on the basis of per capita income, unemployment, and/or percentage of population below the poverty line. However, this study specifically focused on unemployment since it is very easy to obtain is available at the community level from the US Census. The economic distress metric used for this project is one of relative position, defined by the ratio of adjusted local unemployment level to that of US level. This helps to avoid distress classification changes associated with economic booms and downturns, and thus allows pre/post characterizations of economic conditions for projects that are started and completed at different times. An effort was made to ensure a mix of most project types for each economic distress class, when possible. The distribution is shown in Table 2-4.

**TABLE 2-4 Project Types and Settings**

| Project Type | Economic Market Setting | | | Economic Distress | | |
|---|---|---|---|---|---|---|
| | Metro | Rural | Mixed | High | Even | Low |
| Access Road | 2 | 5 | 0 | 2 | 2 | 3 |
| Beltway | 8 | 0 | 0 | 2 | 3 | 3 |
| Bridge | 4 | 3 | 3 | 0 | 8 | 2 |
| Bypass | 4 | 8 | 1 | 6 | 2 | 4 |
| Connector | 4 | 2 | 2 | 3 | 0 | 5 |
| Interchange | 10 | 0 | 2 | 6 | 2 | 4 |
| Major Highways | 5 | 0 | 9 | 3 | 5 | 6 |
| Widening | 4 | 2 | 3 | 1 | 3 | 5 |
| Intermodal | 15 | 15 | 15 | 5 | 11 | 3 |
| **Total** | 56 | 23 | 21 | 28 | 36 | 35 |

## Secondary Setting Indicators

The secondary factors identified in TABLE 2-2 were not used in the selection of projects in the case study design, but information on them was collected. The information was used in the data analysis (reported in Chapter 6) and is also available in the TPICS database (search and selection criteria), including the following:

**Topography.** The extent of mountain terrain, wetlands and other land constraints can also potentially affect the nature of highway economic impacts. The US Geological Survey (from the Department of Interior) has a rating of land surfaces by county from 1 (flat) to 21 (very mountainous).

**Population Density.** This indicator is related to metropolitan area classification, though it can sometimes be useful as a more detailed means of distinguishing high density core counties in a large metropolitan areas from lower density outlying counties. Measures of population density are also readily available at the county level from the US Census.

**Transportation and Market Access.** Transportation projects can change access to intermodal (air, marine or rail) facilities and the size of an area's labor market and same day truck delivery market. The effect can vary depending on the mix of industries in the affected area and their relative dependence on these elements of access. A directory of intermodal transportation terminals is available from the US Department of Transportation. Spatially detailed information on population and employment patterns is available from the US Census. These datasets, used in conjunction with highway network and GIS systems, allow measurement of current access times to intermodal terminals as well as commuter and delivery sheds. They can be directly calculated using the online ESRI GIS system. However, to calculate how these indicators have changed over time, it would be necessary to obtain historical highway network models and they are not widely available.

**Economic Growth Trend.** An area's economic growth is an indicator of how its industries have been performing. In some cases, an area with a higher growth trend may tend to be better positioned to take advantage of new highway connections or capacity, or more in need of such improvements. Economic growth can be measured in terms of percentage change in any economic measure (output, value-added, income or employment) for any time interval. The percentage change in employment was used in this study since it offers the cleanest measure for comparison – all other measures are in dollars and, therefore subject to inflationary adjustments that vary over time. Employment data are available through the US Department of Commerce, including the US Census and the Bureau of Economic Analysis.

**Local Conditions: Development Capacity**. In order for business and population to expand there must be adequate land and utilities. This includes access to water/sewer lines, electricity, and zoning laws. However, these do not have standardized measures that allow for easy comparison; such information is best gathered through local research and interviews. Since this kind of data may not be readily available to users of the system, it cannot be used for screening potential case studies. Nonetheless, it is reflected in the case study narratives, and can be used to complement quantifiable measures.

# 3 CASE SELECTION AND DATA COLLECTION

## 3.1 Case Study Selection Process

The case study selection process was based on the application of criteria described in the preceding chapters of this report. In addition, the project time period was considered insofar as it affected the availability of pre- and post-construction impact data. The result was a multi-stage process designed to ensure a representative mix of cases and meaningful range of project types for imputing economic impacts.

**Identification of Candidate Cases.** The first step in the case selection process was assemble a list of candidate highway capacity. To accomplish this, the project team queried state transportation departments for lists of highway projects that: (1) represented either new highways or major extensions, expansions or performance enhancements to existing highways; (2) were completed at least five years ago and (3) represented a significant magnitude of investment (defined as over $10 million in cost). Altogether, 138 candidate projects were identified in this ways.

Some highway projects were originally considered by the study team but ultimately not included because of the project timing. Major highway projects are often planned 5 to 10 years in advance, take 1-10 years to complete, and subsequent economic development impacts can unfold over another 5 to 10 years after construction completion. Projects completed less than 5 years prior were not considered because they were deemed too soon to fully observe impacts. And projects completed more than 20 years prior were dropped from consideration because of the difficulty collecting data on pre-project conditions, finding interviewees who could report on pre/post land use and development changes and disentangle observed changes from extraneous factors over time.

The second step was to identify previously conducted pre/post economic impact studies that could be candidates for updating and inclusion in the case study database. They were:

- *Major Highway Projects:* Federal Highway Administration – 2005 study that included pre/post evaluation of seven rural interstate highway projects.
- *Urban Highway Interchange Projects:* Pennsylvania Economy League – 2000 study that included pre/post assessment of 7 highway interchange projects.
- *Small Town Bypass Projects:* California DOT – 2006 study that included pre/post meta analysis of 134 town bypass projects conducted in other states by Virginia DOT, Indiana DOT, Wisconsin DOT, California DOT and Montana DOT;
- *Industrial Access Road Projects:* Appalachian Regional Commission, Public Works Program evaluations conducted in 1999 and 2007 that included pre/post evaluation of 199 access road projects in 13 states; plus Oregon Department of

Economic Development, 2006 study that included pre/post evaluation of 56 access road projects.

**Ranking.** Candidate case studies were ranked by age, level of data completeness and expected level of effort required for completion of pre/post data. Some cases were discarded at this point; they were nearly all bypass and access road projects identified in the prior literature of meta analyses but were deemed too old or with too little detail to be considered for case study updating. Remaining cases were evaluated in terms of the availability of economic impact data. Rankings were done based on the number of impact measures available, and that led to three tiers of cases.

- Tier 1 cases (totaling 70) were recommended for initial data collection. This included 24 cases that had data from previously conducted pre/post impact studies, or were deemed to be easily updated so that pre-post construction impacts could be quickly developed. It also included 46 where there was a reasonable amount of impact data available and both pre- and post-construction impacts were deemed likely to be collectable given the level of detail and documentation available from other sources.
- Tier 2 cases (totaling 21) were also considered viable case studies, though they would involve a larger amount of research for impact measures and qualitative information.
- Tier 3 cases (totaling 87) were deemed to be less suitable for case study because they lacked sufficient data for a case study, due to a lower availability of project documentation, as well as information on construction cost and timing.

Initially, 60 case studies were conducted; all were selected from tier 1. Subsequently, additional funding became available to add 40 more cases. They included 21 additional highway cases selected from tier 1 and tier 2, plus 19 intermodal terminals that were added later. All of these latter cases involved interchange between highway and rail modes, including both "passenger intermodal facilities" (which were rail transit stations with highway access) and "freight intermodal facilities" (which were truck/train transfer facilities for freight containers). The added cases were selected to maintain the same wide distribution among geographic regions and settings.

# 3.2 Process for Collection of Empirical Data

All of the case studies required empirical data on impact measures relating to economic development and land development. They also required empirical data on attributes of the projects and their settings. Specific types of empirical impact measures that are appropriate for the case studies are shown in the lists below, which were developed on the basis of recommendations in the FHWA Guide *Using Empirical Information to Measure the Economic Impact of Highway Investments*, 2001.

**Project Data.** The first type of data is the set of project descriptors:

1. Description of project (short paragraph)
2. Project type (highways, widening, bypasses, connectors, interchanges, bridges, beltway, access road, passenger intermodal, freight intermodal)
3. Project motivation (e.g. access, site development, labor/delivery markets, tourism, congestion mitigation).
4. Project cost (planned if available)
5. Construction start and end years
6. Project Sponsor (if applicable)
7. Case study author
8. Post-construction study date
9. Project magnitude (length, lane-miles)
10. GIS latitude/longitude coordinates
11. Related Links
12. Relevant Attachments

**Location Classification.** The next most critical set of project characteristics is the set of project location (setting) indicators, as these factors (along with project type) provide the core options for an initial search by a user of the TPICS system.

1. Region
2. Urban/Rural class (census designation)
3. Population density (population per square mile)
4. Economic distress (unemployment level relative to national average)
5. Employment growth rate (+/- percent annually)
6. Population growth rate (+/- percent annually)
7. Economic market size (population within 40 minutes)
8. Airport travel distance (minutes)
9. Travel distance to interstate (minutes)
10. Travel distance to major market
11. Extent of mountain terrain (Land surface rating: 1 to 21)

**Impact Measures.** Each team member collected pre/ post economic impact data and interviewee reporting of project impacts for as many impact elements as was practical. The impact elements are listed below. Through the local interview process, additional effort was made to estimate the portion of observed economic change that could be attributable to the highway project.

1. Per capita income
2. Economic Distress (unemployment level relative to national average)
3. Number of Jobs in the area (direct and total jobs impacts)
4. Population
5. Wages and other income (per capita or per worker; direct and total wage impact)
6. Business sales (output; direct and total output impacts)
7. Population density
8. $ Capital investment; direct and total investment
9. Property values ($ aggregate total value change in study area)

10. State, local and federal tax revenues and costs (direct and total tax revenue)
11. Annual Average Daily Traffic count (AADT)

Wherever applicable, the data were collected at the local (metropolitan or smaller), county, and state area level.

## 3.3 Case Study Interviews

While a significant part of the empirical impact data was collected via public sources (as listed above) there are some types of impacts that required local information. The case studies also include information about causal factors affecting project impacts (including both transportation programs and non-transportation considerations). To obtain this local information, the case studies relied on interviews with local private sector and public sector participants and observers, as well as review of available local documents. The product of the interviews was to obtain additional information on impact measures and develop a coherent narrative describing project planning, implementation, and results.

**Types of Interviewees.** The interviews focused on filling in missing pieces of empirical information about highway impact outcomes, and additional explanatory insight into causal factors affecting those outcomes. A minimum of three interviews (one from each type below) conducted for each case study.

1. *Staff of the transportation agency that built the project* -- to provide project characteristics, pre/post transportation data, and information on notable aspects of project planning and implementation;
2. *Staff of the local or regional planning agency* – to provide information (and refer us to other appropriate data sources) on changes in local land use and development, and relative roles of the highway project in affecting it; and
3. *Staff of a chamber of commerce or local economic development agency* – to provide information on how the highway project affected business growth and investment, and its role relative to other local initiatives and factors.

**Interview Questions.** A number of questions were asked in order to gather more empirical data. If the pre/post data were already available, the project team asked the interviewee to validate or elaborate on it. When data were not available, interviewees were asked them to fill in the missing data. In both cases, it was useful to get qualitative information to either reinforce or substitute empirical measures. The questions included:

- Describe the land use changes as a result of the project
- How has the project affected property values? (pre and post measures)
- How have property sales or building permits been effected by the project? (pre and post measures)
- Has there been any new construction activity as a result of the project? (pre and post measures)

- How much of the pre and post impacts are attributed to the project? (go through the list of available impacts data)
- Do you have other before and after measures available? (go through list of impact measures that you do not have)
- Do the direct impacts and total economic impacts accurately describe the influence the project has had on the area? (go through the list of economic impacts)

**Special Aspects of the Project Setting and Planning.** These questions focused on planning and development issues to provide more context for the project's existence and impact.

- What were the key motivations driving the need for this capacity improvement project?
- Describe the societal or environmental implications of the project? (emissions, safety, sprawl)
- How has the project affected the capacity for future development?
- Describe the local community involvement in the project.
- What were the roles of various stakeholders & public agencies in supporting or modifying the project?
- Describe the size of the project's area of influence?
- What were the economic and land considerations in project planning and implementation?
- How were economic and land development considerations analyzed? (try to get a copy of any study that was done)
- How were these considerations communicated to the public?
- Describe any other key analysis issues or performance measures used in project prioritization and planning processes.

**Lessons Learned.** A final set of questions was included to help in gathering ideas for future research on transportation projects.

- What impact measures or procedures do you think need to be addressed better or differently in the future?
- What types of impact data do you think are missing or unreliable?
- Do you agree with how the impact measures were estimated?

## 3.4 Organizing Data for Analysis

The information gathered for each case study was organized in a manner that could be entered into the electronic database and become accessible for users to view. For each project that a user selects, the following data were compiled:

- Characteristics of the Project - description of the project, project type, length, AADT, year constructed, etc.
- Intermodal volume: for passenger and freight intermodal projects, a description of freight volume or passenger movement at the project location.
- Characteristics of the Project Setting – description of the project setting including the urban/rural, economic distress, etc.
- Pre/Post Conditions – shows the pre and post measures for the region's economy.
- Case Study Narrative – the full project narrative developed from the interviews.
- Project Impacts – a table of the specific economic impact findings for the project along with the relevant areas of impact.

# 4 DATA TABULATION FINDINGS

## 4.1 Project Profiles

The case study database has two uses: (1) as a direct source of information on individual project cases, which may be accessed via the TPICS tool (www.tpics.us); and (2) as a source of empirical data that can be analyzed by researchers. As a starting point for the latter use, this report presents initial findings from analysis of the database.

**Project Profiles.** Table 4-1 shows a profile of the costs and length characteristics of the case studies. It shows values for both range and median (50th percentile, representing middle of the range). Overall, median project costs ranged from around $2 million for small industrial park access roads to over $5 billion for some major interstate highways (and even higher if mega-projects such as the Oresund Bridge and Boston's Central Artery are included). Projects also varied from 1 to 244 miles in length.

In general, project costs fell into three classes: (a) Low Cost: access road projects, which were most commonly in the $1-2 million range and all under $70 million; (b) Mid Cost – bridge, connector, bypass and interchange projects, which were typically in the $10-100 million range and all under $350 million; and (c) High Cost – Major highways and beltways, which varied from $200 million to over $3 billion in cost.

**Table 4-1 Profile of Projects, Part 1: Range and Median for Cost and Length**

| Type | Total Cost * ($millions) | Length (miles) | Lane Miles |
|---|---|---|---|
| Access Road | 2 (1.0 - 68) | 2 ( 1 - 3) | 4 (2-11) |
| Beltway | 601 (205 – 2,796) | 27.5 (3 - 62) | 110 (21-372) |
| Bridge | 58 (4 – 101) | 1.1 (0.1-12) | 4 (0.2-72) |
| Bypass | 31 (11 - 163) | 5.5 (2 - 11) | 20 (5-44) |
| Connector | 190 (13 - 250) | 7.7 (1.5-10) | 35 (6-58) |
| Interchange | 47 (5 - 348) | NA | NA |
| Major Highway | 980 (160 – 5,042) | 142 (5 - 325) | 632 (32-1300) |
| Widening | 1145 (313 - 2,060) | 24.8 (8-244) | 85 (50-740) |
| Freight Intermodal | 197 (37 - 415) | NA | NA |
| Passenger Intermodal | 74 (4 - 247) | NA | NA |

**excludes "mega projects": Oresund Bridge between Norway and Sweden ($7.2 billion) and Boston Central Artery/Tunnel ($17 billion);*

Table 4-2 presents the median characteristics for additional aspects of the projects – construction time period, cost per mile and traffic level. It shows that construction time was typically in the range of three to five years (40-59 months) for the small and medium category projects, but typically rose to ten or more years in the case of major limited access highways, beltways and widening projects. Cost per mile was highest for the bridge and widening projects, presumably because of the more difficult site settings and engineering involved in such projects. Traffic volumes were highest for the highway/transit passenger intermodal terminals, lowest for the freight facilities (industrial access roads and freight intermodal terminals), and in the middle for highway projects.

