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The Second
STRATEGIC HIGHWAY RESEARCH PROGRAM

SHRP 2 REPORT S2-C03-RR-1

Interactions Between Transportation Capacity, Economic Systems, and Land Use

ECONOMIC DEVELOPMENT RESEARCH GROUP, INC.

with

ICF INTERNATIONAL, INC.

CAMBRIDGE SYSTEMATICS, INC.

WILBUR SMITH ASSOCIATES, INC.

TEXAS A&M TRANSPORTATION INSTITUTE

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The Second Strategic Highway Research Program

America's highway system is critical to meeting the mobility and economic needs of local communities, regions, and the nation. Developments in research and technology—such as advanced materials, communications technology, new data collection technologies, and human factors science—offer a new opportunity to improve the safety and reliability of this important national resource. Breakthrough resolution of significant transportation problems, however, requires concentrated resources over a short time frame. Reflecting this need, the second Strategic Highway Research Program (SHRP 2) has an intense, large-scale focus, integrates multiple fields of research and technology, and is fundamentally different from the broad, mission-oriented, discipline-based research programs that have been the mainstay of the highway research industry for half a century.

The need for SHRP 2 was identified in *TRB Special Report 260: Strategic Highway Research: Saving Lives, Reducing Congestion, Improving Quality of Life,* published in 2001 and based on a study sponsored by Congress through the Transportation Equity Act for the 21st Century (TEA-21). SHRP 2, modeled after the first Strategic Highway Research Program, is a focused, time-constrained, management-driven program designed to complement existing highway research programs. SHRP 2 focuses on applied research in four areas: Safety, to prevent or reduce the severity of highway crashes by understanding driver behavior; Renewal, to address the aging infrastructure through rapid design and construction methods that cause minimal disruptions and produce lasting facilities; Reliability, to reduce congestion through incident reduction, management, response, and mitigation; and Capacity, to integrate mobility, economic, environmental, and community needs in the planning and designing of new transportation capacity.

SHRP 2 was authorized in August 2005 as part of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The program is managed by the Transportation Research Board (TRB) on behalf of the National Research Council (NRC). SHRP 2 is conducted under a memorandum of understanding among the American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), and the National Academy of Sciences, parent organization of TRB and NRC. The program provides for competitive, merit-based selection of research contractors; independent research project oversight; and dissemination of research results.

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

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FOREWORD

David J. Plazak, *SHRP 2 Senior Program Officer, Capacity*

The Capacity focus area of the second Strategic Highway Research Program (SHRP 2) is broadly based on the concept that better consideration of the social, environmental, and economic effects of highway projects as they are planned, programmed, and carried out will result in improved and more rapidly implemented projects. Capacity Project C03 was designed to create a large database of case studies and a web-based tool that allow for more rapid assessment of the long-term economic impacts of highway capacity projects. The main result of the project is that economic impacts can be considered for a greater number of potential projects, and this step can take place earlier in the planning process.

Although there are many excellent economic impact assessment tools for highway capacity planning, they tend to be relatively time consuming and expensive to use. This has meant that the economic impacts of potential projects have not been addressed in the early stages of planning and programming when many possible project alternatives are under consideration. The resources created through the C03 project will make it possible to assess economic impacts during community visioning for transportation or during public and stakeholder involvement in long-range system planning or corridor planning.

This research report is based on 100 detailed case studies that document the long-term, before and after economic impacts of a variety of highway capacity investments, mainly from around the United States. This project focused on long-term impacts on performance metrics such as employment, income, real estate values, and tax revenues. Temporary, construction-phase impacts were not considered in the report or the database of case studies.

The report presents documentation on the background of the research project, an explanation of how the case studies were selected and developed, an introduction to the accompanying web-based tool, and a meta-analysis of the key relationships among factors such as project type, traffic volume, project location, and nontransportation policies put in place to help foster economic development. The findings from the meta-analysis can serve as a high-level guide for transportation agencies in selecting highway capacity projects that, with regard to long-term economic impacts, will provide a greater return on investment. For instance, the meta-analysis indicates that the type of project (e.g., an interchange versus a ring road) and the setting (e.g., in an area that is economically distressed versus nondistressed) matter considerably more than the amount of money spent to build the project.

This report and the accompanying T-PICS (Transportation Project Impact Case Studies) website are intended to serve as a resource for transportation planners and others who are interested in better understanding the long-term economic impacts of highway capacity projects. Although highway projects are the primary focus, a number of intermodal projects (e.g., transit-oriented development projects with both a substantial highway component and freight terminals) are included in the database and web tool. The database and web tool were designed so that future highway case studies and economic impact case studies involving other modes of transportation can be added as they become available.

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Executive Summary

Study Overview

Capacity Project C03 of the second Strategic Highway Research Program (SHRP 2), Interactions Between Transportation Capacity, Economic Systems, and Land Use, produced 100 before and after case studies of the impacts on economic and land development of highway and highway/intermodal projects, along with the creation of a national database for the case studies and a web tool for viewing and using the findings. The study developed standards for a national database of before and after case studies that included requirements for (a) before and after impact comparisons, (b) coverage of local and regional impacts, (c) a wide range of 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 quantitative data and qualitative observations about local economic conditions.

The study sought to include all major project types: 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 United States, urban and rural settings, and different economic distress levels. A small number of English-language studies from Canada and abroad also were 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, dates of construction, cost, size, and level of use.
2. *Project objectives.* For example, congestion reduction and access enhancement.
3. *Impact metrics.* Pre- and postconstruction change in employment, income, business output, land values, building development, and tax revenues.
4. *Quantitative explanatory data.* For example, location (region, metropolitan/rural), topography, and economic distress level.
5. *Qualitative explanatory data.* Local interview findings on land use plans and policies, business climate and support programs, other factors affecting outcomes.

Analysis Results

The case studies were analyzed through statistical analysis of empirical data and identification of common themes from the qualitative interview reports. Key findings are listed here:

- Transportation projects lead to multifaceted 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 the type and setting of the project.

- 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 from 2-mile, short-access roads to major interstate highways spanning several hundred miles.
- Project cost and job growth impacts vary by project size, type, and location.
- Project location matters. Larger numbers of jobs are generated by projects in metropolitan settings than by those in rural settings. Rural projects tend to have lower costs and take less time to build than those in metropolitan settings, although job growth in rural areas also tends to take longer to emerge than in metropolitan areas.
- The economy and business climate of the project 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 do projects in areas without those features.
- Motivations for projects differ, and projects with a coordinated economic development effort (involving complementary policies) generally facilitate more long-term job growth than do projects that lack local supporting policies.

Practical Use

The Transportation Project Impact Case Studies (T-PICS) web tool (http://transportationforcommunities.com/t-pics) provides transportation planners with a way to search for relevant case studies by type of project and setting. The case studies include details of the projects, their impacts, and factors affecting the impacts. The web tool also provides users with an option to specify the type of proposed project and see the range of likely impacts 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 identify the magnitude and types of impact trade-offs to be considered.
- Second, they can be useful in early-stage “sketch planning” processes for identifying the types of local barriers 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 because they can inform responses to the hopes of proponents and fears of opponents with reports of actual impacts from similar projects.

CHAPTER 1

Study Issues and Process

Project Background and Overview

Project

SHRP 2's Capacity Project C03, Interactions Between Transportation Capacity, Economic Systems, and Land Use, involved the development of interviews, case studies, a database, and a web tool for assessing the economic and land development impacts of highway capacity investments. This final report of the project describes the data collection process, results of statistical analysis, and study findings.

Motivation

The project was funded by SHRP 2 to enhance the effectiveness of highway project planning, prioritization, and selection processes by providing complete and accurate information on the nature of typical economic impacts of highway capacity expansion projects. The data collection process, the database tool, and analysis findings all focused on enhancing the effectiveness of local and state public meetings, policy discussions, and planning processes.

Thus, the research study 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 before and after information to observe economic and land development impacts and how they tend to vary by type of project or local setting.

It should be noted that other types of highway investments were not covered in this study because they do not typically lead to economic impacts. These include (a) safety improvements and (b) facility reconstruction, rehabilitation, and preservation investments. These types of highway projects have notable user benefits, in 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 that (a) compared pre- and postproject changes in economic and land development conditions, (b) contrasted them with corresponding conditions for a base of comparison, and (c) included 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 among urban/rural settings in all regions of the United States. An effort was also made to build on highway impact studies in the United States and Canada, to the extent that those studies fit within the case study selection design, which is discussed in greater detail later in this chapter.

T-PICS Web Tool

The case studies were put into a web-based viewing and analysis system called T-PICS (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 T-PICS 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.

Stakeholder Interview Process

Motivation

At the outset of this project, the research 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 among stakeholders.* Levels of awareness of economic impact issues and issues of major concern for impact measurement, assessment, and forecasting.
2. *Uses of economic impact analysis by stakeholders.* Uses made of those impact estimates (for planning and decision making) and types of impact metrics stakeholders find most useful.
3. *Situations in which economic impact analysis is most relevant.* Types of projects and situations in which those impact measures are most needed, timing of when the 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 the Economic Development Research Group, ICF International, Wilbur Smith Associates, Cambridge Systematics, Texas A&M Transportation Institute, and Susan Jones Moses & Associates. 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 with representatives from transportation planning agencies in the states of Iowa, Texas, California, North Carolina, New York, Wisconsin, Michigan, Oregon, Maine, Montana, and New Mexico and the Appalachian Regional Commission. In addition, a focus group of consultants was invited to determine the factors that they collectively thought were most critical for improvement to the state of practice.