**Table 4-2 Profile of Projects, Part 2: Construction Period, Cost/Mile and Traffic**

| Project Type | Median Months to Construct | Median Costs Per Mile *(Millions of Year 2010 US Dollars)* | Median Traffic Level *(AADT: Annual Avg. Daily Traffic)* |
|---|---|---|---|
| Access Road | 57 | $1.61 | 5,502 |
| Beltway | 120 | $30.68 | 88,000 |
| Bridge | 40 | $39.22 | 23,600 |
| Bypass | 46 | $5.34 | 19,774 |
| Connector | 66 | $21.79 | 16,910 |
| Interchange | 40 | $14.05 | 53,450 |
| Major Highway | 183 | $11.05 | 46,150 |
| Widening | 139 | $46.17 | 24,000 |
| Freight Intermodal | 47 | NA* | 10,367 |
| Passenger Intermodal | 59 | NA* | 136,000 |
| **Total** | **81** | **$14.98** | **23,861**** |

** mileage is not defined for these types of projects*
*** 28,856 excluding passenger and freight intermodal terminals*

# 4.2 Economic Impact Metrics

**Nature of Impacts.** To understand the nature of highway economic impacts, it is important to first establish the presence of different impact metrics and their interrelationship. Economic impacts of transportation facilities typically unfold in a sequence, affecting different impact metrics and spatial scales over time. Acknowledging these effects, the SHRP case studies (completed in 2010) were restricted to projects that had been completed at least five years earlier in order to have sufficient time for the impacts to be manifested. In addition, the case studies sought to measure land value and building construction effects at the level of highly localized areas, while employment, income and tax impacts were measured for both local areas and larger areas (ranging from individual municipalities to multi-jurisdictional corridors or counties). The case studies confirmed the following typical sequence of impacts:

1. *Transportation Impact.* Initially, a highway project is initiated to affect travel-related costs or accessibility for some area, by enabling faster or more reliable travel to and from that area, or enabling access to a broader set of origin or destination opportunities. The benefitting area may be adjacent to the project, or

it may include areas well beyond the endpoints of the project corridor. There are occasionally adverse impacts on adjacent areas, which tend to be offset by benefits elsewhere.

2. *Land (Property) Value Impact.* A transportation improvement makes an area more attractive as a place for living, working or recreation – which results in greater demand for land at the location of the improvement. That improvement sometimes leads to an increase in productivity of the location. The greater demand typically leads to higher land values, as reflected in more property sales at higher prices.

3. *Building Construction and Investment Impact.* The greater accessibility and value of location attracts investment in new construction or expansion of housing, commercial buildings and/or recreation facilities. That is reflected initially in terms of building permits and later in terms of new or upgraded building structures (which can be measured as square footage or dollars of investment $).

4. *Employment, Income and Output Impacts.* Once buildings are occupied, there are commonly measurable increases in population (for residential use) or employment (for commercial and other uses). The employment increase reflects an added activity level that can also be viewed in terms of income (wages associated with the employment) or business activity (measured in terms of value added or total output growth). It is important to note that all of these measures reflect different ways to measure the same economic growth, so these measures cannot be added.

5. *Tax Revenue Impacts.* The added land value and construction activity lead to increases in local property tax collections, while the added wages and associated spending lead to increases in income and sales tax collections.

The case studies confirmed two key conclusions pertaining to this sequential list of impact measures. First, impacts unfold over time, so no single project will necessarily show every type of impact at the same time. For that reason, multiple impact measures and an appropriately broad period of observation may be needed to observe economic development impacts. Second, each of the various forms of impact can have a different spatial pattern of observation; some may be observed at a neighborhood level while others will be spread over a broader community or regional level. These effects also vary systematically by type of project. For instance, connectors, access roads and interchanges tend to have localized impacts, while intercity routes and bypass projects can have broader impacts with some beneficiaries hundreds of miles away.

**Incidence of Impact Measures.** Table 4-3 and Figure 4-1 show the extent to which each element of impacts was observed or measured. They distinguish between qualitative information, such as interview observations of a positive or negative direction of impact, and quantitative data that measured the magnitude of impact over time. In some cases, quantitative measures were available, but only for particular set of buildings or properties that did not represent the full area of impact. Of the 100 projects studied, all had some form of quantitative economic impact indicator available. However, the incidence varied widely among impact measures.

**Table 4-3 Availability of Impact Measures, by Impact Element and Form of Data** *(percent of cases)*

| Element of Impact | Observed Direction of Impact | Some Quantitative Data | Full Quantitative Data |
|---|---|---|---|
| Jobs | 100 | 100 | 100 |
| Income | * | * | * |
| Business Output | * | * | * |
| Building Development (Sq. Ft.) | 74 | 38 | 36 |
| Direct Private Investment ($) | 57 | 30 | 27 |
| Property Values | 36 | 30 | 6 |
| Property Tax Revenue | 50 | 36 | 14 |

** These measures were calculated from employment changes, using applicable local and industry ratios*

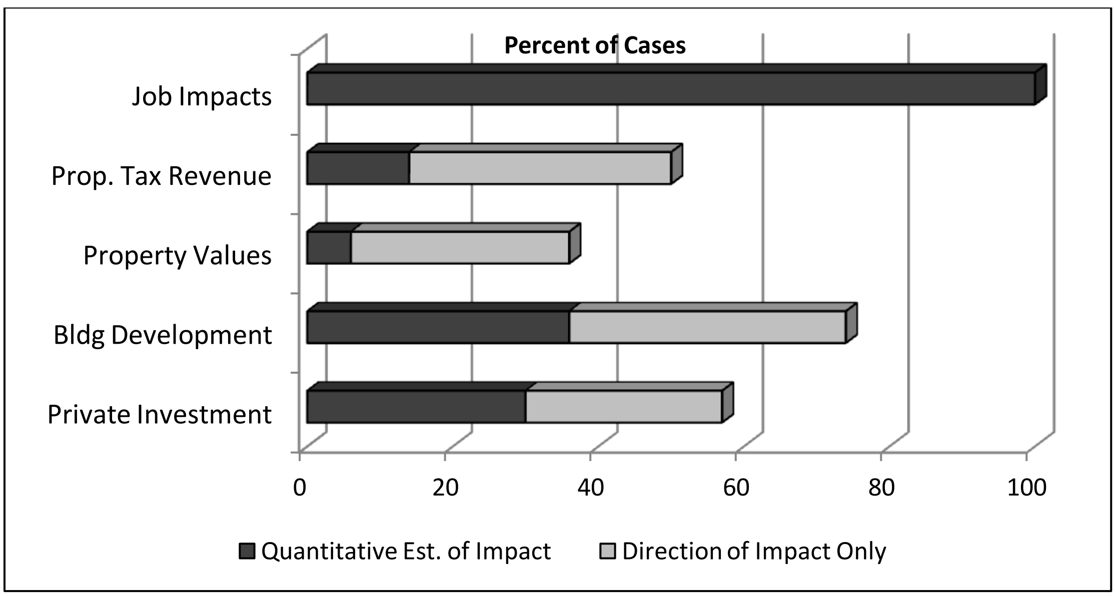


**Figure 4-1 Percent of Cases with Qualitative & Quantitative Impact Data**

These results must be interpreted carefully. The differences among impact measures reflect variation in the availability of data rather than differences in impact occurrence. Generally, a change in any one of those impact elements is likely to also lead to changes in other impact elements. However, there are some notable differences in data availability. In general, employment change is the measure most likely to be measured, because there are widely available employment datasets available at the county, community, and even zip code levels across the US. (For this study, the measure of job change reported as a highway impact was defined to be whatever level of geography was deemed most relevant for that kind of project, adjusted for case study interview findings regarding the portion of observed impact that could be attributed to the highway project.) Information on building permits, property transactions and investment are more difficult to obtain because they come from municipal or county records, which differ widely in their availability and format for tabulation.

## 4.3 Magnitude of Economic Impact

**Direction of Impact**. Impacts can be interpreted in two ways: (a) by drawing upon all qualitative and quantitative information, or (b) by just drawing upon quantitative measures. Adopting the first approach, Table 4-4 combines qualitative and quantitative data to show the incidence of reported positive economic impacts, by project type.

**Table 4-4 Number of Cases with Reported Positive Direction of Economic Impact**
*(including both qualitative observations and quantitative data)*

| Project Type | Total Cases | Job Impact | Private Investment | Building Construct | Property Values | Tax Revenue |
|---|---|---|---|---|---|---|
| Access road | 7 | 7 | 4 | 2 | 1 | 3 |
| Beltway | 8 | 8 | 8 | 8 | 2 | 7 |
| Bridge | 10 | 8 | 7 | 7 | 7 | 7 |
| Bypass | 13 | 7 | 6 | 6 | 5 | 8 |
| Connector | 8 | 6 | 6 | 6 | 4 | 5 |
| Interchange | 12 | 10 | 6 | 8 | 2 | 4 |
| Major Highway | 14 | 14 | 13 | 13 | 10 | 11 |
| Widening | 9 | 9 | 1 | 7 | 2 | 1 |
| Freight Intermodal | 10 | 9 | 2 | 9 | 1 | 1 |
| Pass. Intermodal | 9 | 7 | 4 | 8 | 2 | 3 |
| **Total (100)** | 100 | 85 | 57 | 74 | 36 | 50 |

Viewing Table 4-4 together with prior Table 4-3, it is apparent that all 100 cases had measures of job impact, with 85 showing evidence of a positive change in jobs for the impact area, while two (both rural bypasses) had a negative change. For all of the other impact elements, between 36% and 74% of the cases had observations regarding the direction of impact, and in all of those cases the reported direction of impact was positive. For remaining cases where interviewees reported they were unable to provide observation about a particular impact element, we cannot eliminate the possibility that this may have sometimes occurred because there was no change to observe.

Adopting the second approach, Table 4-5 shows net change results for only those cases that had full quantitative data. Focusing on the most widely available impact metric -- employment (job) impact, the results show that 85 of the cases found positive changes and only two showed a net negative impact, while the remaining 13% showed no net impact. The latter finding includes both cases where there was no evidence of job impact and cases where there were offsetting negative and positive job impacts.

**Table 4-5 Quantitative Impact Findings on Direction of Impact**
*(only for cases with full quantitative data available)*

| Dimension of Impact | Positive Net Change | Negative Net Change | No Net Change | Change Not Observed | Total |
|---|---|---|---|---|---|
| Impact on Jobs | 85% | 2% | 13% | -- | 100% |
| Impact on Bldg Construction | 36% | 0% * | NA | 64% | 100% |
| Impact on Private Investment $ | 27% | 0% * | NA | 73% | 100% |
| Impact on Property Values | 6% | 0% * | NA | 94% | 100% |
| Impact on Local Tax Revenue | 14% | 0% * | NA | 86% | 100% |

** measures reflect the net result of positive and negative impacts*

The quantitative results reflect net impacts. Clearly, highway projects can cause negative visual, air quality or noise quality impacts on areas that are directly adjacent to them, while providing access benefits to broader surrounding areas. In some cases, highway projects can also cause localized negative job impacts, as would be the case if a highway construction or expansion project required the taking of some property with existing commercial activity. However, in nearly all cases, such takings are offset by new activity that occurs somewhere else nearby. The incidence of offsetting impacts is noted in text discussions that are part of the case study database.

The availability of impact metrics other than jobs is best described as spotty; in other words, in a majority of cases it was not possible (after the fact) to reliably reconstruct net changes occurring in investment, construction or tax revenues. Another source of data was municipal data on overall community-wide business sales and property tax base. Those measures, when available, tended to show incidence of both positive and negative changes, though we cannot be sure what portion of the changes are attributable to the highway project rather than other factors.

**Size of Impact.** Table 4-6 shows the range of impact values found in the case study dataset, for various aspects of economic impact. Job impacts are the most commonly measured form of economic impacts because they are easy to understand and provide a reference for analysis and comparison. Other impacts on the economy include growth in personal income and business output, as property values, private investment, building construction, property tax revenues. Value added or gross regional product is another impact measure that is commonly used in economic models, but information on that metric was not available for this study.

**Table 4-6 Ranges and Medians of Economic Impact Measures**

*(where quantitative data is available in the dataset)*

| Measure of Impact | Min | Max* | Median | Mean |
|---|---|---|---|---|
| Employment (Jobs) | -48 | 50,505 | 1,290 | 5,782 |
| Income ($ millions) | $0 | $2,332 | $53 | $267 |
| Business Output ($ millions) | $0 | $8,830 | $142 | $840 |
| Building Development (thousand sq.ft.) | 4.2 | 50,000 | 1,003 | - |
| Direct Private Investment (in $ millions) | $3.0 | $6,300 | $300 | - |
| Property Values (in $ millions) | $0.15 | $85 | $16.0 | - |
| Property Tax Revenue (in $millions) | $0.12 | $55 | $2.1 | - |

**Maximum excludes Santan Freeway widening (AZ), Central Artery Tunnel (MA) and Rt.101 beltway (AZ) which had only rough estimates available for job impact.*

*** not calculated due to small number*

It is notable that job impacts were measured in two different ways depending on the scale of impact area and source of impact measurement. Most often, job impacts were calculated in terms of the change in total level of business activity occurring in a surrounding study area. However, in some cases they were calculated by observing jobs directly attracted to the immediate project area and then applying economic multipliers to account for broader economic impacts also expected to be occurring elsewhere in the region. The income and business output metrics were calculated on the basis of local ratios for wage/worker or output/worker ratios for the applicable industries and areas.

The observed range of impacts varied widely. For instance, nearly half (47%) of the projects accounted for less than 1,000 jobs each, while a small fraction (10%) of the projects accounted for over 20,000 jobs each. As a result, the mean impact was five times larger than the median impact (as shown in the table).

Table 4-7 shows how the job impacts varied by project type and setting. In general, the upside range of project job impacts allowed them to be classified into three groups that reflected differences in project scale. They were: (a) *Small-scale impact*: access road projects that generally supported between 500 and 2,000 jobs; (b) *Mid-scale impact*: bridge, connector, bypass, interchange and intermodal projects that had widely variable impacts, sometimes zero but other times going up to the 10,000 - 25,000 job range; and (c) *Large-scale impact*: major highways and beltways, which always supported some job growth and sometimes supported job increases of 40,000 – 50,000 or more

It is also apparent that job impacts were typically of a much smaller scale in rural areas. Rural connector and bridge projects sometimes had zero impact, though only the rural bypass projects had a mix of negative and positive impacts.

**Table 4-7 Range of Job Impacts, by Project Type and Metro/Rural Setting**
*(where quantitative data is available in the dataset)*

| Project Type | Metro/Mixed Setting | | | Rural Setting | | |
|---|---|---|---|---|---|---|
| | (Cases) | Low | High | (Cases) | Low | High |
| Access Road | (2) | 478 | 3,195 | (5) | 7 | 680 |
| Beltway | (7) | 2,106 | 43,753 | - | - | - |
| Bridge | (7) | 0 | 11,771 | (3) | 0 | 319 |
| Bypass | (5) | 0 | 23,977 | (8) | -48 | 1,420 |
| Connector | (6) | 0 | 14,578 | (2) | 0 | 412 |
| Interchange | (12) | 0 | 23,520 | - | - | - |
| Major Highway | (13) | 90 | 50,505 | - | - | - |
| Widening | (6) | 1,498 | 15,484 | (2) | 3,785 | 4,080 |
| Freight Intermodal | (7) | 0 | 13,646 | (3) | 583 | 3,236 |
| Pass. Intermodal | (9) | 0 | 10,035 | N/A | N/A | N/A |
| **All Project Types*** | **(74)** | **0** | **50,505** | **(23)** | **-48** | **4,080** |

** Excludes Santan Freeway widening (AZ), Central Artery Tunnel (MA) and Rt.101 beltway (AZ) which had only rough estimates available for job impact*

**Projects with No Economic Growth Impact.** The case studies found that 15 of the 100 projects led to a zero or negative impact on job growth. Table 4-8 provides a breakdown of those projects, by type. It shows that nearly all were bridges, bypasses, connectors, interchanges or transfer terminals. With the possible exception of intermodal projects, these were generally projects designed more to help manage traffic flow than to generate economic growth.

The finding for rural community bypass roads was also to be expected. Past bypass studies conducted for a number of different states have shown that job impacts are either slightly positive or negligible in most bypassed communities. That outcome is due to the offsetting positive and negative effects of shifting pass-by traffic out of local communities -- which represents a potential loss for some traffic-serving businesses, but a potential gain for others that benefit from having improved safety and a more attractive urban environment for local residents and visitors.

An important finding is that most of these 15 projects had other forms of positive economic impact despite the lack of positive job impact. This included the following findings:

- 8 of the cases had gains in post-project business sales at the county level;
- 10 of the cases had growth in local per capita income after project completion;
- 6 of the cases had documented increases in local property values.