Stakeholder Needs for Decision Making

The stakeholder interviews and focus group discussions led to the findings described in the following sections.

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. A growing number of state and regional agencies do use economic impact models or tools, but concern remains about the empirical basis of those tools. There is also uncertainty about how to interpret information about 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.

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, such problems can be addressed and the misapplication of evaluation tools reduced.

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 SHRP 2 study of the collaborative decision-making process.

1. Policy/funding allocation;
2. Planning strategy;
3. Programming (including funding);
4. Prioritization;
5. Project development/environmental impact statement; and
6. Preservation, operations, and maintenance.

There was wide divergence among interviewees as to which of these stages most needed economic development impact analysis, a divergence that is not surprising in light of the respondents' different positions and 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), which can play a major role in their stated "purpose and need." Other interviewees noted that analysis of economic development impacts is particularly useful for public information and public participation. Finally, some interviewees noted that there can be value in examining economic development impacts as a way to gain insight into cost recovery opportunities or to recognize long-term mobility and capacity needs at a regional level (beyond the 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.

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 United States 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 encompass land use and development considerations and serve to either increase or decrease estimates of the payback from transportation investments. The range of impacts observed in the case study examples can inform the development of a more systematic and appropriate set of economic benefit metrics for investment decision making in the United States.

Refining Economic Impact Concepts

The interviews with practitioners identified, from a practitioner's perspective, the following key needs and concerns to enhance analysis methods for assessing economic development impacts of transportation investments.

Need for Case Studies of Economic Development Impacts

There is a strong need to establish realistic expectations about economic impacts of transportation projects at the earliest possible point in planning and decision making. Staff of state DOTs continually face, on the one hand, unrealistically high expectations of positive job creation benefits from proponents and, on the other, unrealistically high alarm about loss of land values and uses from opponents. Efforts to address the two perspectives can increase the resources required and the time involved in planning, analysis, and public discussion. They drive demand for analysis of potential economic development impacts, although they also "raise the bar" in the 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 under consideration in early planning discussions.

Defining and Measuring Economic Development Impact

More than one interviewee noted that the definition of economic development impacts is not a simple matter. Most types of economic development impact analysis focus on measuring economic activity expansion by looking at measures of jobs, income, GDP (value added), and business sales. Public groups sometimes broaden the scope of analysis to encompass a wider range of societal goals for economic development, including economic standards (e.g., unemployment rate, average wage, standard of living, and job skill level) and business factors (productivity and competitiveness). Such analyses may also incorporate broader measures of quality of life (e.g., safety/security, air quality, and carbon footprint).

The following are the most common factors used in economic development impact analysis:

- Jobs;
- Income (or gross regional product);
- Productivity;
- Property values;
- Competitiveness (relative costs); and
- Quality of life (e.g., air quality, safety).

Most agencies 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, and others expressed interest in competitiveness and productivity to enable better economic evaluation. Case studies can inform the examination of all these impact elements.

Time and Space Aspects of Economic Development Impacts

Urban planners have noted that economic development impacts can unfold over time and over space. The most common sequence of impacts is the following:

- 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, associated wages, and total business sales (as buildings are occupied); and
- 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 of potential spatial areas for measuring those impacts. Error can be introduced when postproject studies attempt to measure some of the later forms of impact prematurely or focus on too narrow a spatial area. Error can also be introduced when preproject forecasts focus on an overly narrow indicator or are defined for an overly narrow or broad study area.

Errors Caused by Multiple Indicators

The proliferation of ways to measure economic impacts leads to confusion among analysts and users of this information. One example is preproject 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.

Study Design

After completion of the initial stakeholder interviews and focus group discussions (described in the preceding sections), the research team developed 100 case studies of highway impacts on local and regional economic development. The cases were carefully selected to ensure a wide range of project types in different settings (as described in Chapters 2–5). The case studies and accompanying database and T-PICS web tool were designed with the specific intent of addressing issues raised in the stakeholder interviews. The following sections present the key elements that emerged from those interviews.

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 SHRP 2 program is required to focus specifically on highways; within that class, case studies were carefully selected to cover 10 types of highway-related capacity projects, representing essentially the entire range of project types. These spanned all regions of the United States and a wide range of urban/rural settings and economic conditions. The characteristics of the projects and their settings are represented in the case study database.

Economic impacts of the case study projects were defined to include both quantitative data and qualitative observations on how economic conditions changed before and after completion of each highway project, covering impacts on jobs, income, land values, and building investment. The research team also sought to distinguish the extent to which impacts occurred at a localized or regional level. In this way, the case studies illustrated the multifaceted impacts of economic development, depending on the type of project and its setting.

The T-PICS web tool provides tables of quantitative impact metrics and detailed text to describe different forms of economic development impact. 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, largely because preproject data were not available.

Explanation of Factors Affecting Observed Economic Results

The stakeholder interviews and focus group comments underscored a need to recognize and (to the extent possible) control for outside factors that affected changes in economic development. Accordingly, the case studies included not only a comparison of before and after changes in economic conditions but also a comparison to reference areas, to control for external business cycles, as well as interviews with local planners and business representatives to assess the extent to which observed changes were due to the highway project versus other factors.

This approach 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 clarifies 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 establish the extent of causal connection between highway-related improvements and resulting economic impacts.

However, the research team cautions that the case study database cannot relate observed economic impacts to the magnitude of before and after changes 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.

Basis for Sketch Planning

The T-PICS web tool provides a way for transportation planners to search for relevant types of projects in specific types of setting (e.g., region, urban/rural population density). It also enables users to research a given type of proposed project and see the range of impacts actually observed. These features have three important uses. First, they can have value for early policy or strategy development, in which it can be useful to initially identify the magnitude and types of impact trade-offs to be considered. Second, they can be useful for early "sketch planning" processes to identify the types of local barriers and success factors that will need to be addressed in later, more-detailed planning steps. Third, the case study findings can be useful in public hearings because they provide a way of responding to the sometimes unrealistic hopes of proponents or fears of opponents with information about the types of impacts that have actually occurred.

Complementarity with Economic Development Impact Models

The case studies provide empirical evidence of actual economic development impacts 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 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 T-PICS web tool cannot serve as a substitute for predictive economic impact models. For, although such models forecast shifts in economic growth resulting from changes in transportation conditions (e.g., traffic levels, travel times, distances, access, reliability), the case studies lack such detailed information. That was unavoidable given the long time span of the economic impact case studies (often 10–20 years) and the fact that data on preproject transportation conditions were never collected or are 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 impacts. 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, whereas economic impact models are most useful in later stages of planning and priority setting, when more details are available on the nature of proposed projects and their expected transportation system impacts.

CHAPTER 2

Classification of Project Types and Settings

Project Types

Project type is the single greatest differentiator among case studies, for different project types can have 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 10 types representing different functions, spatial footprints, and magnitudes of investment cost. The definitions adopted for purposes of this study are presented here. Case studies were selected to ensure a roughly even distribution of project types, dispersed among different settings and parts of the United States. The number of case studies completed for each project type is shown in Table 2.1.

1. *Major highways* are multilane roadways designed to handle high volumes of vehicles traveling at high speeds. Travel lanes in either direction are separated by distance or crash barriers. Limited-access highways typically are free of traffic lights and stop signs and accessible only via periodic on/off ramps and interchanges with other limited-access highways. Such highways typically are built to provide access from outlying areas to or across metropolitan markets. Where they pass through rural areas, they do so primarily to connect metropolitan areas or to connect rural agricultural areas with metropolitan markets and intermodal terminals (such as airports, marine ports, or rail terminals), which often are 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 may include housing, retail, and major employers, outside the center of cities.
3. *Connectors* provide highway access between two major highways or 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. An option to drive through the town center typically is maintained. Bypasses are designed to improve efficient traffic flow for long-distance travelers by keeping them 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 constructed features, such as 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 to provide 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 support the development of new industrial or business parks; and others allow for the expansion of existing parks by providing access from a new direction.
8. *Highway-widening projects* increase highway capacity by adding lanes. They 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 involve the transfer of 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**

Table 2.2. Project Settings

Setting Indicator	Primary	Secondary
Geographical Setting		
Region	X	
Topography		X
Social Setting		
Urban/rural	X	
Population density		X
Transportation access		X
Economic Setting		
Economic distress	X	
Economic growth		X
Local conditions		X

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 in different parts 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 socioeconomic composition of an area, regardless of geographic setting.
- *Economic setting.* Impacts of highway projects may vary with difference in underlying patterns of unemployment and economic growth or decline that are in effect at the time of project construction.

For this study, quantitative information was collected for eight aspects of project setting; these are listed in Table 2.2. An effort was 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 as the primary indicator for 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 available for use as additional case study descriptors and search criteria. The identification of primary and secondary factors and ways that they can affect economic impact were drawn from research studies developed by the Appalachian Regional Commission and its contractors (*1*).

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 because of differences in climate, topography, land use patterns, highway network density, and travel distances in different parts of the United States. This factor can thus help users compare cases in similar areas or those with characteristics similar to their own. The regions are based on those defined by the U.S. Department of Commerce's Bureau of Economic Analysis (BEA), which classifies the United States into eight regions. The number of regions used for this study was reduced to five because three pairs of regions were combined (Far West and Rocky Mountain, Great Lakes and Plains, and New England and Mid-Atlantic). These regions are shown in Figure 2.1. An effort was made to ensure a reasonable representation of all project types in each region; that distribution is shown in Table 2.3.

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 U.S. Office of Management and Budget, and adopted by the U.S. Census Bureau. 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

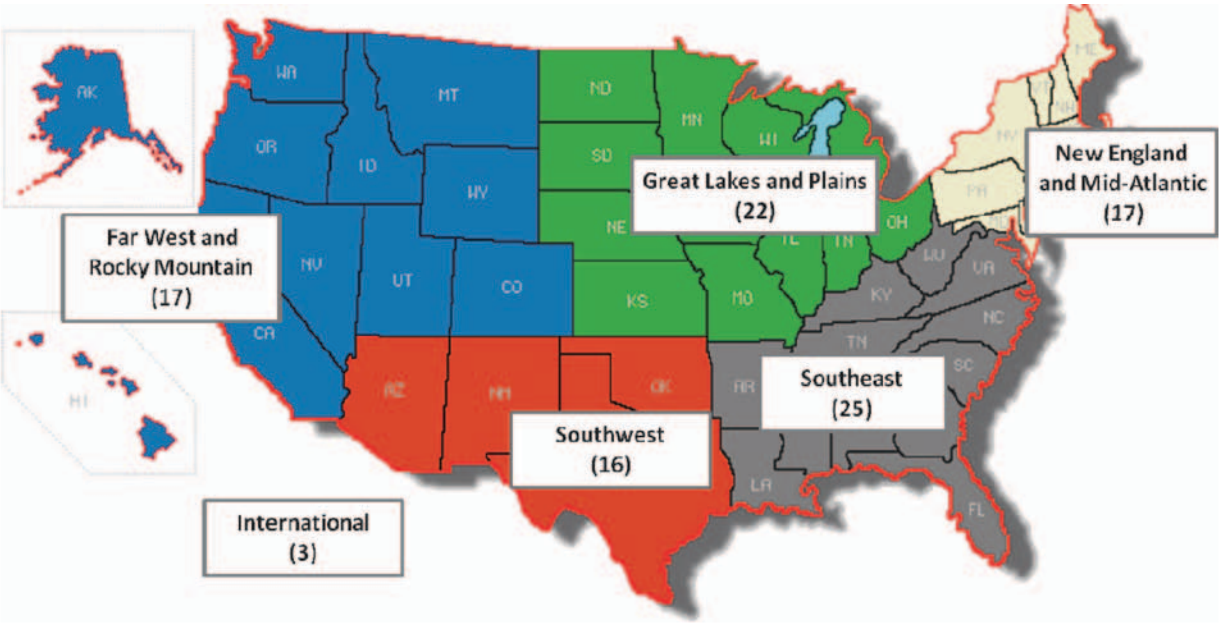

Figure 2.1. Number of cases by geographic region (total 100).

were all classified as metropolitan, then the project setting was classified as "metro"; if the project counties included metropolitan and nonmetropolitan counties, then the project setting was classified as "mixed"; and if all the project counties were nonmetropolitan, then the project setting was classified as "rural." An effort was made to ensure a mix of most project types represented in each class of county setting. (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 because it is easy to obtain such figures, which are available at the community level from the U.S. Census Bureau. 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 the U.S. level. This helps to avoid distress classification changes associated with economic booms and downturns and thus allows before/after 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 2.3. Distribution of Project Types Among Regions

Project Type	Great Lakes and Plains	New England and Mid-Atlantic	Far West and Rocky Mountain	Southeast	Southwest	International	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**

Table 2.4. Project Types and Settings

	Economic Market Setting			Economic Distress		
Project Type	**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 highway	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 indicators 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 available in the T-PICS database (search and selection criteria) and described here.

Topography

The extent of mountain terrain, wetlands, and other land constraints can potentially affect the nature of highway economic impacts. The U.S. 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, although it can sometimes be useful as a more detailed means of distinguishing high-density core counties in large metropolitan areas from lower-density outlying counties. Measures of population density are readily available at the county level from the U.S. Census Bureau.

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 U.S. Department of Transportation. Spatially detailed information on population and employment patterns is available from the U.S. Census Bureau. These data sets, used in conjunction with highway network and geographic information systems (GISs), 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 because 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 U.S. Department of Commerce's Census Bureau and Bureau of Economic Analysis.

Local Conditions: Development Capacity

For business and population to expand, there must be adequate land and utilities. This includes access to water and 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. Because such data may not be readily available to users of the system, they cannot be used for screening potential case studies. Nonetheless, the data are reflected in the case study narratives and can be used to complement quantifiable measures.

Reference

1. Economic Development Research Group, Massachusetts Institute of Technology, and Regional Technology Strategies. *Sources of Regional Growth in Non-Metro Appalachia.* 3 vols. Prepared for the Appalachian Regional Commission, Washington, D.C., 2007.

CHAPTER 3

Case Selection and Data Collection

Case Study Selection Process

The case study selection process was based on the application of criteria described in the preceding chapters. In addition, the project time period was considered insofar as it affected the availability of pre- and postconstruction impact data. The result was a multistage 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 to assemble a list of candidate highway capacity projects. To accomplish this, the research team queried state transportation departments for lists of highway projects that (1) represented new highways or major extensions, expansions, or performance enhancements to existing highways; (2) were completed at least 5 years ago; and (3) represented a significant magnitude of investment (defined as more than $10 million in cost). Altogether, 138 candidate projects were identified in this way.

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, require 1 to 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 before were not considered because they were deemed too recent to allow determination of the full impact of the project. Projects completed more than 20 years before were dropped from consideration because of the difficulty collecting data on preproject conditions and finding interviewees who could report on before and after land use and development changes and disentangle observed changes from extraneous factors over time.

The second step was to identify previous economic impact studies of before and after conditions 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 before and after evaluation of seven rural interstate highway projects.
- *Urban highway interchange projects.* Pennsylvania Economy League—2000 study that included before and after assessment of seven highway interchange projects.
- *Small town bypass projects.* California DOT—2006 study that included before and after meta-analysis of 134 town bypass projects conducted by state DOTs in Virginia, Indiana, Wisconsin, California, and Montana.
- *Industrial access road projects.* Appalachian Regional Commission, Public Works Program evaluations conducted in 1999 and 2007 that included before and after evaluation of 199 access road projects in 13 states; plus Oregon Department of Economic Development 2006 study that included before and after 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 before and after data. Some cases were discarded at this point; they were nearly all bypass and access road projects identified in the previous literature of meta-analyses but 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 before and after impact studies or were deemed to be easily updated so that before and after construction impacts could be developed quickly. It also included 46 cases in which there was a reasonable amount of impact data available and before and after 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 considered viable case studies, although 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 because of a lower availability of project documentation and information on construction costs 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 these latter cases involved interchange between highway and rail modes, including "passenger intermodal facilities" (which were rail transit stations with highway access) and "freight intermodal facilities" (which were truck or train transfer facilities for freight containers). The added cases were selected to maintain the same wide distribution among geographic regions and settings.

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 2001 FHWA guide *Using Empirical Information to Measure Economic Impact of Highway Investments* (*1*).

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 or 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. Postconstruction study date;
9. Project magnitude (length, lane miles);
10. GIS latitude and longitude coordinates;
11. Related links; and
12. Relevant attachments.

Location Classification

The next most critical set of project characteristics is the set of project location (setting) indicators because these factors (along with project type) provide the core options for an initial search by a user of the T-PICS 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 (minutes); and
11. Extent of mountain terrain (land surface rating: 1 to 21).

Impact Measures

Each team member collected before and after 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 impacts);
6. Business sales (output; direct and total output impacts);
7. Population density;
8. Capital investment (dollars; direct and total investment);
9. Property values (aggregate total value change [dollars] in study area);
10. State, local, and federal tax revenues and costs (direct and total tax revenue); and
11. Annual average daily traffic count (AADT).

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

Case Study Interviews

Although a significant part of the empirical impact data were collected via public sources (as listed), some types of impacts required local information. The case studies also include information about causal factors affecting project impacts (including transportation programs and nontransportation 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 a 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) were conducted for each case study.

1. *Staff of the transportation agency that built the project.* To provide project characteristics, before and after 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.
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 to gather more empirical data. If the before and after data were already available, the project team asked the interviewee to validate or elaborate on the data. When data were not available, interviewees were asked to provide the data. In both cases, it was useful to get qualitative information to either reinforce or substitute empirical measures. The questions included the following:

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

Organization of 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 selected, the following data were compiled:

- *Characteristics of the project.* Description of the project, project type, length, AADT, years constructed, and so forth.
- *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, and so forth.
- *Before and after conditions.* Data showing the before and after 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.

Reference

1. Economic Development Research Group and Cambridge Systematics. *Using Empirical Information to Measure Economic Impact of Highway Investments.* 2 vols. Prepared for FHWA, U.S. Department of Transportation, 2001.

CHAPTER 4

Results of Data Tabulation

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 T-PICS tool, 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.

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 more than $5 billion for some major interstate highways (and even higher if megaprojects such as the Oresund Bridge and Boston's Central Artery/Tunnel are included). Projects also varied from 1 to 244 miles in length.

In general, project costs fell into three classes: (1) Low cost—access road projects, which were most commonly in the $1–2 million range and all less than $70 million; (2) Mid-cost—bridge, connector, bypass, and interchange projects, which typically were in the $10–100 million range and all less than $350 million; and (3) High cost—major highways and beltways, which varied from $200 million to more than $3 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 typically was in the range of 3 to 5 years (40–59 months) for the small and medium category projects, but typically rose to 10 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.

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 2 case studies (completed in 2010) were restricted to projects that had been completed at least 5 years earlier so that sufficient time would have passed 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, whereas employment, income, and tax impacts were measured for both local areas and larger areas (ranging from individual municipalities to multijurisdictional corridors or counties). The case studies confirmed the following typical sequence of impacts.