**TABLE 4-8 Types of Projects that Yielded Zero or Negative Job Impacts**
*(where quantitative data is available in the dataset)*

| Type of Project | Cases with Net Zero Job Impact | Cases with Net Negative Job Impact |
|---|---|---|
| Access Road | - | - |
| Beltway | - | - |
| Bridge | 2 | - |
| Bypass | 4 | 2 |
| Connector | 2 | - |
| Interchange | 2 | - |
| Major Highway | - | - |
| Widening | - | - |
| Freight Intermodal | 1 | - |
| Passenger Intermodal | 2 | - |
| **Total Projects** | **13** | **2** |

# 4.4 Job Impact Ratios

The case studies overall had an overall ratio of 7 long-term jobs added per $ million of highway investment, though the ratio varied from less than 2 jobs to nearly 90 long-term jobs per $ million depending on the type of project and urban/rural setting. (See Figure 4-2.) The access roads, interchange and connectors tended to have the highest average ratio of long-term jobs supported per $million of highway spending. At the other extreme, the beltway, major highway and widening projects tended to have the lowest average ratio of long term job growth per $million of highway spending.

These systematic differences occurred for some very good reasons. Project types with the highest ratio of long-term job growth per $ million spent – access roads, interchanges and connectors –were often built specifically to facilitate specific business location or expansion activities that were contingent on having new access routes, interchanges or connectors built.

On the other hand, project types with lowest ratio of observed job growth per $ million spent – urban freeway (limited access highways) and highway widening projects – often required the addition of costly land acquisition and neighborhood impact mitigation costs. And the beneficiaries of those projects were more likely to be through trips based at origins and destinations located beyond the highway project endpoints (thus providing benefits beyond the areas immediately surrounding the highway project).

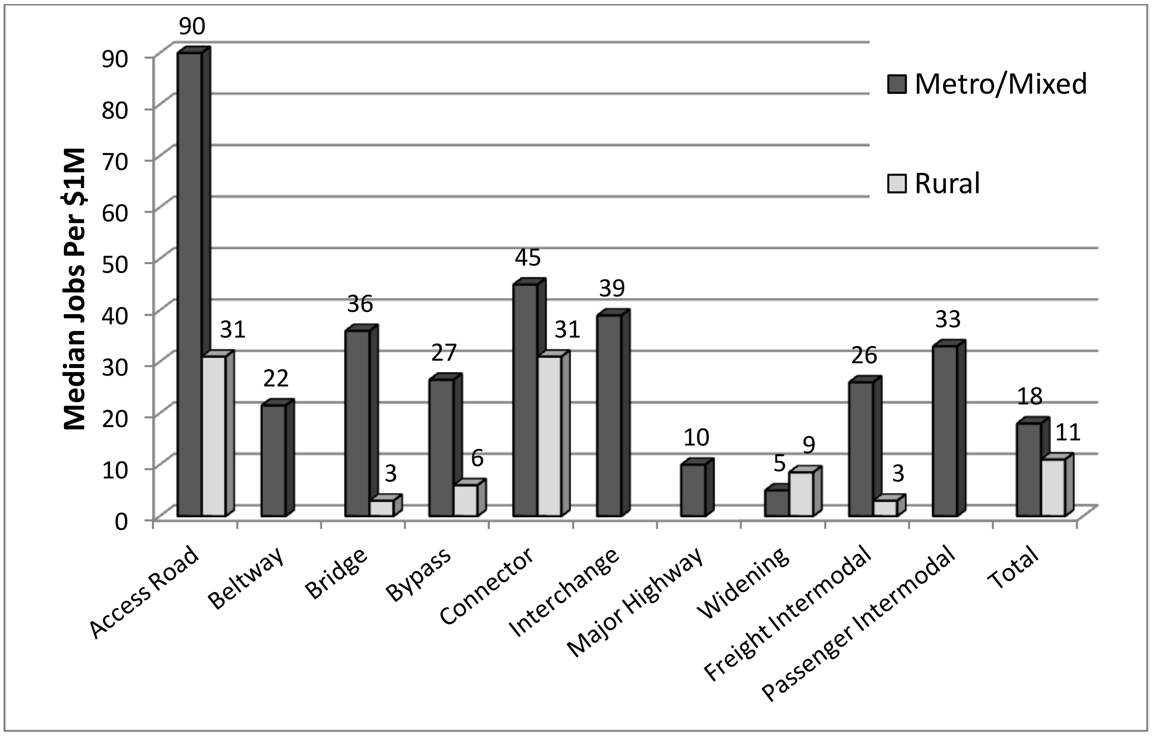


**Figure 4-2 Ratio: Median Long-Term Job Impact per $ Million of Project Cost, by Project Type and Setting**

There were also substantial differences in the job generation ratio by urban/ rural setting. The ratio of long-term jobs per million dollars spent for projects in a metropolitan (or mixed urban/rural) area was more than three times than occurring in rural areas. Fully 22% of the rural projects but only 14% of the metro/mixed projects had zero job creation. And fully 50% of the rural projects but only 22% of the urban/mixed projects had 0 - 99 net jobs added. The upside potential was most evident for the metro area projects, as 66% of them had a long-term job growth impact exceeding 1,000 jobs.

There are many possible explanations for this finding, which will need to be further explored in future research. With differences in densities of population and jobs, one hypothesis is that many of the rural projects serve intercity travel whose beneficiaries are more broadly distributed outside of the project area. Or it may be that rural projects also take longer for land development and private investment impacts to take place.

# 4.5 Role of Project Motivation

As part of the data collection process through interviews, designations were made to classify each project in terms of its purpose. Project motivations were classified into nine major categories. Six are related to increasing access; they include: improving access to terminals of air, rail and marine modes, international borders, labor markets, and delivery markets. Two are related to economic development, which includes tourism market development and facilitation of industrial site development. The final motivation category is congestion management, which most often represents an attempt to reduce or prevent further degradation in traffic flow conditions, rather than to enable positive enhancement compared to past or current conditions.

In the case study interviews for each project, both local planning officials and business representatives were asked to identify project motivations and they were allowed to choose multiple motivations. Findings are reported in Table 4-9. Overall, project motivation was obtained for 97 of the 100 projects. Fifty eight were motivated by an access issue, 65 by an economic development issue and 54 by a congestion management issue. The motivation to mitigate congestion was most often reported for urban highway projects, while the motivation to facilitate site development was most often reported for interchange and access road projects.

**Table 4-9 Project Motivation, by Project Type**

| Category of Motivation | Highway Projects | Freight Intermodal | Passenger Intermodal | Total |
|---|---|---|---|---|
| **ENHANCE ACCESS** | | | | |
| Improve Access to Airports | 18 | 2 | 0 | 20 |
| Improve Access to Rail | 4 | 6 | 0 | 10 |
| Improve Access to Int. Border | 2 | 1 | 0 | 3 |
| Improve Access to Marine Port | 7 | 2 | 0 | 9 |
| Improve Labor Market Access | 26 | 0 | 4 | 30 |
| Improve Delivery Market Access | 29 | 3 | 0 | 32 |
| *Any of the above* | | | | *58* |
| **PROMOTE ECONOMIC DEVELOPMENT** | | | | |
| Facilitate Site Development | 42 | 2 | 8 | 52 |
| Facilitate Tourism | 26 | 0 | 0 | 26 |
| *Any of the above* | | | | *65* |
| **REDUCE CONGESTION** | | | | |
| Mitigate Congestion | 47 | 0 | 7 | 54 |
| | | | | |
| **All Projects** | **78** | **10** | **9** | **97** |

Figure 4-3 shows how the project motivations varied by setting. Many projects had more than one motivation, so they do not sum to 100%. Focusing just on the highway projects (excluding intermodal terminals), the chart shows that the most common project motivation in both rural and metro areas was congestion mitigation. Site access and delivery market access were the next two most frequent reasons in metro/mixed and rural settings, while tourism was an important motivator in rural areas and labor market access was also key in metro/mixed areas.

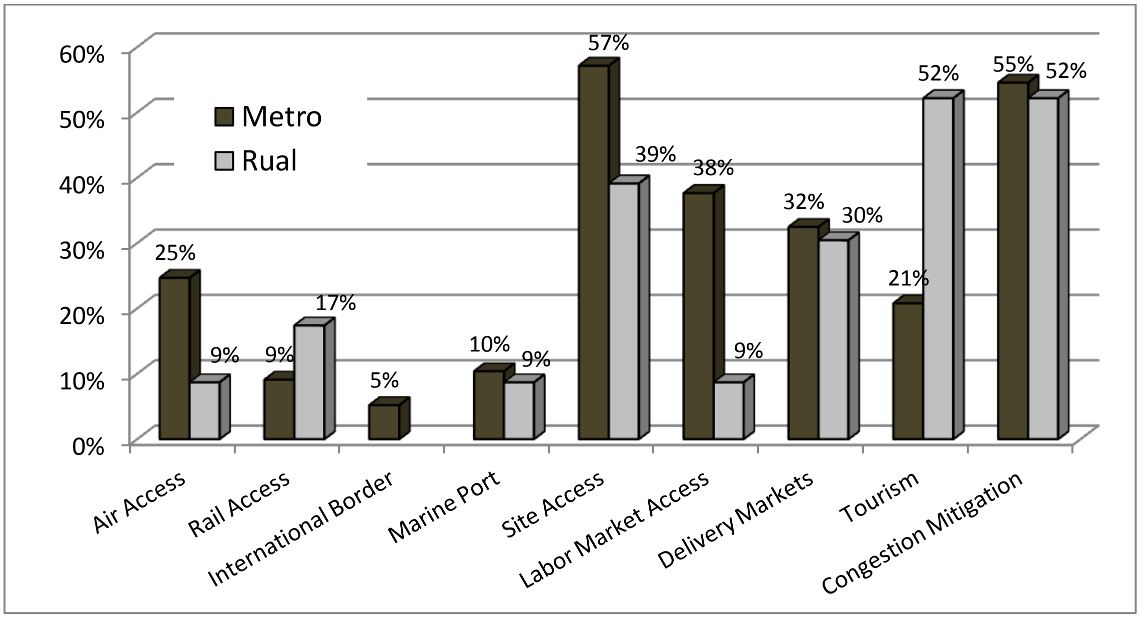


**Figure 4-3 Project Motivations**

*(Percentage of Highway Cases with Each Motivation)*

Figure 4-4 shows how project motivations also varied by type of project. Not surprisingly, access considerations were strongest motivations for the major highways and freight intermodal projects. Congestion mitigation motivations were strongest for the bridge and beltway projects. And economic development motivations were strongest for the access road and passenger intermodal projects.

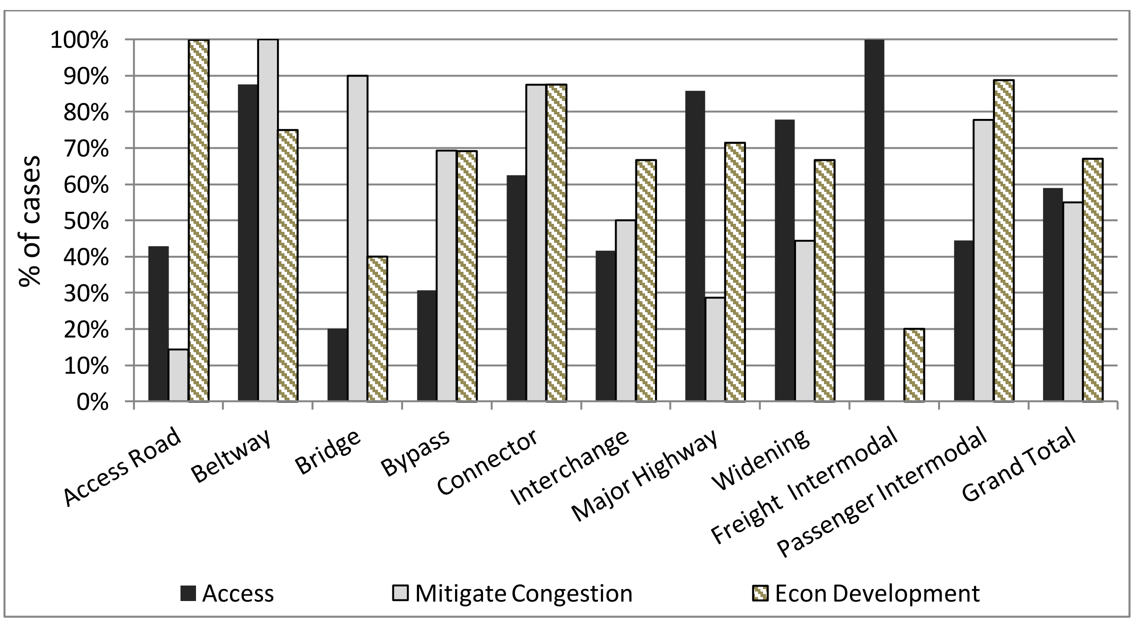


**Figure 4-4 Project Motivation, by Project Type**

# 4.6 Role of Non-Highway Factors

The economic impact was often supported by non-transportation factors, most commonly as the presence of other infrastructure investments, land use policies and/or business development incentive programs. In some cases, the synergy among multiple factors created a positive economic development climate that lead to further job creation. In other cases, a lack of complementary infrastructure and supportive policies diminished job impacts. Table 4-10 shows the frequency with which these various non-transportation factors were cited in case study interviews as matters affecting the long-term job growth impacts of highway projects.

**Table 4-10 Incidence of Non-Transportation Factors Affecting Job Growth**

| | Non-Transportation Factors | Incidence |
|---|---|---|
| Positive Local Factors | Available Infrastructure (sewer, water, telecom) | 33% |
| | Land Use Management | 45% |
| | Financial Incentives/ Business Climate | 46% |
| Negative Local Factors | Lack of Infrastructure (sewer, water, telecom) | 10% |
| | Lack of Land Use Management | 6% |
| | Lack of Financial Incentives/ Neg. Business Climate | 5% |
| **ALL PROJECTS** | | **100%** |

Table 4-11 shows how the job growth impact of highway projects varies, depending on the presence of positive or negative local factors. It indicates that greater long-term job growth was reported for highway projects with positive local factors than occurred with projects lacking those supportive factors. The median job creation was slightly over 180 for projects where a lack of complementary infrastructure or policies inhibited economic development, compared to over 1,420 for projects where supportive factors were reported. Projects that cited both positive and negative policies included a wide range of job impacts which resulted with a median of 1,050 jobs.

The influence that local factors can have on economic outcomes is even more apparent when grouped by level of economic distress, as shown in Figure 4-5. Non-Distressed areas with positive local factors resulted in higher median ratios of jobs per $ million than distressed areas.

**Table 4-11 Effect of Non-Transportation Factors on Magnitude of Job Growth**

| Non-Transportation Factors | Number of Cases | Total Job Impact (all projects) | Median Job Impact (per project) | Mean Job Impact (per project) |
|---|---|---|---|---|
| Positive | 57 | 271,362 | 1,420 | 4,761 |
| Negative** | 8 | 11,757 | 183 | 1,470 |
| Mixed Positive & Negative | 8 | 19,625 | 1,050 | 2,453 |
| Not Reported | 23 | 207,627 | 808 | 9,027 |
| **Totals*** ** | **96** | **510,371** | **1,269** | **5,316** |

* *Note: Excludes Santan Freeway widening (AZ), Central Artery Tunnel (MA) and Rt.101 beltway (AZ) which had only rough estimates available for job impact.*

** *Excluding Interstate 26 project, which reported nearly 31,000 jobs yet local officials reported that the project never reached its full potential due to lack of adequate infrastructure and land use management*

****Note¨ The median of 1,269 and mean of 5,316 reported here differs from the median of 1,290 and mean of 5,782 reported in Table 4-6 are because the Interstate 26 project was excluded (see prior note).*

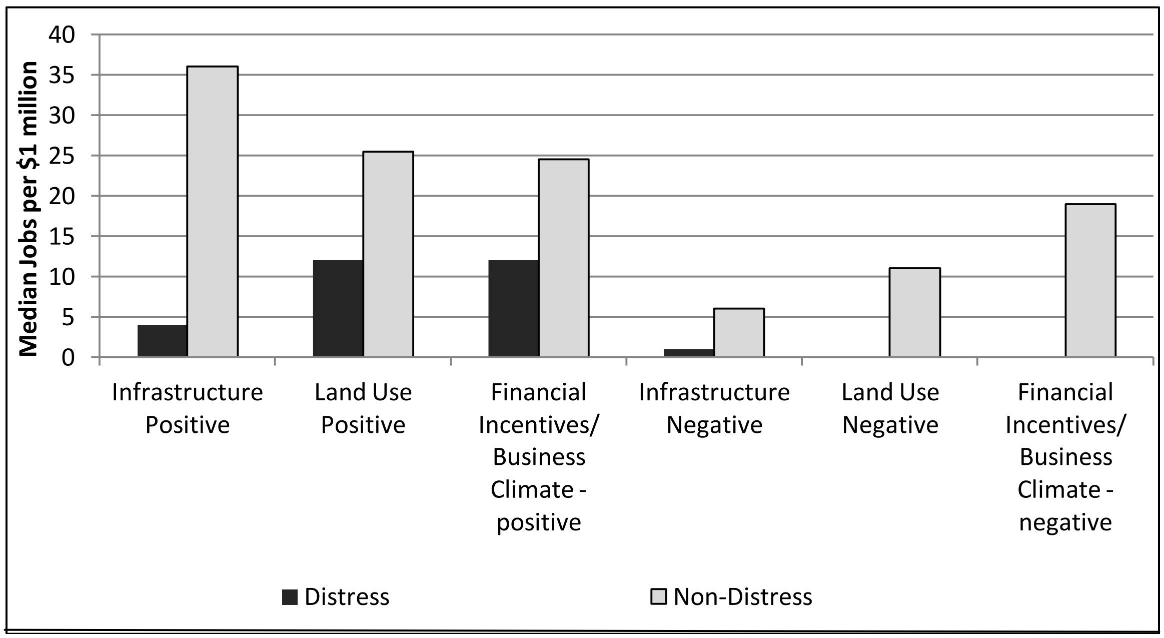


**Figure 4-5 Effect of Non-Transportation Factors on Job Growth, by Local Economic Condition (Distress Level)**

Taken together, these tables and figures illustrate the magnitude of long-term economic activity growth that typically follows highway-related projects, and the ways in which project types and settings interact to affect those outcomes. A further effort to establish these relationships is presented via statistical analysis in Chapter 5.