- *Transportation impact.* A highway project is initiated to affect travel-related costs or accessibility by enabling faster or more reliable travel to and from a particular area or enabling access to a broader set of origin or destination opportunities. The benefitting area may be adjacent to the project or 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.
- *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.
- *Building construction and investment impact.* The greater accessibility and value of the location attracts investment in new construction or expansion of housing, commercial

Table 4.1. Profile of Projects: Median and Range for Cost and Length

Project Type	Total Cost[a] ($ 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 (32–1,300)
Widening	1,145 (313–2,060)	24.8 (8–244)	85 (50–740)
Freight intermodal	197 (37–415)	NA	NA
Passenger intermodal	74 (4–247)	NA	NA

Note: NA = not available.

[a] Excludes “mega-projects”: Oresund Bridge between Denmark and Sweden ($7.2 billion) and Boston’s Central Artery/Tunnel Project ($17 billion).

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).

- *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.
- *Tax revenue impacts.* The added land value and construction activity lead to increases in local property tax collections, whereas 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

Table 4.2. Profile of Projects: Construction Period, Cost per Mile, and Traffic

Project Type	Median Months to Construct	Median Cost Per Mile *(Millions of 2010 U.S. Dollars)*	Median Traffic Level *(Annual Average 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[a]	10,367
Passenger intermodal	59	NA[a]	136,000
Total	**81**	**$14.98**	**23,861**[b]

Note: NA = not available.

[a] Mileage is not defined for these types of projects.

[b] Excluding passenger and freight intermodal terminals.

Table 4.3. Availability of Impact Measures by Impact Element and Form of Data (Percentage 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.

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, whereas 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, whereas 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.

These results must be interpreted carefully. The differences among impact measures reflect variation in the availability of data rather than differences in impact occurrence. In general, a change in any one of those impact elements is likely to 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 data sets available at the county, community, and even zip code levels across the United States. 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 is more difficult

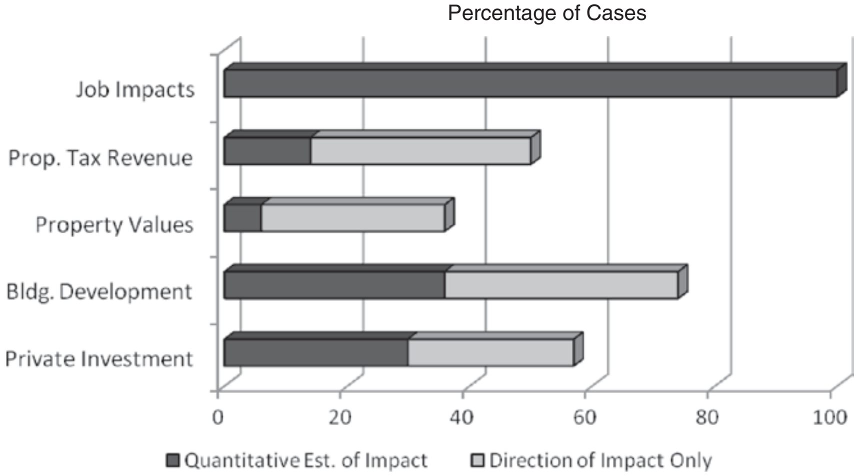

Figure 4.1. Percentage of cases with qualitative and quantitative impact data.

to obtain because such data come from municipal or county records, which differ widely in their availability and format for tabulation.

Magnitude of Economic Impact

Direction of Impact

Impacts can be interpreted in two ways: (1) by drawing on all qualitative and quantitative information, or (2) by drawing only on 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.

Viewing Table 4.4 together with 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, whereas 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 for which 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 only for the 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 had positive changes and only 2 showed a net negative impact, whereas the remaining 13 showed no net impact. The latter finding includes cases for which there was no evidence of job impact and those in which offsetting negative and positive job impacts were seen.

The quantitative results reflect net impacts. 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

Table 4.4. Number of Cases with Reported Positive Direction of Economic Impact (Including 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
Passenger intermodal	9	7	4	8	2	3
Total	100	85	57	74	36	50

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 building construction	36	0[a]	NA	64	100
Impact on private investment ($)	27	0[a]	NA	73	100
Impact on property values	6	0[a]	NA	94	100
Impact on local tax revenue	14	0[a]	NA	86	100

Note: NA = not available.

[a] Measures reflect the net result of positive and negative impacts.

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 positive and negative changes, although the research team 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 data set, 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, such as property values, private investment, building construction, and 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.

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, whereas a small fraction (10%) of the projects accounted for more than 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: (1) *Small-scale impact*—access road projects that generally supported between 500 and 2,000 jobs; (2) *Midscale impact*—bridge, connector, bypass, interchange and intermodal projects that had widely variable impacts, sometimes zero but other times 10,000–25,000 jobs; and (3) *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, although only the rural bypass projects had a mix of negative and positive impacts.

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,

Table 4.6. Ranges and Medians of Economic Impact Measures (For Which Quantitative Data Are Available in the Data Set)

Measure of Impact	Minimum	Maximum[a]	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	$840
Building development (thousand sq. ft.)	4.2	50,000	1,003	—[b]
Direct private investment ($ millions)	$3.0	$6,300	$300	—[b]
Property values ($ millions)	$0.15	$85	$16.0	—[b]
Property tax revenue ($ millions)	$0.12	$55	$2.1	—[b]

[a] Maximum excludes Santan Freeway widening (Arizona), Central Artery/Tunnel Project (Massachusetts), and Route 101 beltway (Arizona), all of which had only rough estimates available for job impact.

[b] Insufficient data.

Table 4.7. Range of Job Impacts by Project Type and Metro/Mixed and Rural Setting (For Which Quantitative Data Are Available in the Data Set)

	Metro/Mixed Setting			**Rural Setting**		
Project Type	**(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
Passenger intermodal	(9)	0	10,035	NA	NA	NA
All project types[a]	**(74)**	**0**	**50,505**	**(23)**	**–48**	**4,080**

Note: NA = not available.

[a] Excludes Santan Freeway widening (Arizona), Central Artery/Tunnel Project (Massachusetts), and Route 101 beltway (Arizona), all of which had only rough estimates available for job impact.

these generally were 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 attributable 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.

Table 4.8. Types of Projects That Yielded Zero or Negative Job Impacts (For Which Quantitative Data Are Available in the Data Set)

Project Type	**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**

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:

- Eight of the cases had gains in business sales at the county level after the project.
- Ten of the cases had growth in local per capita income after project completion.
- Six of the cases had documented increases in local property values.

Job Impact Ratios

The case studies had an overall ratio of 7 long-term jobs added per $1 million of highway investment, although the ratio varied from less than 2 jobs to nearly 90 long-term jobs per $1 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 $1 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 $1 million of highway spending.

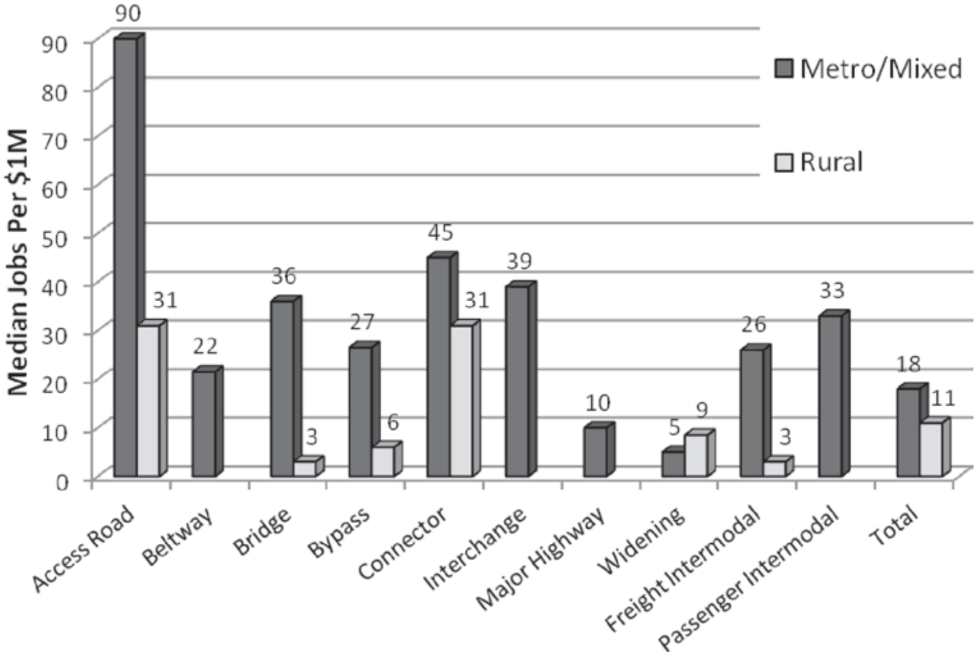

Figure 4.2. Ratio: Median long-term job impact per $1 million of project cost by project type and setting.

These systematic differences occurred for some good reasons. On the one hand, project types with the highest ratio of long-term job growth per $1 million spent—access roads, interchanges, and connectors—often were built 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 the lowest ratio of observed job growth per $1 million spent—urban freeway (limited-access highways) and highway-widening projects—often required the addition of costly land acquisition and neighborhood impact mitigation costs. The beneficiaries of the projects were more likely to be those whose trips were based at origins and destinations located beyond the highway project endpoints (thus providing benefits beyond the areas immediately surrounding the highway project).

There were also substantial differences in the job generation ratio by urban/rural setting. The ratio of long-term jobs per $1 million spent for projects in a metropolitan (or mixed urban/rural) area was more than three times that occurring in rural areas. Fully 22% of the rural projects but only 14% of the metro/mixed projects had zero job creation, and 50% of the rural projects but only 22% of the urban/mixed projects had 0 to 99 net jobs added. The upside potential was most evident for the metro area projects, of which 66% 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 and the beneficiaries are more broadly distributed outside of the project area. Or it may be that land development and private investment impacts take longer to manifest for rural projects.

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 categories are related to increasing access. They are improving access to terminals of air, rail, and marine modes; international borders; labor markets; and delivery markets. Two categories are related to economic development: 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 enabling positive enhancement compared with 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: 58 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 reported most often for urban highway projects, while the motivation to facilitate site development was reported most often 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 international 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[a]
Promote economic development				
Facilitate site development	42	2	8	52
Facilitate tourism	26	0	0	26
Any of the above				65[a]
Reduce congestion				
Mitigate congestion	47	0	7	54
All projects	78[b]	10[b]	9[b]	97[b]

[a] The reported numbers for "any of the above" are less than the sum of the preceding lines because some projects had multiple motivations.

[b] The reported numbers for "all projects" are less than the sum of the preceding lines because some projects had multiple motivations.

Figure 4.3 shows how the project motivations varied by setting. Many projects had more than one motivation, so the sum is not 100%. Focusing just on the highway projects (excluding intermodal terminals), the chart shows that the most common project motivation in rural and metro areas was congestion mitigation. Site access and delivery market access were the next two most common reasons in metro/mixed and rural settings, whereas tourism was an important motivator in rural areas and labor market access also was key in metro/mixed areas.

Figure 4.4 shows how project motivations also varied by type of project. Not surprisingly, access considerations were the strongest motivations for the major highways and freight intermodal projects. Congestion mitigation motivations were

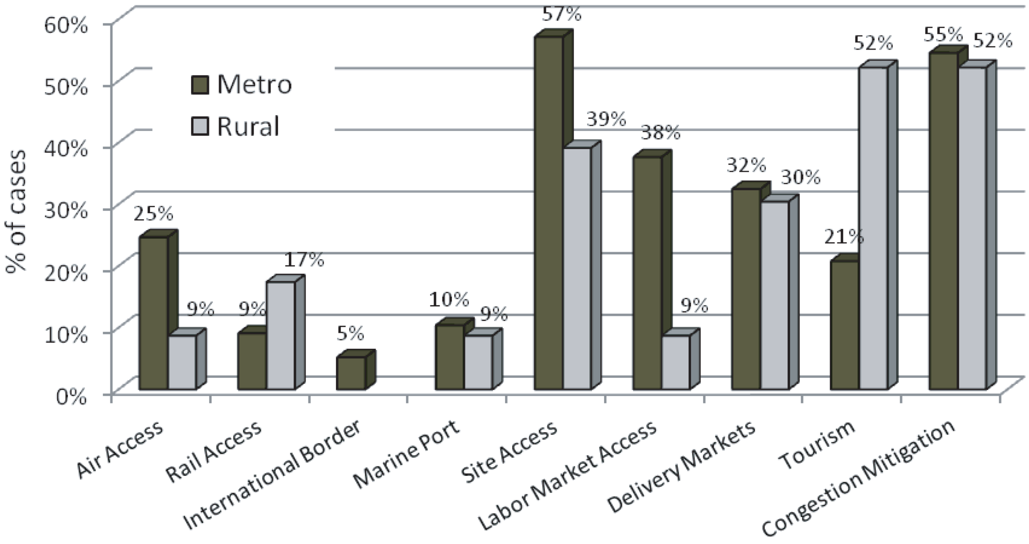

Figure 4.3. Project motivations (percentage of highway cases with each motivation).

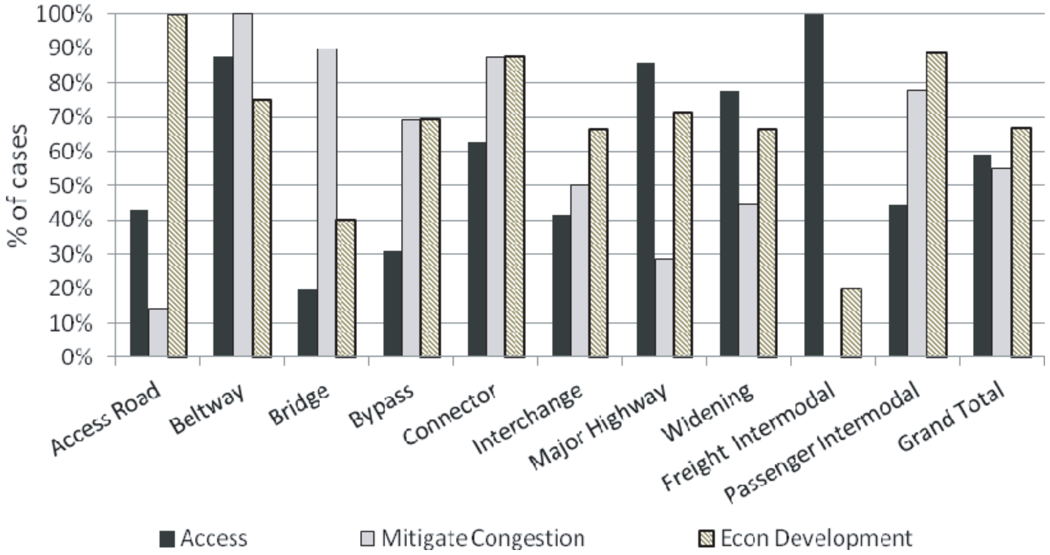

Figure 4.4. Project motivation by project type.

strongest for the bridge and beltway projects, and economic development motivations were strongest for the access road and passenger intermodal projects.

Role of Nonhighway Factors

The economic impact was often supported by nontransportation factors, most commonly as the presence of other infrastructure investments, land use policies, or business development incentive programs. In some cases, the synergy among multiple factors created a positive economic development climate that led to additional 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 nontransportation factors were cited in case study interviews as matters affecting the long-term job growth impacts of highway projects.

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 such supportive factors. The median job creation was slightly more than 180 for projects for which a lack of complementary infrastructure or policies inhibited economic development, compared with more than 1,420 for projects for which supportive factors were reported. Projects that cited both positive and negative policies included a wide range of job impacts, which resulted in 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. Nondistressed areas with positive local factors had higher median ratios of jobs per $1 million than did distressed areas.

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.

Table 4.10. Incidence of Nontransportation Factors Affecting Job Growth

	Nontransportation 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/negative business climate	5
All projects		**100**

Table 4.11. Effects of Nontransportation Factors on Magnitude of Job Growth

Nontransportation 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 and negative	8	19,625	1,050	2,453
Not reported	23	207,627	808	9,027
Total	**96**	**510,371**	**1,269**[a]	**5,316**[a]

Note: This table excludes Santan Freeway widening (Arizona), Central Artery/Tunnel Project (Massachusetts), and Route 101 beltway (Arizona), which had only rough estimates available for job impact. It also excludes Interstate 26. That project reported nearly 31,000 jobs, yet local officials reported that the project never reached its full potential because of lack of adequate infrastructure and land use management.

[a] The median of 1,269 and mean of 5,316 reported here differ from the median of 1,290 and mean of 5,782 reported in Table 4.6 because the Interstate 26 project was excluded from this table.

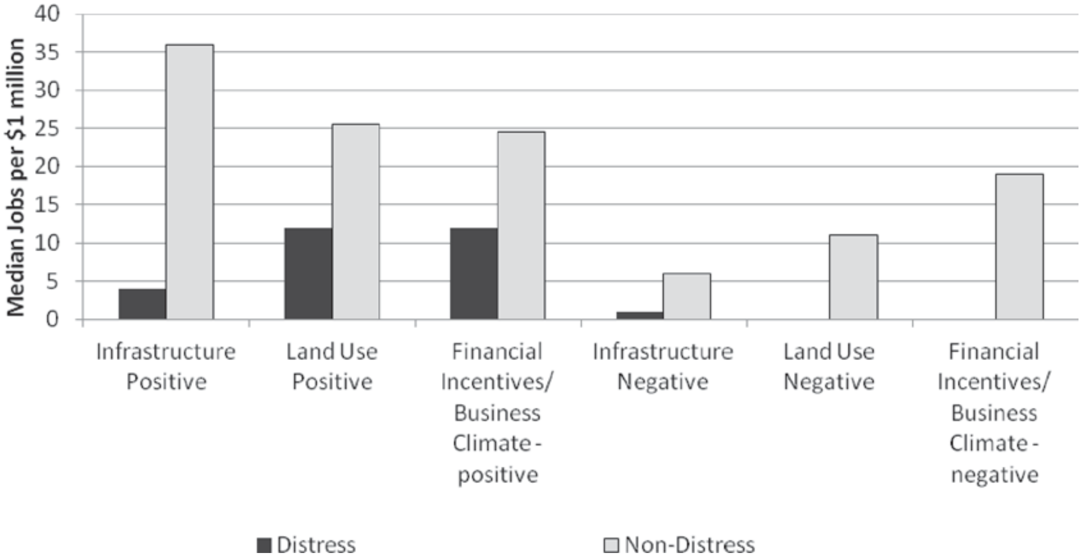

Figure 4.5. Effect of nontransportation factors on job growth by local economic condition (distress level).