# 5 STATISTICAL ANALYSIS OF JOB IMPACTS

## 5.1 Structure of Regressions

**Focus on Direct Job Impact.** Regression analysis is a statistical technique used to calculate the magnitude of incremental impact that various explanatory factors (variables) can have on outcomes, holding all else equal. For this study, regression analysis was used to identify factors that are statistically significant in explaining project impacts in terms of: (a) long-term job growth at nearby businesses, or (b) the ratio of job impact per million dollars of project cost.

Whereas the Chapter 4 tabulations represented job impacts in terms of *total* job growth attributable to a project, the statistical analyses results reported in this chapter examines factors affecting *direct* impact, which counts only added jobs occurring at nearby locations benefitting from improved access or enhanced travel conditions. It excludes other aspects of total impact, such as growth of suppliers to the directly affected businesses, that may be located elsewhere in a broader surrounding area. This was done to enhance statistical accuracy for prediction, as total impacts can be calculated by multiplying each project's direct impact by an input-output economic multiplier that is specific to the project area and its economic profile.

The direct impact area is usually defined as a neighborhood or corridor, though the corridor may be many miles in length. The total impact area is typically defined as a metropolitan area, county or aggregation of multiple counties. On average, the direct impact accounts for approximately 70% of the total impact, though that ratio can vary between 50% and 100%, depending on the specific project and its setting.

**Classification of Project Types.** For statistical analysis, the 100 case study projects were pooled into three classes, designed to distinguish fundamental differences in project length (size) and traffic volumes. These classes were:

- *"Roadway Corridors"* – Beltway, Bypass, Major Highway, Widening (44 projects)
- *"Point-to-Point"* - Interchange, Access Road, Bridge, Connector (37 projects)
- *"Intermodal"*- Terminals for passenger and freight road/rail transfers (19 projects).

The study team then developed and tested a series of separate regression equations for US "roadway" and "point-to-point" classes of projects, to determine the most important factors that affected the magnitude of their job impacts.

**Independent (Explanatory) Variables.** Independent variables are the explanatory factors that are hypothesized to affect observed job impacts; in this case they describe the nature of the project and/or its setting. Location-specific data was obtained from the Bureau of Economic Analysis, Bureau of Labor Statistics, Census Bureau, and GIS database of ESRI. The independent variables that were tested as explanatory factors fell into seven categories, each with a hypothesized behavioral impact as noted below.

- *Level of traffic activity* – Projects with higher levels of AADT (traffic count) or VMT (total vehicle-miles of traffic) are most likely to be facing congestion delays, which can have particularly important consequences for access and travel time reliability.
- *Scale of Project* – Projects involving the highest number of lane-miles are most likely to be connecting between urban areas or linking urban activity centers to their surrounding markets.
- *Urbanization* – Projects set in areas of higher average population density are most likely to be in urbanized areas where congestion is a particularly important consideration.
- *Market Scale* – Projects with the largest size market (measured in terms of population within a 40 minute drive) are most likely to be within large metropolitan regions, where access is a particularly important consideration. They may also be more likely to have rail and air facilities located nearby, which can also gain from highway access improvements.
- *Terrain* – Projects in mountain terrain are most likely to face limited route options are higher sensitivity to slow vehicle or accident delays.
- *Economic Health* – Projects in areas that are already economically healthy (measured in terms of higher income and lower unemployment rates) are more likely to enable economic development without facing other barriers (occurring in economically distressed areas) that need to be addressed before further business investment can occur.
- *Underlying Growth Trend* – Projects in regions that are already strong and growing (in terms of jobs and income) can be particularly dependent on additional transportation capacity enhancement to successfully attract new business.

# 5.2 Statistical Analysis of Job Impact

**Regression Results for Explanatory Use.** The first set of regressions had total job impact as the dependent variable. Findings are summarized in Table 5-1 for various alternative combinations of project class (roadway and point-to-point) and setting (expressed in terms of metro, rural or mixed classification). Only explanatory variables that were found to be statistically significant at the 90% confidence level are shown. The results were tested for "multicolinearity" – a way to ensure that the power of each explanatory variable is estimated in an efficient manner that is not biased by correlations among the explanatory variables. The overall explanatory power of each regression, is shown in terms of the $R^2$ value, which represents the portion of variance in the dependent variable (job impact) that is explained by the explanatory variables.

The results showed that some explanatory variables had a statistically significant effect for all combinations of project class and setting, while others were statistically significant only for a subset of project-setting combinations. All seven categories of independent variables had some explanatory power for at least some project-setting combinations. The location setting variables that most consistently emerged as important were the level of traffic activity, market scale, urbanization and underlying growth trend.

**Table 5-1 Regression Results: Factors Affecting Job Impact**

| Project-Setting Combinations | Statistically Significant Explanatory Variables *(those with over 90% statistical significance are listed)* | $R^2_{adj}$ |
|---|---|---|
| Rural Setting, Point-to-Point and Roadway Projects | • Level of Traffic Activity (VMT)<br>• Market Scale (pop. size)<br>• Underlying Economy: per capita income growth trend<br>• Economic Health (per capita income level) | .70 |
| Metro & Mixed Setting, Roadway Projects | • Level of Traffic Activity (AADT)<br>• Project Scale (Lane Miles)<br>• Urbanization (Population Density)<br>• Market Scale (pop. size)<br>• Underlying Economy: local pop. & job growth trend | .81 |
| Metro Setting, Roadway Projects | • Level of Traffic Activity (AADT)<br>• Project Scale (Lane Miles)<br>• Urbanization (Population Density)<br>• Underlying Economy: local pop. & job growth trend | .91 |
| Mixed Setting, Roadway Projects | • Level of Traffic Activity (AADT)<br>• Project Scale (Lane Miles)<br>• Urbanization (Population Density)<br>• Market Scale (pop. size)<br>• Terrain (Mountain Terrain) | .91 |
| Urban Setting, Point-to-Point Projects | • Economic Distress (dummy variable)<br>• Underlying Economy: regional job & income growth trend | .58 |
| Rural & Mixed Setting, Point-to-Point Projects | • Level of Traffic Activity (VMT)<br>• Urbanization (Population Density)<br>• Underlying Economy: regional & local income growth trend<br>• Economic Health (per capita income level) | .88 |

**Regression Results for Predictive Use.** The underlying economic growth trend is an important factor in understanding why the economic impact of highway projects varies from place to place. However, at the time of project planning, one may not be able to assume that local or regional economies will continue to trend over time in the same way as they have in the past. For that reason, it is also useful to consider regression equations in which the underlying growth trend is not available as an explanatory variable. Accordingly, Table 5-2 summarizes revised regression results in which only known or planned project characteristics and existing pre-project socio-economic factors are used as explanatory variables. While the resulting explanatory power of the regression equation drops, the results still confirm the importance of differences in project class and setting, including factors such as project scale, level of traffic activity, urbanization, market scale and economic health. Those results are also used as a basis for the predictive impact calculator called "My Projects" in the TPICS web tool.

**Table 5-2 Regression Results: Limited to Factors Known Before Construction**

| **Project-Setting Combinations** | **Significant Explanatory Variables** *(Pre-Project Knowledge Only)* | $R^2_{adj}$ |
|---|---|---|
| Rural Setting, Point-to-Point & Roadway Projects | • Project Scale (miles) | .42 |
| All Settings, Roadway Projects | • Level of Traffic Activity (AADT)<br>• Project Scale (Lane-miles)<br>• Urbanization (Population Density)<br>• Market Scale (pop. size) | .41 |
| Metro & Mixed Setting, Roadway Projects | • Level of Traffic Activity (AADT)<br>• Project Scale (Lane-miles)<br>• Urbanization (Population Density)<br>• Market Scale (pop. Size) | .35 |
| Mixed Setting, Roadway Projects | • Level of Traffic Activity (AADT)<br>• Project Scale (Lane-miles)<br>• Urbanization (Population Density)<br>• Market Scale (pop. Size)<br>• Terrain (Mountain Terrain) | .91 |
| Rural & Mixed Setting, Point-to-Point Projects | • Level of Traffic Activity (AADT)<br>• Project Scale (miles) | .61 |

## 5.3 Statistical Analysis of Job Impact per Dollar

**Objective.** It is not surprising that there is a statistical relationship between project cost and resulting economic impacts. That certainly does not mean that spending more money on a project automatically leads to a larger economic impact. Rather, it indicates that, all else equal, larger scale projects do tend to lead to larger scale economic impacts. Furthermore, decisions to fund most major highway projects involve some form of (explicit or implicit) consideration of the benefit relative to cost, so projects that have a high expected cost and low expected benefit are unlikely to ever be built.

While there is a general relationship between project cost and economic impact, it can be useful to identify the nature of that relationship, and the extent to which it is affected by other factors associated with either the project type or setting. Accordingly, the project team conducted a statistical analysis of ways to relate cost and impact.

**Analysis Design.** To assess the statistical relationship of job impacts to project cost, several alternative regression specifications were tested. Explanatory variables included in various regression estimations included combinations of project cost (adjusted to constant dollars), magnitude of cost scaled by highway size (measured in terms of length) and multiplicative terms combining the cost metrics with a measure of traffic: either AADT (average annual daily traffic) or VMT (vehicle-miles of travel). Those variables were examined for the entire set of projects, for the pooled classes of highway and point-to-point projects, and for classes of rural and metropolitan settings.

Prior statistical analysis, shown in Table 5-2, showed that we can a large share of the variation in job impacts among the case studies by considering project cost and additional factors such as project type, traffic level and urbanization of the study area. Projects in metropolitan areas, for example, are more likely to be implemented to reduce congestion than with a primary objective to create jobs. Secondly, certain types of projects are initiated specifically to facilitate job development, such as roads that connect highways with office or industrial parks. In this situation, it would be expected that the cost of a project would be related to the scale of development to be served.

It should also be noted that jobs are only one way of measuring the economic impact of highway development. Expansive (and expensive) projects generally are conceived to generate significant user benefits, including personal time savings for drivers and passengers and household cost savings, although such user benefits are not part of an economic development impact analysis in this report. Similarly, environmental, social and safety impacts may also be important considerations for some or many of the projects studied here. It is reasonable to assume that major highway investments would not be undertaken without assuming that the benefits are equal or greater than the costs involved. However, this aspect of the analysis focuses only on job creation impacts

**Findings.** Table 5-3 shows the outcome of four alternative regression specifications. It shows that, when considering the full pool of all case study projects, total cost emerges with a stronger relationship to job impact than cost per lane mile. Similarly, total VMT emerges with a stronger relationship to job impact than AADT and highway length. By considering both the cost of a project and its VMT level, we can account for up to 55% of the variation in jobs generated by all projects.

**Table 5-3 Relationship of Project Cost and Job Impact**
*(Dependent variable = Job Impact)*

| Equation Specification | Explanatory Variables | Coefficient "t" Score | $R^2_{adj}$ |
|---|---|---|---|
| A | • Constant term<br>• Project Cost | 3.42*<br>9.14* | .46 |
| B | • Constant term<br>• Project Cost<br>• AADT | 1.80<br>8.83*<br>2.06* | .47 |
| C | • Constant term<br>• Project Cost<br>• AADT<br>• Length | 1.07<br>8.26*<br>2.24*<br>1.88* | .49 |
| D | • Constant term<br>• Project Cost<br>• VMT | 2.24*<br>8.98*<br>4.62* | .55 |

**=statistically significant with better than 90% confidence*

To gain a second perspective, the dataset was split into "roadway" projects (which do not have a specific destination point); and "point-to-point" projects (that generally have defined start and end points). The 19 intermodal freight projects and intermodal passenger projects were excluded for this analysis.

The analysis again considered combinations of project cost, VMT, AADT and length. Results are shown in Table 5-4. Results again showed that the strongest statistical relationship was between jobs and total project cost. The regressions explained approximately 83% of the variance in job impacts for point-to-point projects, but less than 50% of the variance for continuous roadway projects.

**Table 5-4 Relationship of Project Cost & Job Impact, by Project Class**
*(Dependent variable = Job Impact)*

| Project Class | Explanatory Variables | Coefficient "t" Score | $R^2_{adj}$ |
|---|---|---|---|
| Point-to-Point | • Constant term<br>• Project Cost | 2.15*<br>11.83* | .83 |
| Roadway | • Constant term<br>• Project Cost | 2.95*<br>5.66* | .38 |
| Point-to-Point | • Constant term<br>• VMT<br>• Project Cost | 1.54<br>3.28*<br>5.67* | .83 |
| Roadway | • Constant term<br>• VMT<br>• Project Cost | 1.59<br>0.97<br>11.69* | .48 |
| Point-to-Point | • Constant term<br>• AADT<br>• Project Cost | 1.99*<br>-0.29<br>11.63* | .83 |
| Roadway | • Constant term<br>• AADT<br>• Project Cost | 0.43<br>3.21*<br>4.93* | .48 |
| Point-to-Point | • Constant term<br>• AADT<br>• Length<br>• Project Cost | -1.39<br>0.21<br>0.40<br>10.95* | .82 |
| Roadway | • Constant term<br>• AADT<br>• Length<br>• Project Cost | -0.42<br>3.49*<br>1.56<br>4.56* | .49 |

**=statistically significant with better than 90% confidence*

There are several explanations for this difference. After all, "point-to-point" projects generally create access to industrial parks, office parks and other economic development nodes. Moreover, it is likely that state and local area officials are willing to invest in high-cost point-to-point highway development for strong and foreseeable jobs and benefit returns on investments. Continuous roadway projects, in contrast, may be created to relieve congestion – in which case there is a less pronounced job impact, and/or job creation may be generated hundreds of miles from the project investment, or may have a robust local job impact. Therefore, the variation of jobs generated by continuous roadway projects does not reflect investment as smoothly as for point-to-point projects.

Projects were further divided into metro and rural as a third test to account for the relationship of project cost and jobs. Those results are shown in Table 5-5. They show that the regression explained between 44% and 53% of the job impact variance for urban projects, and between 47% and 70% of the variance for rural projects.

**Table 5-5 Relationship of Project Cost & Job Impact, by Urban Setting**
*(Dependent variable = Job Impact)*

| Urbanization Setting | Dependent Variable(s) | T-Score Variables | $R^2_{adj}$ |
|---|---|---|---|
| Metro or Mixed | • Constant Term<br>• Project Cost | 3.56<br>7.82 | .44 |
| Rural | • Constant Term<br>• Project Cost | 1.41<br>4.76 | .50 |
| Metro or Mixed | • Constant Term<br>• VMT<br>• Project Cost | 2.41<br>3.85<br>7.73 | .53 |
| Rural | • Constant Term<br>• VMT<br>• Project Cost | 1.05<br>4.10<br>5.86 | .71 |
| Metro or Mixed | • Constant Term<br>• AADT<br>• Project Cost | 2.09<br>1.35<br>7.63 | .45 |
| Rural | • Constant Term<br>• AADT<br>• Project Cost | 1.0<br>0.04<br>4.64 | .47 |
| Metro or Mixed | • Constant Term<br>• AADT<br>• Length<br>• Project Cost | 1.37<br>1.55<br>1.53<br>7.11 | .46 |
| Rural | • Constant Term<br>• AADT<br>• Length<br>• Project Cost | 0.82<br>-0.26<br>3.94<br>5.72 | .69 |
| Metro or Mixed | • Constant Term<br>• Length<br>• Project Cost | 2.81<br>1.33<br>7.37 | .45 |
| Rural | • Constant Term<br>• Length<br>• Project Cost | 0.87<br>4.02<br>5.86 | .71 |

**=statistically significant with better than 90% confidence*
*Sample size: based on 77 metro or mixed projects, and 23 rural projects*

## 5.4 Calculations in the TPICS Web Tool

The TPICS (Transportation Project Impact Case Studies) web tool enables users to either: (a) search for case studies meeting specified criteria (the "Case Search" feature), or (b) allow the system to calculate a range of potential impacts that is consistent with prior cases, given a specified type of project and setting (the "My Project Tools" feature). This latter feature is enabled by utilizing factors and statistical relationships drawn from the tabulations and regression analyses.