CHAPTER 5

Statistical Analysis of Job Impacts

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 $1 million 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 examine 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 because 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, although the corridor may be many miles in length. The total impact area typically is defined as a metropolitan area, county, or aggregation of multiple counties. On average, the direct impact accounts for approximately 70% of the total impact, although 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:

- 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 research team developed and tested a series of separate regression equations for U.S. "roadway" and "point-to-point" classes of projects to determine the most important factors affecting 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 or its setting. Location-specific data were obtained from the Bureau of Economic Analysis, Bureau of Labor Statistics, Census Bureau, and Esri GIS database. The independent variables that were tested as explanatory factors fell into seven categories, each with a hypothesized behavioral impact, as noted here.

- *Level of traffic activity.* Projects with higher levels of AADT (traffic count) or VMT (total vehicle miles traveled) 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 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 and 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 additional 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.

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 "multicollinearity" 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.

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

Table 5.1. Regression Results: Factors Affecting Job Impact

Project-Setting Combinations	Statistically Significant Explanatory Variables *(those with more than 90% statistical significance)*	R^2_{adj}
Rural setting, point-to-point, and roadway projects	• Level of traffic activity (VMT) • Market scale (population size) • Underlying economy: per capita income growth trend • Economic health (per capita income level)	.70
Metro and mixed setting, roadway projects	• Level of traffic activity (AADT) • Project scale (lane miles) • Urbanization (population density) • Market scale (population size) • Underlying economy: local population and job growth trend	.81
Metro setting, roadway projects	• Level of traffic activity (AADT) • Project scale (lane miles) • Urbanization (population density) • Underlying economy: local population and job growth trend	.91
Mixed setting, roadway projects	• Level of traffic activity (AADT) • Project scale (lane miles) • Urbanization (population density) • Market scale (population size) • Terrain (mountain terrain)	.91
Urban setting, point-to-point projects	• Economic distress (dummy variable) • Underlying economy: regional job and income growth trend	.58
Rural and mixed setting, point-to-point projects	• Level of traffic activity (VMT) • Urbanization (population density) • Underlying economy: regional and local income growth trend • Economic health (per capita income level)	.88

Table 5.2. Regression Results: Limited to Factors Known Before Construction

Project-Setting Combinations	**Significant Explanatory Variables *(preproject knowledge only)***	R^2_{adj}
Rural setting, point-to-point and roadway projects	• Project scale (lane miles)	.42
All settings, roadway projects	• Level of traffic activity (AADT) • Project scale (lane miles) • Urbanization (population density) • Market scale (population size)	.41
Metro and mixed setting, roadway projects	• Level of traffic activity (AADT) • Project scale (lane miles) • Urbanization (population density) • Market scale (population size)	.35
Mixed setting, roadway projects	• Level of traffic activity (AADT) • Project scale (lane miles) • Urbanization (population density) • Market scale (population size) • Terrain (mountain terrain)	.91
Rural and mixed setting, point-to-point projects	• Level of traffic activity (AADT) • Project scale (lane miles)	.61

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 preproject socioeconomic factors are used as explanatory variables. Although 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 T-PICS web tool.

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 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.

Although 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 research 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 were 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 traveled). 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.

Previous statistical analysis, shown in Table 5.2, showed that we can explain 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. For example, projects in metropolitan areas are more likely to be implemented to reduce congestion than to have a primary objective of creating jobs. In addition, 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 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 as much as 55% of the variation in jobs generated by all projects.

To gain a second perspective, the data set was split into "roadway" projects (which do not have a specific destination point) and "point-to-point" projects (which 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 5.3. Relationship of Project Cost and Job Impact (Dependent Variable Is Job Impact)

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

* Statistically significant with better than 90% confidence level.

Table 5.4. Relationship of Project Cost and Job Impact by Project Class (Dependent Variable Is Job Impact)

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

* Statistically significant with better than 90% confidence level.

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. In contrast, continuous roadway projects may be created to relieve congestion, in which case there is a less pronounced job impact, 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 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).

Table 5.5. Relationship of Project Cost and Job Impact by Urban Setting (Dependent Variable Is Job Impact)

Urban Setting	Dependent Variables	*T*-Score	R^2_{adj}
Metro or mixed	• Constant term • Project cost	3.56* 7.82*	.44
Rural	• Constant term • Project cost	1.41 4.76*	.50
Metro or mixed	• Constant term • VMT • Project cost	2.41* 3.85* 7.73*	.53
Rural	• Constant term • VMT • Project cost	1.05 4.10* 5.86*	.71
Metro or mixed	• Constant term • AADT • Project cost	2.09* 1.35 7.63*	.45
Rural	• Constant term • AADT • Project cost	1.0 0.04 4.64*	.47
Metro or mixed	• Constant term • AADT • Length • Project cost	1.37 1.55 1.53 7.11*	.46
Rural	• Constant term • AADT • Length • Project cost	0.82 –0.26 3.94* 5.72*	.69
Metro or mixed	• Constant term • Length • Project cost	2.81* 1.33 7.37*	.45
Rural	• Constant term • Length • Project cost	0.87 4.02* 5.86*	.71

Note: Sample size: 77 metro or mixed projects, 23 rural projects.
* Statistically significant with better than 90% confidence level.

Calculations in T-PICS Web Tool

The T-PICS 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 previous cases, given a specified type of project and setting (the "My Project Tools" feature). This latter feature is enabled by using 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 here.

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 T-PICS system estimates typical baseline traffic level (in terms of AADT) 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 cost values if 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 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 on regression results described in this chapter. The total impact is calculated by applying applicable input-output economic multipliers for each study area.

User Adjustments

T-PICS users may adjust five factors, which will lead to recalculation of the estimates of impacts on jobs, wages, and output. They are the following:

- Project length (miles);
- Project baseline traffic level (AADT);
- Infrastructure conditions (including water, sewer, telecom, broadband);
- Land use and development policies; and
- 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 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 (because 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. 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 T-PICS 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 settings	–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 U.S. 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 U.S. highway projects had a predicted value within 1 standard deviation of the actual (observed) impact (Table 5.7).

Table 5.7. Percentage of Cases with the Predicted Job Impact Accurate within 1 Standard Deviation of Observed Impact

Project Type	Percentage of Cases Accurate Within 1 Standard 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**[a]

[a] The analysis excluded intermodal terminals, international projects, and mega-projects.

CHAPTER 6

Lessons Learned for Case Study Interpretation

Types of Benefits and Impacts Covered

The 100 case studies (listed in Table 6.1) are a source of empirical data on project characteristics and impacts, as well as considerable qualitative information obtained from interviews with local public-sector 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.

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, business output, and changes in building construction and land values. But that is far from all of the aspects of economic impact that might result from a transportation investment. The case studies 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 because changes in jobs, wages, building construction, and land values often do not move proportionally at the same rates.

Travel efficiency benefits have clearly been realized for some projects in the database, such as major highway investments that span long corridors (e.g., Interstates 16, 26, 27, 29, 68, 81, 86, and 476, and Appalachian Corridors B, D, J, and Q). Many of the intermodal freight projects also have wide-reaching economic impacts (e.g., Ayer Intermodal, Auburn Intermodal, Global III Terminal, World Port at DIA, Fairburn UP Intermodal Yard, Port of Huntsville, Tchoupitoulas Corridor, and Alliance Intermodal Logistics Park). Other tools, such as transportation and economic models, are needed to calculate the potential economic efficiency benefits of these types of investments.

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 disbenefits often evaluated as part of the environmental impact assessment of transportation investments. Although 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. In addition, 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, and industrial), number of housing units, or dollars of investment. Changes in property values provide another measure of the economic impacts of the transportation investment. The T-PICS database includes information on both investment and property value impacts for many of the case studies, although data were not available in all instances.

Table 6.1. List of Case Study Projects Sorted by Project Type

Project Name	ID	Location	Project Type
Hammondsport	1	N.Y.	Access Road
Clermont County Industrial Park in Miami	11	Ohio	Access Road
Cattaraugus Economic Development Zone Infrastructure	12	N.Y.	Access Road
Carolina Factory Shops Infrastructure	13	S.C.	Access Road
Columbus–Lowndes County Riverside	14	Miss.	Access Road
New Phalen Boulevard Corridor	79	Minn.	Access Road
State Route 126, Fenton Lake Bridge	84	N.M.	Access Road
Richmond, Virginia, I-295 Bypass	6	Va.	Beltway
Appleton, Wisconsin, Route 441 Bypass	32	Wis.	Beltway
Fort Wayne, Indiana, I-469 Bypass	33	Ind.	Beltway
Danville, Virginia, I-785 Bypass	35	Va.	Beltway
Beltway 8 Houston segments	36	Texas	Beltway
E-470 Denver	40	Colo.	Beltway
Arizona Route 101	57	Ariz.	Beltway
I-476 Blue Route	90	Pa.	Beltway
World Trade Bridge	7	Texas	Bridge
Oresund Bridge	39	Denmark, Sweden	Bridge
Gene Hartzell Memorial Bridge	76	Pa.	Bridge
Third Bridge (Route 3)	78	Maine	Bridge
Missouri Route 370 Bridge	80	Mo.	Bridge
Isle of Palms Connector (SC-517)	85	S.C.	Bridge
Neuse River Bridge	87	N.C.	Bridge
Lexington Bridge between I-5 and SR-411	94	Wash.	Bridge
Potato Hill Bridge	95	Wash.	Bridge
Lake Natoma Crossing Bridge	96	Calif.	Bridge
Yass Bypass	3	Australia	Bypass
Karuah Bypass	15	Australia	Bypass
Eastern Washington—SR-195 Bypass	16	Wash.	Bypass
Fort Atkinson Bypass	17	Wis.	Bypass
Verona Bypass	18	Wis.	Bypass
Stonewall Bypass	19	Okla.	Bypass
Wichita Northeast Bypass	20	Kans.	Bypass
Hollister SR-156	44	Calif.	Bypass
Sonora and East Sonora SR-49 and SR-108	45	Calif.	Bypass
US-400 Parsons Bypass	46	Kans.	Bypass
Georgetown Bypass	47	Ky.	Bypass
Mercer County US-127 Bypass	48	Ky.	Bypass
Bennington Bypass, VT-279	77	Vt.	Bypass
US Highway 281, San Antonio (Extension)	5	Texas	Connector
I-705 Connector	31	Wash.	Connector

(continued on next page)

Table 6.1. List of Case Study Projects Sorted by Project Type (continued)

Project Name	ID	Location	Project Type
Branson West (Ozark Mt. Highroad)	49	Mo.	Connector
Southern Connector	50	S.C.	Connector
Ted Williams Freeway	56	Calif.	Connector
Topsham Bypass/Connector	75	Maine	Connector
US-460	86	Va.	Connector
US-25 Kentucky	93	Ky.	Connector
Auburn Intermodal Center	61	Maine	Freight Intermodal
Devens Intermodal Rail Terminal	62	Maine	Freight Intermodal
Global III Intermodal Terminal, Rochelle	63	Ill.	Freight Intermodal
Fairburn CSX Industry Yard, Fairburn	64	Ga.	Freight Intermodal
Huntsville, Alabama	65	Ala.	Freight Intermodal
Tchoupitoulas Corridor, New Orleans	66	La.	Freight Intermodal
Logistics Park—Alliance	67	Texas	Freight Intermodal
Bayport, Texas	91	Texas	Freight Intermodal
World Port at Denver International Airport	92	Colo.	Freight Intermodal
CenterPoint Center—BNSF Logistics Park	97	Ill.	Freight Intermodal
I-70 and 110th Street Interchange	8	Kans.	Interchange
Blue Route and Schuylkill Interchange	9	Pa.	Interchange
Commerce Parkway Interchange	21	Kans.	Interchange
I-95 and Route 128 Peabody	42	Maine	Interchange
Freeway Interchanges—Bloomington	51	Minn.	Interchange
Big I Albuquerque	52	N.M.	Interchange
Dallas High Five Interchange	53	Texas	Interchange
I-435 and Nall Avenue/Roe Avenue Interchange	54	Kans.	Interchange
Central Freeway, San Francisco	81	Calif.	Interchange
I-20 Interchange	82	Miss.	Interchange
I-35 and US-290, Texas	98	Texas	Interchange
Veteran’s Parkway, Georgia	99	Ga.	Interchange
Interstate 68	2	Md.	Major Highway
Interstate 29	4	Iowa	Major Highway
Interstate 43	22	Wis.	Major Highway
SR-29	23	Wis.	Major Highway
Interstate 81 (Pennsylvania)	24	Pa.	Major Highway
Interstate 81 (Virginia)	25	Va.	Major Highway
Interstate 16	26	Ga.	Major Highway
Interstate 26	27	S.C.	Major Highway
Interstate 27	28	Texas	Major Highway
Appalachian Corridor B	29	Tenn.	Major Highway
I-515 Henderson	37	Nev.	Major Highway
Central Artery/Tunnel	41	Mass.	Major Highway

(continued on next page)

Table 6.1. List of Case Study Projects Sorted by Project Type (continued)

Project Name	ID	Location	Project Type
Casey Highway (US Route 6)	55	Pa.	Major Highway
Interstate 105/Interstate 110 Interchange	83	Calif.	Major Highway
Anderson Regional Transportation Center	68	Mass.	Passenger Intermodal
Sunset Transit Center, Portland	69	Ore.	Passenger Intermodal
Bellevue Transit Center, Bellevue	70	Wash.	Passenger Intermodal
Tri-Rail Boca Raton Intermodal Transit Center	71	Fla.	Passenger Intermodal
Lindbergh Station, MARTA (Atlanta)	72	Ga.	Passenger Intermodal
DART Station Development	73	Texas	Passenger Intermodal
BART Station Development	74	Calif.	Passenger Intermodal
Arlington Heights METRA	88	Ill.	Passenger Intermodal
Emerson Park MetroLink	89	Ill.	Passenger Intermodal
Appalachian Corridor D	10	W.Va.	Widening
I-86 NY Southern Tier	30	N.Y.	Widening
I-15 Reconstruction–Salt Lake City	34	Utah	Widening
I-70 Glenwood Canyon	38	Colo.	Widening
Santan Freeway: Maricopa Regional Transportation Plan	43	Ariz.	Widening
Appalachian Corridor J	58	Ky.	Widening
Appalachian Corridor Q	59	Va.	Widening
US-75 North Central Expressway, Dallas	60	Texas	Widening
I-394 Minnesota	100	Minn.	Widening

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 occur, and as such they can be used at public meetings to temper unrealistic fears of negative impacts and 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, whereas 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 T-PICS 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 details about each case that are 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, which can influence how the transportation investment affects the economy.

Objectives in the Use of Case Study Information

The T-PICS web tool is intended to help policy makers 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.

T-PICS may also be used as one tool (but not as 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, because T-PICS 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, T-PICS cannot provide the level of detail and location-specific analysis necessary to accurately measure potential impacts for individual projects. For both alternative 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 in estimating productivity and efficiency impacts, as well as indirect and induced impacts.

T-PICS 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 give audiences a realistic understanding of the likely range of potential impacts of a project.

The tool also can be 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 in greater detail in Chapter 7.

Appropriate Use of the Database

The case studies show that the economic development impacts of transportation investments depend on myriad 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, as explained in the following seven statements of strengths and limitations.

1. *T-PICS 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. The US-25 Kentucky (Dry Ridge Connector) project illustrates this point. The 2.2-mile connector was built for two reasons: (1) to take truck traffic off the downtown streets of Dry Ridge and (2) 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. Although 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, Maine, and US Route 1, a heavily traveled tourist route. The economic development impacts of the roadway in Topsham are easily measured because 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 interregional economic benefits in a growing corridor. The Blue Route has had some 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 impacts 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. 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 affected 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, interregional business, or accessing an expanded labor pool. For example, the Henderson (Nevada) 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 twofold. 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. Second, 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 the airport extension line of the Bay Area Rapid Transit (BART), development of affordable housing around stations was a prominent goal. This goal has been achieved. However, because nonprofit 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 and 110th Street Interchange in Kansas City, Kansas, 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 an 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 individuals 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. Although the numbers reported in the database have been adjusted to reflect that not all the development is attributable to the highway interchange, it is impossible to fully separate out the impacts because 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 improved significantly.

The I-70 and 110th 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 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, for which "smart growth" concepts often are part of predevelopment planning. In the latter cases, sometimes communities are more interested in long-term land use considerations than more immediate economic impacts.

4. *T-PICS provides before and after comparison for specific points in time and thus may miss impacts that happened earlier and those that have yet to be realized.*

The before and after impacts included in the T-PICS 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 the fall of many dot-com industries in 2000) may mask some of the earlier positive impacts of older projects. Examples in which 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, Massachusetts.

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 after September 11, 2001, and the real estate market collapse 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 World Port 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 T-PICS. 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, more than 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; 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 been affected by changes in the regional economic climate. The 47-mile road was built through rural communities east 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 real estate collapse of 2007, and a period of recession in the ensuing years. 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 and 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, the project 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, Oregon, 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 suburban in character, and at the time the station opened (and continuing to today), the market for higher-density housing and mixed-use development had 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, the development will support regional land use goals.

6. *Data for more recent projects are easier to collect and potentially more accurate than data collected for older projects.*

It is much easier to accurately capture the economic development impacts of 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 more than 20 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. Furthermore, 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 primary 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 Route 101 in Phoenix, and the Dallas High Five Interchange.

CHAPTER 7

Lessons for Future Project Planning

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 giving both a project history and a project impact analysis, most of the 100 case studies offer 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 the case studies and identified seven common themes that affect the nature and magnitude of economic impacts. They are organized under two categories.

- Land use policies and conditions
  - Consistency with land use policies;
  - Zoning and site preparation; and
  - Real estate market conditions.
- Proactive government actions
  - Promotion of a shared vision among stakeholders;
  - Interagency coordination and consensus building;
  - Effective integration with larger public investment and development efforts; and
  - Complementary targeting of economic development efforts.

Land Use Policies and Conditions

Connection Between Highways and Policies in Shaping Land Development

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 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 successful case studies described below, these impacts have largely been anticipated and planned.

- A prime example is in the city of Verona, a suburb 10 miles southwest of Madison, Wisconsin. 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 Highways 151 and 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, Wisconsin, 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 Route 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 Route 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. Route 101 fueled 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 Route 101 corridor.

- Arizona Route 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 such as Chandler and Gilbert has been fueled.
- 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, Wisconsin, the Neuse River Bridge that bypassed downtown New Bern, North Carolina, and the Third Road Bridge in Augusta, Maine, 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.