The economic impact estimation function of "My Project Tools" is divided into five modules: (1) initial user entry; (2) initial system feedback; (3) preliminary economic impact estimation, (4) user adjustments; and (5) final economic impact estimation. Each module is discussed below.

**Initial User Entry.** User inputs are: Project Type, Region, Setting (Metro/Rural/ Mixed), Local economy (distress) rating, and Length of the project (miles).

**Initial System Feedback.** Given the user inputs, the TPICS system then estimates: typical baseline traffic level (in terms of AADT --annual average daily traffic), and typical project cost, as well as a range for typical economic impacts (in terms of jobs, income and output, based on the impacts of applicable case studies).

The traffic level is estimated based on the median for each project type, adjusted by the setting classification. The project cost is calculated using the median cost per mile for each project type, multiplied by the project length (in miles). Users may adjust the traffic and/or cost values if a more accurate numbers are available, although changing the cost alone will not affect economic impact outcomes.

**Preliminary Economic Impact Estimation.** The range of estimated job, income and business output impacts is presented in terms of both direct impact and total impact. The direct impact is calculated based on statistical relationships between the average project impact per mile (or per project) and each of the five classes of user entry variables. The calculation draws upon regressions results described in Chapter 5. The total impact is then calculated by applying applicable input-output economic multipliers for each study area.

**User Adjustments.** TPICS users may adjust five factors, which will lead to recalculation of the estimates of impacts on jobs, wages and output. They are:

- Project length (miles)
- Project baseline traffic level (AADT);
- Infrastructure conditions (including water, sewer, telecom, broadband);
- Land use and development policies;
- Business climate policies, including availability of financial incentives.

**Final Economic Impact Estimation**. Based on analysis of the case study database, the estimated economic impacts are scaled by project size (as reflected by a combination of highway length and traffic level) and then adjusted upward or downward based on the policy adjustment factors shown in Table 5-6. In this table, it may be noted that the potential for upward adjustment in economic impacts is larger than the potential for downward adjustment. The reason is that the range of actual project impacts is far broader above the median than it is below the median (as few projects have net impacts below zero). In actual use, the economic impact calculations shown in "My Project Tools" can reflect the compounded effects of any or all of these factors. And finally, the estimated magnitude of estimated project impacts is capped at 1.2 times the largest value observed to date from any case studies of the applicable project type. This serves to prevent anomalous occurrences generating unreasonably large impact estimates.

**Table 5-6 Impact of TPICS Adjustment Factors on Estimated Economic Impact**

| Factor | Max Negative Impact | Max Positive Impact |
|---|---|---|
| Local Economy (Distress) Rating | -11% | +38% |
| Local Economy Rating * per mile scale factor | -14% | +46% |
| Local Economy Rating * traffic volume factor | -7% | +31% |
| Urban/Rural Setting | -58% | +121% |
| Infrastructure Conditions | -40% | +32% |
| Land Use Policies | -34% | +24% |
| Business Climate | -12% | +20% |

**Validation of Predictive Accuracy.** To test whether the predicted values of direct jobs fall within a reasonable range of accuracy, the project team calculated the mean and standard deviation of actual job impacts associated with each project type. This enabled statistical confidence intervals to be constructed for the observed impacts. It was done for all US highway projects (omitting intermodal terminals, international projects and mega-projects). Predicted values were compared against those confidence intervals, and it was found that 92% of the US highway projects had a predicted value within one standard deviation of the actual (observed) impact.

**Table 5-7 Percent of Cases With Predicted Job Impact Accurate within One Standard Deviation of Observed Impact**

| Project Type | Percent of Cases Accurate Within 1 Std. Deviation | Total Cases |
|---|---|---|
| Access Road | 100% | 7 |
| Beltway | 63% | 8 |
| Bridge | 78% | 9 |
| Bypass | 100% | 11 |
| Connector | 88% | 8 |
| Interchange | 100% | 12 |
| Major highway | 100% | 13 |
| Widening | 100% | 9 |
| ***% within Range*** | ***92%*** | ***77**** |

**The analysis excluded intermodal terminals, international projects and mega-projects*

# 6 LESSONS LEARNED FOR CASE STUDY INTERPRETATION

## 6.1 Types of Benefits and Impacts Covered

The 100 case studies (listed in Table 6-1 on the following pages) are a source of empirical data on project characteristics and impacts, as well as considerable qualitative information obtained from interviews with local public and private sector representatives. The two types of data together provide a sound basis for case study interpretations. This chapter draws on both forms of information to clarify impacts covered by the case studies, and illustrate lessons learned regarding interpretation of impact findings.

**Impact Measures.** The case studies focused on identifying the magnitude and pattern of economic development impacts associated with transportation enhancement projects. They included expansion of jobs, worker income and business output, as well as changes in building construction and land values. But that is far from all aspects of economic impact that might result from a transportation investment. The cases do not directly measure the economic value of efficiency benefits such as travel time savings, operating cost savings and reliability improvement, as well as productivity growth associated with increased accessibility and efficiency of business operations.

In theory, travel efficiency benefits and access enhancement benefits are the drivers of business expansion and investment, which in turn enable other economic development impacts. From that perspective, all of the various benefits can be viewed as highly related. But in reality, these various economic impact measures often do not coincide. For instance, travel cost savings and access benefits are realized by firms some distance away from the actual transportation investment (sometimes hundreds of miles away), and those impacts may not be identified through interviews with local officials and businesses, nor measured by local economic growth data. Even local statistics can vary, as changes in jobs, wages, building construction and land values often do not move proportionally at the same rates.

There are some projects included in the database for which it is clear that travel efficiency benefits have been realized. They include major highway investments that span long corridors.[1] Many of the intermodal freight projects also have wide-reaching economic impacts.[2] Other tools, such as transportation and economic models, are needed to calculate the potential economic efficiency benefits of these types of investments.

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[1] *For example, Interstates 16, 26, 27, 29, 68, 81, 86 and 476, and Appalachian Corridors B, D, J and Q.*

[2] *For example, Ayer Intermodal, Auburn Intermodal, Global III Terminal, WorldPort at DIA, Fairburn UP Intermodal Yard, Port of Huntsville, Tchoupitoulus Corridor and Alliance Intermodal Logistics Park.*

**Table 6-1 List of Case Study Projects, Sorted by Project Type** *(page 1 of 2)*

| Project Name | ID | Location | Project Type |
|---|---|---|---|
| Hammondsport | 1 | NY | Access Road |
| Clermont County Industrial Park in Miami | 11 | OH | Access Road |
| Cattaraugus ED Zone Infrastructure | 12 | NY | Access Road |
| Carolina Factory Shops Infrastructure | 13 | SC | Access Road |
| Columbus - Lowndes County Riverside | 14 | MS | Access Road |
| New Phalen Boulevard Corridor | 79 | MN | Access Road |
| State Route 126, Fenton Lake Bridge | 84 | NM | Access Road |
| Richmond, Virginia, I-295 Bypass | 6 | VA | Beltway |
| Appleton, Wisconsin, Route 441 Bypass | 32 | WI | Beltway |
| Fort Wayne, Indiana, I-469 Bypass | 33 | IN | Beltway |
| Danville, Virginia, I-785 Bypass | 35 | VA | Beltway |
| Beltway 8 Houston segments | 36 | TX | Beltway |
| E470 Denver | 40 | CO | Beltway |
| Arizona Route 101 | 57 | AZ | Beltway |
| I-476 Blue Route | 90 | PA | Beltway |
| World Trade Bridge | 7 | TX | Bridge |
| Oresund Bridge | 39 | Denmark, Sweden | Bridge |
| The Gene Hartzell Memorial Bridge | 76 | PA | Bridge |
| Third Bridge (Route 3) | 78 | ME | Bridge |
| Mo. Route 370 Bridge | 80 | MO | Bridge |
| Isle of Palms Connector (SC 517) | 85 | SC | Bridge |
| The Neuse River Bridge, | 87 | NC | Bridge |
| Lexington Bridge between I-5 and SR 411 | 94 | WA | Bridge |
| Potato Hill Bridge | 95 | WA | Bridge |
| Lake Natoma Crossing Bridge | 96 | CA | Bridge |
| Yass Bypass | 3 | Australia | Bypass |
| Karuah Bypass | 15 | Australia | Bypass |
| Eastern Washington - SR 195 Bypass | 16 | WA | Bypass |
| Fort Atkinson Bypass | 17 | WI | Bypass |
| Verona Bypass | 18 | WI | Bypass |
| Stonewall Bypass | 19 | OK | Bypass |
| Wichita Northeast Bypass | 20 | KS | Bypass |
| Hollister SR156 | 44 | CA | Bypass |
| Sonora & East Sonora SR49 & SR108 | 45 | CA | Bypass |
| US-400 Parsons Bypass | 46 | KS | Bypass |
| Georgetown Bypass | 47 | KY | Bypass |
| Mercer Co. KY, US-127 Bypass | 48 | KY | Bypass |
| Bennington Bypass, VT 279 | 77 | VT | Bypass |
| US Highway 281, San Antonio (Extension) | 5 | TX | Connector |
| I-705 Connector in Washington | 31 | WA | Connector |
| Branson W (Ozark Mt. Highroad) | 49 | MO | Connector |
| Southern Connector | 50 | SC | Connector |
| Ted Williams Freeway | 56 | CA | Connector |
| Topsham Bypass/Connector | 75 | ME | Connector |
| US 460 | 86 | VA | Connector |
| US 25 Kentucky | 93 | KY | Connector |
| Auburn Intermodal Center | 61 | ME | Freight Intermodal |
| Devens Intermodal Rail Terminal | 62 | MA | Freight Intermodal |
| Global III Intermodal Terminal , Rochelle | 63 | IL | Freight Intermodal |
| Fairburn CSX Industry Yard, Fairburn | 64 | GA | Freight Intermodal |

**Table 6-1 List of Case Study Projects, Sorted by Project Type** *(page 2 of 2)*

| Project Name | ID | Location | Project Type |
|---|---|---|---|
| Huntsville Alabama | 65 | AL | Freight Intermodal |
| Tchoupitoulas Corridor, New Orleans | 66 | LA | Freight Intermodal |
| Logistics Park – Alliance | 67 | TX | Freight Intermodal |
| Bayport TX | 91 | TX | Freight Intermodal |
| WorldPort at DIA | 92 | CO | Freight Intermodal |
| CenterPoint Center – BNSF Logistics Park | 97 | IL | Freight Intermodal |
| I-70 and 110th Street Interchange | 8 | KS | Interchange |
| Blue Route and Schuylkill interchange | 9 | PA | Interchange |
| Commerce Parkway Interchange | 21 | KS | Interchange |
| I-95 and Route 128 Peabody | 42 | MA | Interchange |
| Freeway Interchanges – Bloomington | 51 | MN | Interchange |
| Big I Albuquerque | 52 | NM | Interchange |
| Dallas High Five Interchange | 53 | TX | Interchange |
| I-435 & Nall/Roe Ave. Interchange | 54 | KS | Interchange |
| Central Freeway, San Francisco | 81 | CA | Interchange |
| I-20 Interchange | 82 | MS | Interchange |
| I-35 and US 290, Texas | 98 | TX | Interchange |
| Veteran's Parkway Georgia | 99 | GA | Interchange |
| Interstate 68 | 2 | MD | Major Highway |
| Interstate 29 | 4 | IA | Major Highway |
| Interstate 43 | 22 | WI | Major Highway |
| SR 29 | 23 | WI | Major Highway |
| Interstate 81 (PA) | 24 | PA | Major Highway |
| Interstate 81 (VA) | 25 | VA | Major Highway |
| Interstate 16 | 26 | GA | Major Highway |
| Interstate 26 | 27 | SC | Major Highway |
| Interstate 27 | 28 | TX | Major Highway |
| Appalachian Corridor B | 29 | TN | Major Highway |
| I-515 Henderson | 37 | NV | Major Highway |
| Central Artery Tunnel | 41 | MA | Major Highway |
| Casey Highway (US Route 6) | 55 | PA | Major Highway |
| Interstate 105/Interstate 110 Interchange | 83 | CA | Major Highway |
| Anderson Regional Transportation Center | 68 | MA | Passenger Intermodal |
| Sunset Transit Center, Portland | 69 | OR | Passenger Intermodal |
| Bellevue Transit Center, Bellevue | 70 | WA | Passenger Intermodal |
| Tri-Rail Boca Raton Intermodal Transit Center | 71 | FL | Passenger Intermodal |
| Lindberg Station, MARTA (Atlanta) | 72 | GA | Passenger Intermodal |
| DART Station Development | 73 | TX | Passenger Intermodal |
| BART Station Development | 74 | CA | Passenger Intermodal |
| Arlington Heights METRA | 88 | IL | Passenger Intermodal |
| Emerson Park MetroLink | 89 | IL | Passenger Intermodal |
| Appalachian Corridor D | 10 | WV | Widening |
| I-86 NY Southern Tier | 30 | NY | Widening |
| I-15 Reconstruction - Salt Lake City | 34 | UT | Widening |
| I-70 Glenwood Canyon | 38 | CO | Widening |
| Santan Freeway: Maricopa RTP | 43 | AZ | Widening |
| Appalachian Corridor J | 58 | KY | Widening |
| Appalachian Corridor Q | 59 | VA | Widening |
| US 75 North Central Expressway, Dallas | 60 | TX | Widening |
| I-394 Minnesota | 100 | MN | Widening |

The case study database also does not attempt to cover economic impacts associated with changes to safety, air quality, noise and vibration, neighborhood cohesion, environmental justice and many other types of benefits or dis-benefits often evaluated as part of the environmental impact assessment of transportation investments. While there have been attempts to measure the economic effects of some of these impacts, they generally have minimal impact on economic development.

Economic development impacts can be measured in terms of jobs, sales, income and investment. The case studies relied heavily on the employment impacts because municipalities and economic development officials collect data on and report employment impacts more frequently than other impacts. Also, individual businesses are more willing to share information about employment levels than sales. When possible, data on private and public investment resulting from each case study project were collected, measured in terms of square feet of development by type (e.g., retail, office, industrial), number of housing units, and/or dollars of investment. Changes in property values provide another measure of the economic impacts of the transportation investment. The TPICS database includes information on both investment and property value impacts for many of the case studies, although data were not available in all instances.

# 6.2 Use of Case Studies

**Combining Qualitative and Quantitative Information.** The case studies conducted for this project are intended to inform project screening and initial ("sketch level") planning processes, by providing insight into the range of impacts typically occurring from various types of highways in various types of settings. The case studies can provide an initial estimate of the likely range of impacts that typically occurs, and as such they can be used at public meetings to temper both unrealistic fears of negative impacts as well as unrealistic expectations of positive impacts. However, they are not meant to replace more careful local analysis of transportation and economic conditions, nor the use of transportation and economic impact models needed for more detailed planning.

The case studies do provide a rich database for understanding how different types of transportation investments affect a local or regional economy. However, the cases are spread over several different types of projects located in many different regions. Many of the cases are complex. Some were built in phases over many years and others have several component parts. Some were built specifically to encourage economic development, while others were built primarily for congestion relief. Many of the projects combined the transportation investment with other public policies or incentives to achieve the greatest benefits possible from the investment.

The empirical (quantitative) analysis of case study data is described in Chapter 4; it discusses how economic impacts vary by project type, location, size, and other characteristics of transportation investments. However, because of the range of local factors that may also be applicable, it is difficult to draw strong conclusions about expected impacts of future investments based *solely* on the empirical data analysis. Instead, users of the TPICS web tool should look for individual cases that best mirror their own projects, and review not only the empirical metrics for those cases, but also the accompanying narratives. The narratives provide important detail about each case that is not captured in the empirical database.