Impacts of Zoning and Site Preparation on Economic Development

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 effective way to control the development outcome is 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, although 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, Vermont Route 279 Bypass is an example of a bypass case in which planning authorities did not want to encourage growth along highways. 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, Wisconsin Bypass, was to encourage investment in the city's historic Main Street downtown district, which has proved 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 district have doubled since 2000 to $22.8 million (as of 2010).
- Cattaraugus Access Road in Olean, New York, demonstrates what can happen when land sites near freeways are made more accessible for development. The project was a new two-lane, 2-mile 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 and 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.
- Phelan Boulevard in St. Paul, Minnesota, is a new 2.5-mile urban access road built along a blighted rail corridor. The road 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; the sites 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, Illinois, 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 limited new economic development. The project led to a 170-mile section of US-50 connecting I-77 in Parkersburg, West Virginia, 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, Georgia, is a case in which benefits have occurred in transportation time savings for trips to Savannah's southwestern periphery. However, the new, 6-mile parkway has not yet had a discernible impact on adjacent land use or economic development, largely because wetland conditions and noise from aviation flight paths hinder building on surrounding sites.

Real Estate Markets 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 thus generate new jobs) most quickly in areas where there is a 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 Route 101 in Phoenix, a 62-mile beltway through semirural 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 East Phoenix became bedroom communities for these cities, linked by Route 101.
- The I-295 Bypass in Richmond, Virginia, passes through Henrico County, where the median income is 75% of the metropolitan average. This area attracted most of the new commercial development along the route because it had the strongest real estate market. The 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 the affluent western suburbs of Minneapolis 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 more than 3,000 jobs in small retail establishments, it gained 12,500 positions in other service sectors for a net gain impact of more than 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, Texas. 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 had virtually no impact on development in its vicinity because of the city's lagging economy. This project demonstrates that congestion relief alone does not necessarily generate new jobs and investment in the vicinity of the project.
- Interstate 105 connecting Los Angeles International Airport (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 Central Los Angeles, which was exacerbated by the 1992 riots that occurred shortly before the project was completed.

Proactive Government Actions

Promotion of a Shared Stakeholder Vision

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 a development vision is in place.

- The case of Tri-Rail Boca Raton Transit Center in Florida shows how failure to achieve an initial consensus of key stakeholders can delay development. The city, 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 more than 1 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.
- In contrast, the Neuse River Bridge in New Bern, North Carolina, had a clear vision of project goals and desired outcomes on the part of planning agencies and the community. The bridge was relocated from historic downtown New Bern, where it was choking the Victorian street pattern, to a site out of town, eliminating congestion, which 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, Minnesota. 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. That effort 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 more than 2,000 well-paying jobs.

Interagency Coordination

Intermodal centers have particularly high needs 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 and the applicable freight rail or rail transit operating organizations. The other level of coordination is among stakeholders in land and building development, including 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, Illinois, 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 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, rather than against, CSX. They organized the South Fulton County Community Improvement District (CID) to identify, prioritize, and provide funding for transportation improvements to accommodate the additional traffic and abate inconvenience for area residents. 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.

Integration with Larger Projects

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

- BNSF Railroad Logistics Park Chicago (LPC) in Elwood, Illinois, 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 Economic Development Administration 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, $1 billion has been invested by 10 firms that 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 as many as 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 Real Estate donated land and engineering studies for a new $6.8 million highway connecting the industrial park with the Intermodal Yard. Within 8 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 subregion of the northwest Dallas–Fort 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 more than 200 acres of new park land. The project led to dramatic expansion of residential and office construction in formerly isolated and cutoff areas of the downtown waterfront and seaport district, adding 29,000 jobs, which is projected to grow to 50,000 as planned projects are completed.

Targeting of Projects to Specific Industries

Some transportation projects are designed to meet the needs of specific industries that are already growing and have proved 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, Kansas, was built as part of a package to retain Sprint in the Kansas City metro area, by accommodating the company's expansion needs. The project also attracted other large development projects that altogether supported another 17,500 jobs.
- Other transportation projects have been built to support tech industries, with notable results. The US-460 Bypass in Blacksburg, Virginia, provides a direct connection between I-81 and Virginia Tech University. The 10-mile 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 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, South Carolina, metropolitan area, supports 2,800 jobs in tourist-serving industries on the mainland side of the bridge, where sites are available.

Lessons Learned

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. These elements can include actions such as zoning policy, investment in complementary sewer/water infrastructure, and project planning integrated with broader public investment and private development efforts.

CHAPTER 8

Conducting Future Case Studies

The T-PICS system has been designed to allow practitioners to add new case studies to the database. This chapter provides guidance on how to conduct such studies.

Data Collection

Review of Similar Cases

The T-PICS database includes 100 case studies of projects throughout the United States and abroad. Reviewing cases in the system before conducting new case studies can help the researcher identify potential sources of background information and 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 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 aaroads.com and state DOT websites, as well as local economic development agency websites.

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 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 websites should be recorded for entry into the system.

Quantitative (Empirical) Data Collection

T-PICS includes empirical data for each case study. Those adding new cases to T-PICS will need to collect background demographic and economic data on a local, regional, and statewide basis to populate the database. Such data usually can be collected from published sources. The researcher may not be able to fill in all fields; that is all right, although researchers 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 representing 1 year before construction and 5 or more years after project completion.

The specific empirical data to be assembled were defined in Chapter 3, and categories of project types were defined in Chapter 2. Data sources are listed in the Data Dictionary and in a supplemental spreadsheet table, which are both available on the T-PICS website (http://transportationforcommunities.com/t-pics; click About T-PICS). Additional notes and pointers are provided here.

- *Impact area.* The impact area typically is 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.* Measures 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 representing conditions before and after the project. Items (f) and (g) describe activity occurring between the two points in time. All may be measured at the local, county, and state levels.

- *Time periods.* "Preproject" data are collected for the year before construction begins and "postproject" data for at least 3 years after project completion. The postyear selection may depend on the project type. The full economic effect of an access road may take only 2 years to be observable, while the full effects of an interstate may take 5 to 10 years.
- *Employment.* Employment 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). This information 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

Although 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 developers), as well as review available local documents. The purpose of the interviews should be to develop a coherent narrative describing the planning, implementation, and results of the project.

A list of basic interview topics was presented in Chapter 3. Questions do not need to be followed verbatim; they are simply guidelines for the types of information to be collected. Interviews generally are more effective if they are conversational, as opposed to asking a numbered series of questions. Thus, interviews should start with an explanation regarding the 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.

Analysis

Net Economic Impact

Net economic impact is calculated as the change in employment or other impact metrics between a preproject year and a postproject 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 additional comparisons of how local changes differ from the effects of underlying trends and business cycles that also affect broader state and multistate 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 economic measures before and after construction. 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 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 versus 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 for the surrounding area that also accounts for "indirect effects" (growth of other area businesses that supply products and services to the directly growing business) and "induced effects" (growth of other area retail and service businesses due to spending of income by the additional workers).
- The second way is to observe changes in the broader economy of the county or multicounty study areas, in which case total impacts are already being captured.

The likely source for direct impact information is employment data, which can be obtained for multiple points in time by census tract or zip code. (Employment by place of work can be acquired from the census tract files of the Longitudinal Employer-Household Dynamics database [http://lehd.did.census.gov/led] or from the zip code files of County Business Patterns [www.census.gov/econ/cbp].) Local data often can also be obtained on property sales, construction activity, and tax receipts from 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. These estimates are available from sources such as the Urban Land Institute (www.uli.org), which reports on typical ratios of workers per 1,000 square feet of occupied building space. (The 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.)

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 by industry mix. The T-PICS case studies have all used IMPLAN model multipliers that have been customized for the applicable study areas of each of the 100 projects.

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 previous local studies. The narrative should be a relatively brief (3- to 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. The summary 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. The backgrounder 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 the nearest commercial airport, and other transportation features.
- *Project description and motives.* Describe the project (type, cost, and so forth) and why it was built.
- *Transportation impacts.* Discuss the 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 preconstruction and postconstruction data and impacts attributed to the project, such as new firms attracted and retained and changes in employment, land use, and land development.
- *Nontransportation 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.* Compile a list of studies and links to websites used in the case study.
- *Interviews conducted.* Compile a list of organizations participating in the interview process.

Challenges

Although much of the requested data for case studies can be relatively straightforward 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, although certain elements are particularly elusive. This includes information regarding the following:

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

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

Time Series Not Available

Although planning and land use context information often is available in database form, it generally is not 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 and 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. In the United States—and even in individual 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 many forms and from 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. 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 reassessed, then 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 other jurisdictions, 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 although 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 changes 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 subjurisdictional or parcel-level data may not be available. Although some jurisdictions have sophisticated GIS-based database systems and are willing to do specialized data runs, other jurisdictions have basic systems for which subarea data runs would be an overly time-consuming imposition on the assessor's staff.

In the case of the commercial space data discussed above, market and submarket 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 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, nonmetropolitan 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 preceding variables 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 subjurisdictional 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, the challenge becomes clear.

CHAPTER 9

Conclusions and Next Steps

Analysis Results

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

- 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 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 metropolitan 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. Although rural projects take less time to build, job development in rural areas often takes a longer time to mature than in metropolitan 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.

Follow-on Research and Development

From the viewpoint of interviewed stakeholders and the project review panel, the development of case studies and the T-PICS 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 data set 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 nonlinear impacts on economic growth and development, including both threshold effects and scale effects. The results should help to 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, SHRP 2 Capacity Project C11 (Development of Improved Economic-Analysis Tools), has been initiated to build directly on the findings of this project. It seeks to enable an evolution toward 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.

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Related SHRP 2 Research

A Framework for Collaborative Decision Making on Additions to Highway Capacity (C01)

Performance Measurement Framework for Highway Capacity Decision Making (C02)

Linking Community Visioning and Highway Capacity Planning (C08)

Development of Improved Economic-Analysis Tools (C11)