For example, the narratives include a detailed description of supportive public policies and incentives adopted in conjunction with the transportation investment that often helped boost the economic development impacts of the investment. These might include land use regulations (e.g., zoning changes), financial incentives (e.g., establishment of tax increment finance districts), public land assembly, additional infrastructure investments, or similar policies included in a comprehensive economic development program. The narratives also detail local economic conditions, such as plant closures or new investments that can affect how the transportation investment impacts the economy.

**Objectives in Use of Case Study Information.** The TPICS web tool is intended to help policymakers and transportation agencies understand the range of impacts that might result from a particular type of transportation investment. This approach can be used to screen a range of alternative transportation investment proposals or schemes, and help identify those most likely to result in positive economic benefits. Used in this way, the tool can help in programming investments in a transportation improvement plan, particularly if economic development benefits to a region are an important consideration in the transportation programming.

TPICS may also be used as one tool (but not the only tool) for screening alternative proposals for a single transportation project. In an "alternatives analysis," planners may be evaluating a range of transportation solutions and the system can then be used to provide an initial sense of the magnitude of economic development impacts that might accrue from each of these alternatives. However, since TPICS does not measure efficiency and productivity benefits, and because each investment is unique, that tool is *not* intended to be used as the sole measure of potential impacts in this type of analysis. In addition, for more detailed environmental impact analyses, TPICS cannot provide the level of detail and location-specific analysis necessary to accurately measure potential impacts for individual projects. For both alternatives analysis and environmental impact studies, analysts need to rely on site-specific analysis, local data, and interviews with local officials. Economic models may be useful to estimate productivity and efficiency impacts, as well as indirect and induced impacts.

TPICS also provides a means for using the case study database as a "reality check" on public hopes and fears concerning proposed transportation investments. It can be used to reign in unrealistically high positive expectations of project supporters as well as unrealistically negative expectations of project critics. An understanding of the actual range of impacts that have occurred around the country from particular types of projects can thus be used at public meetings or press briefings, to help provide audiences with a realistic understanding of the likely range of potential impacts of a project.

The tool can be further used to help define supporting strategies to bolster the economic development impacts of a transportation investment. Many of the case studies describe additional land use tools and business development incentives that have worked in conjunction with the transportation investment to stimulate investment and job growth.

By reading the case study narratives, planners can gain an understanding of the types of land use and development tools that can be adopted to maximize positive development impacts from a transportation investment. This use is discussed further in Chapter 7.

# 6.3 Avoiding Misuse of the Database

The case studies show that the economic development impacts of transportation investments depend on a myriad of factors. Some of these factors are accounted for better than others in the impact estimation process. For that reason, the case studies are better at capturing some types of impacts than others, and are more reliable for some types of projects than for others. There are seven key findings:

**(#1) TPICS is best at capturing the full economic development benefits of transportation investments that serve a small, isolated geographic area.**

These include access roads, bypasses in more rural areas, and interchanges. This is because the effects are more contained, often occur in conjunction with or over a short time after the transportation improvement is completed, and, in the case of more rural examples, may be the only new economic activity occurring in an area. *US 25 Kentucky (Dry Ridge Connector)* illustrates this point. The 2.2 mile connector was built for two reasons: to take truck traffic off the downtown streets of Dry Ridge and to provide direct access to an area east of the town slated for industrial development. The impact of the bypass is clear. There has been some expansion at the industrial park east of the town and some small offices have located near the intersection of the bypass with the north-south highway serving the region. There has not been any additional economic development activity in Dry Ridge since the bypass was built.

The ability to measure impacts through the case study approach decreases as the region served by the project expands and areas of more diverse economic activity are included in the impact area. The Topsham Bypass project in Maine demonstrates this. While the project is similar to the Dry Ridge project in that it was built, in part, to remove traffic from downtown Topsham streets, the project also improves access to Brunswick, ME and US Route 1, a heavily traveled tourist route. The economic development impacts of the roadway in Topsham are easily measured as local officials and developers could point to the role the road improvement played in several development projects. However, the impacts become less clear in Brunswick, where the bypass delivers people to the coastal highway more efficiently, but where the decommissioning of a major military installation had overarching negative economic impacts that were difficult to segregate from the impacts of the bypass.

Isolating impacts became even more difficult in projects serving large, growing metropolitan areas. The *Blue Route (I-476)*, which is a major connector in the western suburbs of Philadelphia, is a good example of how difficult it can be to measure the impact of a transportation project that provides inter-regional economic benefits in a growing corridor. The Blue Route has had some very clear impacts in the area around its interchange with I-76, as well as in the City of Chester at the southern terminus of the route and these could be identified through the case study approach. However, the Blue Route provides benefits to travelers and shippers that reach at least as far south as Baltimore, but it is impossible to capture all those impacts in a case study approach. These impacts become more dissipated and obscured by other economic influences the farther away one moves from the transportation investment itself. In addition, improvements to the heavy rail transit system and other area roadways occurred over the same time that the Blue Route was developed, making it difficult to isolate impacts associated solely with the Blue Route construction.

**(#2) Impacts are easiest to substantiate for the area in the immediate vicinity of the transportation investment.**

This is a corollary of the first point, above. Isolating impact measures such as number of jobs, square feet of investment, dollars of investment, and changes in property values proved easiest for smaller projects where new development occurred immediately adjacent to the new transportation facility, particularly in areas that are more isolated and not impacted by other concurrent activities. The tool does a good job of capturing new development, and business expansion and attraction at firms that benefit from nearby access to the transportation investment. Local officials often have worked with developers and firms that are interested in locations near the new transportation facilities and thus have a clear understanding of the relationship between the facility and local economic development.

The relationship between the facility and business growth becomes more difficult to measure for firms using the facility for pass-through shipments, inter-regional business, or accessing an expanded labor pool. For example, the *Henderson (NV) I-515* project completed an important link between Las Vegas and points south. However, the case study focused on the impacts in the City of Henderson, not possible employment impacts in downtown Las Vegas (15 miles north) where the highway expansion was one of many factors influencing growth.

Both the *I-476* and *Henderson I-515* projects represent extensions to an existing interstate roadway. This meant that the impacts that occurred were also related to a previous highway investment not captured in the database. The implications are two-fold. First, there is a symbiotic relationship between the newer investment and older investment, leading to a greater impact than would have been realized by either investment alone. Secondly, some of the impacts that could be related to the highway extension may be occurring many miles away along the first investment. These impacts are difficult to capture in the analysis.

For intermodal and transit projects, this issue is more pronounced. For intermodal facilities, much of the impact accrues to manufacturing firms that are scattered throughout a broad region, not at the intermodal facility itself. For example, the *Ayer Intermodal Facility* in Massachusetts provides rail connections to rail service throughout the United States and to ports with international connections. The *Auburn Intermodal Facility* in Maine has direct rail service to Canada, with connections to west coast shipping terminals serving the Far East. The *Huntsville Air Intermodal Facility* provides air access worldwide. The companies that use these facilities for shipping are located over a broad region, not just within a few miles of the facility itself. The job and sales impacts are felt nationally and are not captured in the case study approach.

The case studies of passenger (road/rail) intermodal terminals generally focus on how land and building development is spurred in areas within walking distance of new or expanded stations. However, one of the greatest impacts of transit stations is to provide access to city employment centers. In this way, transit stations can support growth of a broader regional economy, without any of those direct jobs necessarily occurring at or close to the stations. In fact, at many of the passenger intermodal stations covered in the study database, development impacts on adjacent areas were concentrated in housing investments (rather than office activities) because that was a specific goal established for those station areas.

In some cases, such as the *Colma Station* on BART's airport extension line, development of affordable housing around stations was a prominent goal. This goal has been achieved. However, because non-profit housing development in the station area does not generate property taxes, the economic impacts of station development that are easily measured in money terms (such as property tax revenue) end up understating the overall economic impact of the project.

**(#3) It is sometimes difficult to isolate the impacts of a transportation investment from other supporting, concurrent public policies.**

In many of the case studies, the transportation investment was made in conjunction with other public policies and incentives aimed at stimulating economic growth. A good example of this is the *I-70 & 110th Street Interchange* in Kansas City, KS, a project that had substantial job creation and investment impacts. The interchange was one of five major public initiatives that together led to several major private sector investments, significant job creation, and measurable increases in property values. Other initiatives cited as important to the development included state STAR bonds to pay for infrastructure (repaid with the increase in retail sales tax collected in the area after completion of the project), rezoning of 1,600 acres of land to accommodate mixed-use development, assembly of a 400 acre development site by the city and county, a payment in-lieu-of-taxes paid by the developer of the Kansas City Speedway, and unification of the City and County governments.

According to those interviewed for this project, no single one of the public policies adopted in the vicinity of the interchange could have attracted the scale of development that has occurred. It is the whole package of incentives that have resulted in the magnitude of development in the area. While the numbers reported in the database have been adjusted to reflect that not all the development is due to the highway interchange, it is impossible to fully separate out the impacts as the package of incentives worked to produce a larger impact than what might otherwise have occurred. This is an important lesson for those planning a transportation investment with a goal of stimulating economic growth. By marrying the investment with other economic development tools, the potential for positive economic development impacts can be significantly improved.

The *I-70 & 100th Street Interchange* is just one case that points to the need to bundle additional incentives with the transportation incentive when the object is to stimulate economic development. In the case of the *Anderson Regional Transportation Center* in Massachusetts, site cleanup was the most significant catalyst for development because without the site cleanup, the land could not have been developed. At the same time, without three types of transportation improvements made to the site, it would also not have been possible to develop the site at the level that has occurred.

In some instances, land use considerations and regulations have superseded market forces to direct the type of development that has occurred in the vicinity of the investment. This is particularly true for some of the passenger intermodal projects, where "smart growth" concepts are often part of pre-development planning. In the latter cases, sometimes communities are more interested in long-term land use considerations than more immediate economic impacts.

**(#4) TPICS provides pre/post comparison for specific points in time, and thus may miss impacts that happened earlier as well as impacts that have yet to be realized.**

The pre/post impacts included in the TPICS database reflect snapshots in time, recording the economic development impacts at the time the case study was conducted. For older projects, the data do not reflect turnover that may have occurred over many years. For instance, a project completed in 1985 might have attracted businesses in a particular industry soon after it opened, but some of these businesses may have since closed or moved elsewhere. Similarly, structural changes in the economy (such as the contraction of oil industries in the 1980s, changes in agricultural production and shipping processes, reductions in basic manufacturing over time, and fall of many dot.com industries in 2000) may mask some of the earlier positive impacts of older projects. Examples where structural economic changes have affected the impacts of transportation investments include *US 281* in San Antonio, *I-29* in Iowa, and the *I-95 Interchange* in Peabody, MA.

At the same time, the database includes several newer projects, completed in the 2000 to 2005 period. The full potential of many of these projects may not yet have been realized, in part because of economic and travel downturns following September 11, 2001, the real estate bubble burst in 2007 and subsequent global economic recession from which many communities have not yet recovered. A good example of a project whose impacts have not yet been realized because of those broad economic trends is the *WorldPort* facility at the Denver International Airport. This project was commissioned in 2000 to provide additional cargo facilities for shipping to national and international markets. However, the above-noted aviation events and economic downturns have stymied the anticipated demand for new space at the facility. As a result, expected economic development impacts have not yet been realized.

There are also projects in the database for which impacts continue to occur and are not captured in the data included in TPICS. One example is *SR 29* in central Wisconsin. Between 1988 and 2000, the state of Wisconsin expanded this road from a two lane highway to a four lane highway. By 2001, over 6,000 jobs had been created in the corridor as a result of the improved access it provides. Communities within the corridor continue to improve local infrastructure and development sites to attract even more jobs to the corridor. The economic development impacts are expected to continue to accrue well into the future.

**(#5) The time frame for impacts varies considerably among case study projects.**

There are several reasons for this variation. First, the economic conditions of the region in which a project is built will significantly affect the project's economic development impact. Second, some projects were built in anticipation of future growth, while others were built to accommodate more growth in an already expanding area.

The *E-470 Highway* in the Denver region is an example of a project built in anticipation of future growth, the impacts of which have also been affected by changes in the regional economic climate. The 47-mile long road was built through rural communities east of the city of Denver in an area expected to support the next wave of development. The E-470 is a primary factor determining where within eastern Denver County this development occurs. The development is now occurring and is expected to continue for several decades. However, the economic impact of this highway has been slowed by economic downturns associated with the dot.com bubble in 2000, the housing price bubble in 2007 and a period of recession since then. The area remains targeted as the next development corridor, as evidenced by plans to expand fixed guideway transit service to the corridor.

Similarly, in some instances, transportation investments have been made to help kick-start a local or regional economy. The results of this strategy are mixed, and in some cases it will take many more years to really understand the magnitude of the transportation investment on overall regional growth. The *I-86 Corridor* through southwestern New York State is a case in point. The highway links communities that once relied on heavy manufacturing, such as steel and auto parts production. Between these old economic centers the highway passes through farmland and hills. Each community along the road markets the access improvement that the highway provides in hopes of attracting new industry to the region. The highway has, in fact, helped to attract new tourist-related businesses, as well as light manufacturing facilities to the region. Still, some parts of the region remain remote, the labor force is aging and distance to major markets remains a limitation. Economic development officials are pursuing additional strategies, such as the development of specialty industrial parks, to enhance the potential of the highway for attracting new jobs. The impact of the highway will likely continue to be realized, but because of the inherent nature of the region, may take years to reach its full potential for economic development.

Another factor that can affect how long it takes for a project to generate economic development impacts is the regulatory climate of the locality in which the project is built. The *Sunset Transit Center* demonstrates this point. At the time the transit center was being planned, Washington County, OR adopted land use regulations that required higher density residential and mixed use development in the vicinity of the station. The regulations mirrored the land use regulations put in place around transit stations in many parts of the Tri-Met service area. However, Washington County was still very suburban in character and at the time the station opened (continuing to today), the market for higher density housing and mixed use development has not yet emerged. In this case, County officials are not concerned insofar as they are less interested in seeing short term development occur and more interested in ensuring that when larger scale development *does* happen, it will support regional land use goals.

**(#6) Data for more recent projects is easier to collect and potentially more accurate than that collected for older projects.**

It is much easier to accurately capture the economic development impacts of more recent projects than of projects built many years ago. First, in some instances, there are few people still around to talk to about projects built over twenty years ago. *Interstate 68* in western Maryland was built over 23 years between 1966 and 1999. Many of the current municipal staff in towns along the corridor were not working in the region when the highway was constructed, and needed to rely on old documents or information handed down by word of mouth over many years to provide input into the case study. Further, the time span of the project coincided with many broad, national economic trends that affected the economic development potential of the road. For example, computers became commonplace in industry, manufacturers became reliant on just-in-time deliveries, and the broader national economy transitioned from a manufacturing base to a service base. When the highway was built, it was expected to be heavily used by manufacturers. In reality, much of the impact of the highway has been to encourage tourism, including resort destinations and second home development.

Ferreting out impacts of older projects is particularly difficult in metropolitan areas, where so many factors combine to influence development patterns. Examples of other projects that fall into this category include *US 281* in San Antonio and *I-476 -the Blue Route* through Philadelphia's western suburbs.

**(#7) The economic development impacts of a transportation investment can be difficult to isolate.**

When there are simultaneous factors at play, it can be difficult to parse out the impacts of the transportation investment relative to other factors. In general, the more economic activity is occurring in an area, the more difficult it can be to sort out causation for observed impacts. For instance, the primarily goal of some case study projects was to relieve traffic congestion slowdowns that were caused by an already growing economy. The case study approach could capture some of the economic development impacts, particularly if interviewees could identify businesses that stayed only because of the congestion relief or a new business that located in a place because of the new access, but could not capture all the firms that stayed or expanded because of congestion relief. Examples of this type of project include the *Central Artery/Tunnel Project* in Boston, *Arizona Loop 101* in Phoenix, and the *Dallas High Five Interchange*.

# 7 LESSONS FOR FUTURE PROJECT PLANNING

## 7.1 How Project Details Affect Outcomes

The case study narratives and supporting documents provide a wealth of information that can be of direct use to transportation planners and economic development policy planners. By providing both a project history and project impact analysis, most of the 100 case studies provide insight into the roles of different agencies, programs and policies in either reinforcing or limiting the economic impacts observed to follow completion of transportation projects.

To address this subject, members of the project team reviewed all of the case studies and together identified seven common themes affecting the nature and magnitude of economic impacts. They are classified into the following categories:

Land Use Policies and Conditions

- Consistency with land use policies
- zoning and site preparation
- attractive real estate market conditions

Proactive Governmental Actions

- shared vision among stakeholders
- inter-agency coordination and consensus-building
- effective integration with larger public investment and development efforts
- complementary targeting of economic development efforts

## 7.2 Land Use Policies and Conditions

**Highways can shape land development in desired ways, with supporting policies.**

Some types of projects, particularly beltways and bypasses, can have a profound impact on the spatial pattern of regional growth and development. Such projects can influence affect patterns of real estate demand and prices, affecting quality of life, availability of support services, and a community's tax and employment bases. Land use impacts of major highway infrastructure need to be anticipated and planned for, particularly in growing areas. In the more successful case studies, these impacts have largely been anticipated and planned.

- A prime example is in the City of Verona, a suburb ten miles southwest of Madison, WI. The *Verona Bypass* is a belt route constructed at a radius of 1.5 miles around the town center. The city reacted proactively by annexing the area served by the bypass, effectively doubling its residential, tax, and employment base. Before the project, new commercial development had been sprawling in an east-west pattern along Highway 151 and Highway 69, while growing northward toward the Madison city limits. After the bypass was built, development began to fill in more evenly in the area south of the city center. Improved access to new commercial and housing sites on the city's south side spurred new development in this area. New investment, producing 4,000 jobs, was attracted by the bypass. By shifting the city's boundaries south, the Main Street District became the core of the city and its position as the major locus for local services has been strengthened.

- Likewise, by constructing the *Route 441 Bypass* around the city center of Appleton, WI, planning agencies sought to balance the pattern of the city's growth to the southeast and helped to fill in the pattern of sprawl that had developed along the city's arterial roads. The new bypass has attracted 1,750 new jobs, including a regional headquarters of Time Warner.
- *Arizona Loop 101*, a 62-mile beltway around Phoenix's outer suburbs, was built to accommodate growth in the metro area. The beltway reduced commuting times between previously-distant suburbs. In response to the traffic capacity enabled by Loop 101, mixed-use, lifestyle-oriented "mega-developments" began to locate on sites near planned exits, transforming open space into high-density hubs of mixed use development. Loop 101 fuelled the growth of suburban satellite cities such as Glendale and Scottsdale that provided sites and infrastructure for future growth. There are now 100,000 jobs and 400,000 residents within the Loop 101 corridor.
- *Arizona Loop 202/Santan Freeway*, a loop around the southeastern quadrant of outer Phoenix, has also shaped the growth of the region, directing it away from Southeast Phoenix's Mountain Park region. The new freeway enabled the construction of 12 million square feet of commercial development and creation of 50,000 jobs along this high-density corridor, where the growth of major satellite cities like Chandler and Gilbert has been fuelled.
- Whereas beltways have the effect of shaping growth, bypasses can have the effect of strengthening the central business districts that they skirt. The *Route 26 Bypass* in Fort Atkinson, WI, the *Neuse River Bridge* that bypassed downtown New Bern, NC and the *Third Road Bridge* in Augusta, ME removed long-haul traffic that was congesting historic city centers, leading to safety and environmental enhancements that created jobs in new tourist-serving and entertainment businesses.

**Zoning and site preparation can enable or prevent economic development impacts.**

If a local area is to achieve maximum economic impacts from a new transportation project, one critical requirement is that the surrounding area must offer a good supply of sites available for development (or redevelopment). Conversely, a community desiring to prevent new development can act to block sites from being available. Either way, the most effective way to control the development outcome is then by: (A) enabling zoning to define allowable forms of development, and then (B) ensuring that infrastructure availability and site preparation will support the allowable uses. These basic statements apply for all forms of transportation projects, though they are most immediately applicable for projects that open up access to specific land sites. Such projects include town bypasses, access routes to economically-depressed urban areas, highway interchanges and intermodal facilities.

- The *Bennington, VT Route 279 Bypass* is an example of a bypass case where planning authorities did not want to encourage growth along highways. There, sites were zoned for agricultural use, which generally permits only very low density housing. Water and sewer infrastructure is not extended to these sites. As a result of the restrictive zoning and lack of supporting infrastructure, essentially no development has occurred along the 43-mile bypass route. The bypass has had no impact on existing businesses in the city, in accordance with the goals of local planning authorities.

- The main planning objective of the *Fort Atkinson, WI Bypass*, was to encourage investment in the city's historic Main Street downtown district, which has proven to be a magnet for tourists. The bypass removed truck and other through traffic from Main Street, a narrow four-lane road with parking on both sides. This resulted in a significant improvement in the environment and in pedestrian safety. Assessed values in the downtown Tax Incremental Financing (TIF) district have doubled since 2000 to $22.8 million (as of 2010).

- *Cattaraugus Access Road* in Olean, NY demonstrates what can happen when land sites near freeways are made more accessible for development. The project was a new two-lane, two-mile long arterial road built to connect an industrial site with I-86. Completion of the road, along with water and sewer infrastructure extensions to adjacent land, has led to the development of several industrial sites as well as a strip retail/commercial center. The $3 million project leveraged an additional $5 million in private investment that brought 100 new jobs paying $2.5 million in wages to this remote community of 14,000 in Cattaraugus County, NY.

- *Phelan Boulevard* in St. Paul, MN is a new 2.5 mile urban access road built along a blighted rail corridor in St. Paul, MN. This provided access to hundreds of acres of previously-landlocked and contaminated industrial sites that could be redeveloped. Funding was assembled from federal, state, foundation, and private sources for the cleaning and redevelopment of sites along the attractive boulevard that have attracted an estimated $500 million in private investment. The new boulevard has breathed new life into some of the city's oldest neighborhoods and has brought an estimated 2,000 jobs within reach of some of the city's poorest residents.

- *Emerson Park Metro Station* in East St. Louis, IL, one of the country's most economically depressed cities, is another example of success with site improvement. The project required land site assembly, development incentives and community activism, along with transportation investments, to turn around the area. The station became a cornerstone of revitalization, with an estimated $65 million invested in new housing development on blighted sites surrounding the station.

- In contrast, the *Appalachian Corridor D* project in West Virginia has so far led to very limited new economic development. The project led to a 170-mile section of US-50 connecting I- 77 in Parkersburg, WV with I-79 in Clarksburg. The limited impact on industrial attraction to the corridor has been attributed in part to a lack of public funds to extend water and sewer service to newly accessible sites. Instead, lack of restrictive zoning resulted in low-density residential development supported by wells and septic systems that began to draw population from the two older cities anchoring the study corridor. From 1970 to 2001, the populations of the cities of Clarksburg and Parkersburg declined by 33% and 25% respectively, as residents began to move to fringe locations brought within commuting range by the new highway.
- *Veteran's Parkway* in Savannah, GA is a case where benefits have occurred in transportation time savings for trips to Savannah's Southwestern periphery. However, the new, six-mile parkway has not yet had a discernible impact on adjacent land use or economic development, largely because most of the surrounding sites are unbuildable due to wetland conditions and noise from aviation flight paths.

**Real estate market conditions can accelerate or delay development impacts.**

Some factors affecting project impacts are not fully within the control of public officials or private parties. Prominent among these factors is the local real estate market, which can be affected by national and global economic trends, as well as regional growth and competitiveness conditions. As a general rule, transportation access and travel time enhancements help attract large scale commercial and industrial investments (and hence generation of new jobs) most quickly in areas where there is an trained workforce, available sites for business location, and strong economic conditions that support expansion of demand for business products and services. In areas that are economically depressed or otherwise lacking in some of those factors, the economic impacts of transportation projects may unfold at a slower rate.

- In the case of *Arizona Loop 101* in Phoenix, a 62-mile beltway through semi-rural areas on the fringe of Phoenix, the more affluent communities on the west (e.g., Scottsdale, Tempe, Chandler, and Gilbert) attracted large-scale corporate parks, entertainment complexes, shopping malls, and higher density housing. The less affluent communities outside of East Phoenix became bedroom communities for these cities, linked by Loop 101.
- The I-*295 Bypass* in Richmond, VA passes through Henrico County, where the median income is 75% of the metro average. This area attracted most of the new commercial development along the route because it had the strongest real estate market. Henrico County also had the resources to attract large scale development, including site assembly and provision of utilities to large sites at interchange exits.)
- *Interstate 394* in Minneapolis' affluent western suburbs spurred a significant amount of redevelopment in the established suburban enclave of St. Louis Park, as older, low density residential and retail uses were cleared for new commercial buildings. Although the corridor lost over 3,000 jobs in small retail establishments, it gained 12,500 positions in other service sectors for a net gain impact of over 9,400 jobs – a

30% increase. Similarly, the new *I-435 Interchange* in the prime Kansas City suburb of Overland Park attracted major corporate, tourism, health care, and medical center development, with 17,500 jobs.

- In contrast, only 75 new jobs were created by the $31.6 million *I-35/ US 290 Interchange* in Austin, TX. This project, built in a lower-middle income area of Austin, demonstrates that a major access improvement will not spark redevelopment in areas with property values that are too low to support higher prices and rents.
- Likewise, the *Big I Interchange* in downtown Albuquerque has to date had virtually no impact on development in its vicinity due to the city's lagging economy. This demonstrates that congestion relief alone does not necessarily generate new jobs and investment in the vicinity of the project.
- *Interstate 105* connecting LAX with low-income communities in East Central Los Angeles has had relatively little impact on development of the surrounding area. No proactive planning measures were put in place to encourage site assembly and redevelopment of potential key sites. Again, this is attributable to the depressed investment climate in East Los Angeles, which was exacerbated by the 1992 riots that occurred shortly before the project was completed.

# 7.3 Proactive Government Actions

**A shared vision among stakeholders enables development impacts.**

Local projects such as passenger intermodal (transit) stations, new urban bridges and urban roadway interchanges can attract business investment to adjacent areas where the access enhancement is most pronounced. However, when that enables significant new building development, then it becomes important to ensure that there is a common vision for the area. Visioning can thus be considered a tool for gaining consensus on the future of an area in which a new transportation project is planned. This exercise allows all interested parties, including local planning authorities, regional and state funding authorities, developers, and other interested agencies, to develop and agree on a clear vision for the future of the site. The case studies provide examples of both success and failure in establishing development visions for the areas of local transportation terminals, and they show that greater development occurs when such a vision is in place.

- The case of *Tri-Rail Boca Raton Transit Center* in Florida shows how failure to achieve in initial consensus of key stakeholders can delay development. There, the city, the transit authorities, and private developers could not agree on a vision of what was possible and appropriate for a 2.5 acre site next to the station that was slated for transit-oriented development. The City's development plan for the site endorsed a mid-rise commercial development of 70,000 square feet. But Tri-Rail, the transit authority and the owner of the station site, favored a development proposal for a mixed use development of over a million square feet. After years of consideration, negotiation, and debate, Tri-Rail and the City failed to achieve consensus on the plan.

The recession of 2007 onward began to soften the real estate market, resulting in the withdrawal of prior transit-oriented development plans for the site.

- In the case of the *LBJ-Skillman DART Station* in Texas, there was an amply-sized 50-acre adjacent development site. However, the site is poorly connected for both pedestrians and vehicles and there has never been a clear concept for its development. In 2010, a planning process was initiated to develop a workable vision for the site and to provide it with needed pedestrian, transit, and road connections.
- The *Neuse River Bridge* in North Carolina, by contrast, emanated from a clear vision of project goals and desired outcomes on the part of planning agencies and of the community. The bridge was relocated from historic downtown New Bern, NC, where it was choking the Victorian street pattern, to a site out of town, eliminating congestion that visibly improved the city center, attracted more tourists, and created jobs. The project has won three national awards for excellence in highway design.
- Another positive example is the *Phelan Boulevard project* in St. Paul, MN. The project has won multiple awards for highway design. Its success is built on a process of effective community mobilization and consensus-building regarding the future of a blighted patch of East St. Paul, MN. That effort project brought together long-time residents, former residents and new immigrant residents. The new vision for the area as a center for corporate and health care office park-type development has already yielded over 2,000 well-paying jobs.

**Effective inter-agency coordination can facilitate development impacts around intermodal facilities.**

Intermodal centers have particularly high need for coordination, which must take place at two levels. One level of coordination is among stakeholders in transportation terminal operations and use – including those responsible for roads and parking, as well as the applicable freight rail or rail transit operating organizations. The other level of coordination is among stakeholders in land and building development – including both government agencies and private businesses.

- *The Emerson Park Metro Station* offers an example of effective consensus building. The new light rail station has been the cornerstone of revitalization of the dynamic Emerson Park neighborhood in East St. Louis, IL, one of the poorest cities in the country. The Emerson Park Development Corporation (EPDC) fought to convince regional, state, and federal agencies to back their vision for the revitalization of their neighborhood. EPDC convinced agencies to move the station from a site where it would have performed as merely a park and ride facility to their neighborhood. The $3 million station opened in May of 2001. In the past 6 years, ridership has more than doubled. An estimated $65 million has been invested in new housing development on sites surrounding the station. EPDC effectively harnessed federal and state grants and built relationships with private developers, who built new housing here for the first time in more than half a century.

- When CSX announced plans for the new *Fairburn Intermodal Center* in Atlanta's far eastern suburbs, Fairburn residents were opposed to the facility due to the traffic congestion impacts that were anticipated. Realizing that the local citizenry had limited veto power over the new Intermodal Center, residents led a campaign to work with CSX rather than against them. They organized the South Fulton County CID to identify, prioritize, and provide funding for transportation improvements to accommodate the additional traffic and abate inconvenience for area residents. The CID has undertaken a number of new road, overpass, and signaling projects to improve the flow of road traffic and to alleviate delays at at-grade rail crossings. The intermodal center has attracted warehousing and logistics operations that have created 1,500 new jobs in Fairburn, adding millions to the state and local tax base.

**Effective integration with larger projects can increase development impacts.**

Transportation investments made as part of larger development projects can have more profound economic impacts than those undertaken as solo projects.

- *BNSF Railroad Logistics Park Chicago (LPC*) in Elwood, IL, 40 miles southwest of Chicago, was built as part of the redevelopment program for Joliet Arsenal. A funding package of $80 million in local, state, and federal EDA funding was assembled to build and expand the road network to support the $1 billion, 9 million square foot Logistics Park. LPC has produced 2,000 jobs, supporting a 40% growth in the population of the Village of Elwood. Since the park opened in 2002, a total of $1 billion has been invested by ten firms who occupy 9 million square feet within the 770-acre park. Eventually, the park will be expanded to 6,000 acres with a Union Pacific Railroad Intermodal Terminal with up to 25,000 jobs.
- The *Alliance Global Logistics Hub Park*, which was focused around an intermodal terminal, was spearheaded by Perot Real Estate who speculatively acquired 17,000 acres near the Fort Worth cargo airport and worked to bring a BNSF Railroad intermodal terminal on site. Perot donated land and engineering studies for a new $6.8 million highway connecting the industrial park with the Intermodal Yard. Within eight years of the development's opening, private investors developed 8 million square feet of commercial space, bringing 8,500 new jobs to the area. The Logistics Hub has sparked the growth of a new sub-region of the northwest Dallas - Ft. Worth Metroplex.
- *Boston's Central Artery/Tunnel Project* was initiated to replace a decaying I-93 elevated structure with a higher capacity tunnel. However, it grew into a larger package of projects to enhance downtown accessibility, improve the urban environment and support the city's plan for redevelopment of the seaport district. The package included a new rapid transit line (and stations), tunnel extension of I-90 with a new interchange in the seaport district, a tunnel route for I-93 through downtown, a new Charles River suspension bridge, and the development of over 200 acres of new park land. The project led to dramatic expansion of residential and office construction in formerly isolated and cut-off areas of the downtown waterfront and

seaport district, adding 29,000 jobs - which will grow to 50,000 as planned projects are completed.

**<u>Projects aimed at supporting target growth industries can be particularly effective.</u>**

Some transportation projects are designed to meet the needs of specific industries that are already growing and already proven to be particularly important job generators. Such projects are most often successful because there are already business organizations ready to take advantage of access improvements.

- For example, the *I-435 Interchange* in Overland Park, KS was built as part of a package to retain Sprint in the Kansas City metro area, by accommodating its expansion needs. The project also attracted other large development projects,that altogether supported another 17,500 jobs.
- Other transportation projects have also been built to support tech industries, with notable results. The *U.S. 460 Bypass* in Blacksburg, VA provides a direct connection between I-81 and Virginia Tech University. The ten-mile long bypass was completed in 2002 at a cost of $87 million. As a result nearly 750 new jobs in technology spinoff firms and new startups have been produced in this corridor, including the new Falling Branch Corporate Center.
- A number of successful projects were also undertaken to support tourism industries. The *I-70 Glenwood Canyon*, which double-decked I-70 through the Glenwood Canyon in Central Colorado, is one of the most spectacular stretches of interstate highway ever built. The project supported tourist industries, producing 2,400 jobs.
- The Isle of Palms Connector, a new bridge to a resort island in the Charleston, NC metro area, supports 2,800 jobs in tourist-serving industries on the mainland side of the bridge, where sites are available.

The common lesson for future project planning is that contextual factors are key determinants of the timing, nature and magnitude of economic impacts from transportation projects. Foremost among the context factors are elements that are (or can be) within the control of planners and governmental officials. They include an effective planning process that builds on a shared vision for development and an ability to achieve consensus among local agencies and developers regarding economic development goals. This can include actions such as zoning policy, investment in complementary sewer/water infrastructure investments and project planning integrated with broader public investment and private development efforts.

# 8 CONDUCTING FUTURE CASE STUDIES

The TPICS system has been designed to allow practitioners to add new case studies to the database over time. This chapter provides guidance on how to conduct new case studies that can be added to the system.

## 8.1 Data Collection

**Review of Similar Existing Cases.** The TPICS database includes 100 case studies of projects throughout the United States and abroad. Reviewing cases within the system before conducting new case studies can help the researcher identify potential sources of background information, the types of people or organizations that should be interviewed, and provide insights into the types of questions that can be asked to elicit the most useful data and information. The database can be sorted to help the researcher identify those projects that most closely correspond with his or her project.

**Collection of Background Documents and Literature.** As a starting point for each case study, it is useful to gain an understanding of the context in which the project has been introduced and matured. An internet search should be undertaken to gain general knowledge of the project and the region in which it was built. Good places to start include wikipedia.com, aaroads.com and state DOT websites, as well as local economic development agency web sites.

A web search of the project itself can also turn up environmental impact reports and other project-related documents, as well as newspaper articles about the project. It is also useful to search the name of the community and any development projects related to the investment of which you are aware. The literature search will provide the researcher with a general understanding of the project and can be used to help tailor interview questions to collect the best information for understanding the project and its impacts, and for relating the story of the project in the project narratives. Any useful documents or web sites should be recorded for entry into the system.

**Quantiative (Empirical) Data Collection.** TPICS includes empirical data for each case study. Those adding new cases to TPICS will need to collect background demographic and economic data on a local, regional and statewide basis to populate the database. Such data can usually be collected from published sources. The researcher may not be able to fill in all fields; that is OK though s/he should try to fill in as possible. The categories of data are: (a) *Project Data* – general information about the project, (b) *Setting* – information about the project's local area, and (c) *Impact Measures* -- economic activity levels for representing one year before construction and five or more years after project completion.

The specific empirical data to be assembled is defined in Section 3.2 of this report. Categories of project types are defined in Chapter 2. Data sources are listed in the Data Dictionary and a supplemental spreadsheet table, both available on the www.tpics.us web site (click on "About TPICS"). Additional notes and pointers are provided below:

- *Impact Area* –This is typically the counties in which the project passes or is located. However, for some large projects there may be additional counties of impact identified through the interview process.

- *Impact measures* – They may include: (a) employment, (b) income, (c) business sales, (d) property values, (e) tax revenues generated, (f) square feet of building construction and (g) value of investment in terms of construction cost. Items "a" – "e" are measured in terms of annual levels for two points in time – one representing pre-project conditions and another representing post-project conditions. Items "f" and "g" describe of activity occurring between the two points in time. All may be measured at the local, county and/or statewide levels.

- *Time Periods* – Typically, "pre-project" data is collected for the year before construction begins, while "post-project" data collected for a time that is at least three years after project completion. The post-year selection may depends on the project type. The full economic effect of an access road may take only two years to be observable, while the full effects of an interstate may take five to ten years.

- *Employment* - This is measured by place of work, i.e., it represents the number of people working at locations within the study area, regardless of where they live. It should not be confused with data on employment by place of residence, which represents a measure of local labor force. Average worker income is similarly measured by place of work.

**Interview Data Collection.** While some of the empirical impact data (such as employment trends) can be collected via public sources, other types of impacts require local information (such as property values and building construction information). In addition, the case studies should include information about causal factors affecting project impacts (including supporting infrastructure, land use policies and business programs). To obtain this local information, the researcher must conduct interviews with key public officials (e.g., local or regional planning agencies) and private sector representatives (e.g., Chamber of Commerce or developer types), as well as review available local documents. The product of the interviews should be to develop a coherent narrative describing the planning, implementation, and results of the project.

The list of basic interview topics was presented in Section 3.3 of this report. The questions do not need to be followed verbatim; they are simply guidelines for the types of information to be collected. Interviews are generally more effective if they are conversational, as opposed to asking a numbered series of questions. Therefore, interviews should start off with an explanation regarding purpose and use of the case study database, and why there is interest in this specific project case. Questions may also be amended or added, based on issues identified from the background information.

# 8.2 Analysis

**Net Economic Impact** is calculated as the change in employment or other impact metrics between a pre-project year and a post-project year, which may reflect the net result from a mix of positive changes (such as new jobs created at one part of the study area) and negative changes (such as job loss elsewhere in the study area). Information for statewide trends over the same period are also collected, to enable further comparisons of how local changes differ from the effects of underlying trends and business cycles that also affect broader state and multi-state regions.

**Attribution of Causal Credit.** The attribution of causality for observed economic impacts is another important consideration. In other words, the impact of a highway project is not necessarily the difference between pre- and post-construction economic measures. For instance, if there are 5,000 local jobs before a highway's construction and 6,000 after its construction, this does not mean that the highway is responsible for creating 1,000 jobs. There are many other factors that may have come into play during the highway's construction period that may have had nothing to do with the project.

**Direct vs Total Impacts.** Impacts on business activity (including employment, income and output changes) may be calculated in either of two ways.

- The first way is to observe direct effects, defined as changes in adjacent or nearby areas, and then apply a localized input-output multiplier to calculate a total impact figure that also accounts for "indirect" and "induced" effects on surrounding areas.[3]
- The second way is to observe changes in the broader economy of county or multi-county study areas, in which case total impacts are already being captured.

The most likely source for direct impact information is employment data (which can be obtained for multiple points in time by census tract or zip code).[4] Often local data can also be obtained on property sales, construction activity and tax receipts, enabled by inquiries made during local interviews. Direct impacts on jobs can also be estimated if the researcher obtains information on the square feet of new development built as a result of the transportation improvement.[5]

Input-output economic multipliers reflect the ratio of total/direct effects. There are separate multipliers for employment, income and output changes, and they also vary by county (or aggregation of counties). They are also affected industry mix. The TPICS case studies have all utilized IMPLAN model multipliers that have been customized for the applicable study areas of each of the 100 projects.

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[3] Indirect effects refer to the growth of other area businesses that supply products and services to the directly growing businesses. Induced effects refer to the growth of other area retail and service businesses due to re-spending of income by the additional workers.

[4] Employment by place of work can be acquired from the zip code files of CBP (County Business Patterns), or by the census tract files of the LEHD (Longitudinal Employer-Household Dynamics) database.

[5] Sources such as the Urban Land Institute report on typical ratios of workers per 1000 sq. ft. of occupied building space. These estimates vary, but are typically in the range of 1.0 for warehouses, 2.1 for industrial space, 2.2 for retail space, 4.2 for office space and 0.7 for hotels.

# 8.3 Construction of a Narrative

A full understanding of the impacts of a transportation investment requires not only data analysis, but also a distillation of findings from interviews, local data collection and a review of prior local studies. The narrative should be a relatively brief (3-5 page) story of how the project came about and its impacts on the local area. The structure should be in the following order:

- *Synopsis* - A one paragraph summary of the project history and its outcomes. This should include a description of the project, its location, dates of construction, project cost, and impacts in terms of jobs or types of businesses attracted.
- *Background* - Describe the local project context. This should include a brief economic history of the region, population and employment trends, description of major transportation routes and facilities that serve the area, travel time to nearest commercial airport and other transportation features..
- *Project Description and Motives* - Describe the project (type, cost, etc.) and why it was built.
- *Transportation Impacts* – Discuss implications of the project on local transportation, such as changes in average annual daily trips, travel time savings, or other factors.
- *Demographic, Economic, and Land Use Impacts* – Discuss pre- and post-construction data and impacts attributed to the project such as new firms attracted and retained and changes in employment changes, land use and land development.
- *Non-Transportation Factors* – Discuss other factors that influenced project outcomes e.g., supportive policies and incentives). If several factors combined with the transportation investment to create a climate for economic growth, then transportation investments can only be attributed a portion of that growth. The allocation of causality for each project should be discussed with interviewees.
- *Resources and Citations* – list of studies and links to websites used in the case study.
- *Interviews Conducted* – list of organizations participating in the interview process.

# 8.4 Challenges

While much of the requested data for case studies can be relatively straight forward to collect, the availability of some data elements varies from project to project. The level of effort needed to collect each data element also varies by project type and scale, though certain elements are particularly elusive. This includes information regarding:

| | |
|---|---|
| Complementary actions | Congestion |
| Interventions | Property values |
| Land use patterns and policies | Property tax revenue |
| Future development capacity | Private Investment |
| Financial incentives/business climate | Commercial space |

Difficulty collecting information on these data elements can be attributed to one or more of the following challenges:

- **Time Series Not Available.** Though planning and land use context information is often available in database form, it is not generally available as time-series data. A researcher interested in a particular project can obtain current land use information from the planning department covering the project's jurisdiction. But if the project crosses city or county lines, the researcher has to visit several planning departments. It is also unlikely that the planning department can provide land use data covering previous periods, making before/after changes to land use difficult to determine other than anecdotally.
- **No Centralized, Consistent Source.** Economic development intervention and support policies are a perfect example of information that is difficult to collect because it is not housed in a centralized source. Within the US, and even within states, there is no single agency charged with economic intervention or provision of financial/business attraction incentives. In fact, such efforts often come from multiple levels of government with varying degrees of coordination. Furthermore, economic development intervention and support policies are heterogeneous, ranging from streamlined permitting processes, to shovel-ready sites, to tax credits and direct cash transfers. A retail center at a major highway visible site created by a transportation investment could receive various incentives from any number of sources. Sometimes such support is tracked either formally or informally by an economic development agency, but because support can come in so many forms and from so many different entities, it can be difficult for a researcher to identify all of the agencies with relevant information. The interview process can help with this task, but if the information is scattered across numerous agencies, the level of effort needed to obtain complete information can become substantial.

  Data covering property values and property taxes can be obtained from a centralized source - the local property tax assessor's office - but neither assessed value nor tax collections data are defined consistently across jurisdictions. First, obtaining property value from the tax assessor is problematic because each jurisdiction assesses property value differently. In some jurisdictions assessed value is meant to represent the full market value of a property, and when updated regularly, generally reflects market values. However, if properties are not routinely re-assessed, over time values in the assessor's database will deviate from market values. Some jurisdictions use a percentage of market value as assessed value, while others, such as those in California, are statutorily limited in how much value may increase from year to year, which tends to artificially hold assessed values far below market values.

  Therefore, it is not enough for a researcher to simply collect property value data from a local assessor's office. The researcher also needs to understand the local system concerning how property values are assessed (full, partial, statutorily) and how often assessed values are updated. Analysis of property tax data can also be problematic, for while most assessors' databases can capture time series data, property tax rates are subject to change from year to year. Thus, in addition to property tax associated with a particular property or total property tax for a jurisdiction, the researcher needs to know the prevailing tax rate for each time period for which data are collected, to ensure that fluctuations are the result of actual changes in underlying property value and not simply a change in tax rates.

- **Data Availability/Accessibility Limitations.** Some data elements exist but cannot be readily accessed the way researchers interested in studying the impacts of transportation impacts need them. For instance, it may be relatively simple to obtain jurisdiction-wide totals for assessed values or taxes paid, but sub-jurisdictional or parcel-level data may not be available. While some jurisdictions have sophisticated GIS-based database systems and are willing to do specialized data runs, others have very basic systems for which sub-area data runs would be an overly time consuming imposition upon assessor's department staff.

  In the case of the commercial space data discussed above, market and sub-market definitions used by the data source may not match those relevant to the project of interest and the private firms that collect the data may not be willing or able to do specialized data runs, or may charge a fee for the service.

  Collection of some data elements is stymied by a combination of the above. Data tracking total commercial space before and after a project typically lacks a centralized source and lacks consistency. Commercial real estate broker firms often collect data for the larger real estate markets reflecting total space, rents and vacancy levels by product type. However, they do not typically maintain time-series data, nor do they cover smaller, non-metropolitan markets. Broker interviews can be used to get a general sense of current property values, but few brokers track property values over long periods of time.

- **Scale of the Data Collection Effort.** All of the above must be considered in the context of the larger data collection effort. The researcher collecting each of the above may be collecting dozens of other pieces of data from a broad range of sources, sometimes from multiple jurisdictions, sometimes at the sub-jurisdictional level, for many projects across the country, all under time and budget limitations. If this effort is multiplied by a number of separate case study projects, then the challenge becomes clear.

# 9 CONCLUSIONS AND NEXT STEPS

## 9.1 Analysis Findings

The wide variation observed in economic impacts among the 100 projects and within each category of projects is explained by multiple factors that were revealed in the course of compiling case studies and conducting data analysis. The factors that lead to the differences in economic impacts include the following:

- *No single economic impact metric can capture all of the economic growth and development effects of all types of projects.* That is partly because various types of projects lead to economic impacts at different spatial scales, which unfold differently over time. Access projects (such as interchanges and industrial access roads) tend to show land development impacts at a highly localized level. Other projects (such as long distance highway corridors) can have very broadly dispersed beneficiaries, ultimately affecting regional job growth. Yet other projects (such as beltways and bypasses) tend to reshape local and regional growth patterns.

- *Job impacts also vary tremendously by project size and type.* To enable comparison between large and small projects, long-term job growth impacts were portrayed in terms of ratios relative to the size of the project investment. Still, there are systematic differences in results that have more to do with project type and setting than the intrinsic value of building projects. For instance, smaller projects that provide access to planned development at specified sites (sometimes referred to as "contingent development") naturally tend to show the highest long-term job impact/cost ratio. Larger projects that improve traffic flow can have diffused impacts that are not fully captured because some occur hundreds of miles beyond the project study area.

- *The economic context of the study area is a critical factor*. Projects tend to generate larger economic impacts in economically vibrant areas. Economic impacts appear to be smaller and take longer in areas where the contextual economy is in a downturn and is distressed.

- *Project location matters.* More jobs were generated by project in metro settings than in rural settings. Case studies show that metro projects are more complex and often have a longer construction time frame than rural projects. Though rural projects take less time to build, job development in rural areas often takes a longer time to mature than in metro areas.

- *Urban projects tend to be most expensive*, due in part to higher land acquisition and social/environmental impact mitigation costs. That causes large urban projects to show a lower ratio of long-term job impact/cost, even though they generate the largest absolute numbers for long-term jobs growth. Of course, transportation projects are built for many reasons other than just economic development, so one cannot simply conclude that projects with the highest job impact ratio are most needed or desired.

- *Motivations for developing projects differ*. Some projects are planned and constructed to enable or facilitate economic development, but many others are constructed to address environmental, safety, congestion relief or facility preservation needs.
- *Economic impacts tend to be greatest when a project is part of a broader coordinated plan.* Factors that increase economic impacts include interagency coordination and sharing of a common vision for land and economic development, along with other supportive actions that may include zoning, water/sewer infrastructure development, site assembly, site preparation and other complementary transportation investments.

# 9.2 Follow-On Research &Development

From the viewpoint of interviewed stakeholders and the project review panel, the development of case studies and the TPICS database system is only a beginning. These products of this project now provide a new source of data that can be applied to help develop enhanced methods for forecasting future economic impacts of proposed projects.

One of the first steps to move forward in that direction is to make the dataset available for more sophisticated statistical analysis, in conjunction with efforts to enhance the measurement of associated changes in access, connectivity, reliability and spatial patterns of impact. Such analysis may also focus on capturing non-linear impacts on economic growth and development, including both threshold effects and scale effects. The results should help to better identify the specific conditions and situations that are most likely to generate a wider economic impact. They should be directly applicable to better inform decision-making at various stages in the planning process.

As a step forward to addressing these opportunities, a follow-on project has been initiated to build directly on the findings of this project. It seeks to enable an evolution towards more empirically-based methods that are responsive to planning and decision-making needs. Accordingly, the follow-on project focuses on (1) development of an enhanced accounting framework for tracking and distinguishing various types of impacts and benefits, (2) improvement in development of access, connectivity and reliability impact metrics, and (3) further development of methods for assessing and portraying spatial patterns of economic impact. The results should make it easier for economic development impacts to be considered in other planning analysis elements such as benefit-cost assessment, project prioritization, travel forecasting and land use forecasting.