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TPICS TIGER and US Experience: A Focus on Case-based Ex-post Economic Impact Assessment

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Abstract

This paper presents the results of research recently conducted by the authors on ex-post analysis focused on the long-term economic impacts of transportation system investments in the United States (US). For a variety of reasons, the US has had a tradition of making transport investments to address economic development goals and applying ex-post analysis to assess achievement of economic development impacts. These past studies are reviewed, as are some of the deficiencies and suggested improvements in methods for ex-post analysis.

The paper also reviews methods to refine ex-post analysis of economic development in the US via the Transportation Impact Project Case Studies (TPICS) system developed as a national database of land and economic development impact studies. The paper concludes with a series of recommendations for broader distribution and support for the tools and methods developed in TPICS, and an assessment of the challenges facing wider adoption and application of the ex-post analysis in the US context. Specific adoption and implementation issues and opportunities are addressed in the context of the US Department of Transportation's TIGER (Transportation Investment Generating Economic Recovery) discretionary grant program.

1. Introduction: Use of Ex-post Studies to Assess Achievement of Economic Impact Goals

Ex-post (after the fact) analysis provides an important means of learning from the past. In the field of transportation planning, ex-post studies have received particular attention when focused on major investment projects, particularly cases where costs have ultimately ended up being higher and travel benefits lower than originally expected. Yet, ex-post analysis can do much more than simply assess the accuracy of estimated costs, forecast benefits and resulting cost-benefit ratios. It can also be used to observe the extent to which projects achieve desired and intended social and economic goals. Ex-post analysis can also be used on a continuous basis to monitor the long-term performance of transportation infrastructure investments.

In the US, there is a history of establishing specific funding to achieve particular social and economic goals (e.g. safety enhancement, air quality enhancement, poverty reduction, expansion of employment opportunities, neighborhood revitalization (regeneration), and land redevelopment in target areas). The federal government has had designated funding programs aimed at projects to achieve each of these above-cited goals (Weisbrod, 2000; US Department of Transportation, 2013). The states, which generally prioritize projects based on forms of multi-criteria analysis, often explicitly incorporate similar goal elements into their rating criteria (Weisbrod, 2011).

Using results of ex-post analysis of economic development impacts

There is a critical difference between ex-post and ex-ante studies of economic impact. Simply stated, forecasts of economic development impact that are included in ex-ante analyses are typically based on economic models accompanied by the simple caveat that they do not cover unforeseen circumstances that may affect future economic growth in a given study area. In contrast, ex-post evaluations face the much harder task of actually distinguishing the net effect of the transport investment from those very unforeseen circumstances that were so conveniently dismissed as unmeasurable in the ex-ante studies. That reality has caused much of the US experience with ex-post analysis to focus on whether or not it is possible to extract "lessons learned". These pertain to ways that future project design, implementation and/or impact forecasting may be improved by better identifying and anticipating risk or vulnerability to exogenous factors (that can accentuate or minimize actual economic development impacts).

Stepping back, it is useful to contrast this approach to ex-post analysis with the greater effort made in many European studies that have concentrated more effort on validating benefit-cost methodologies and assessment outcomes – for a variety of performance outcomes (Louwa *et al.*, 2013; Kjerkreit, 2008; Chapulut *et al.*, 2005; Braathen and Hervik, 1997; Florio and Vignetti, 2013). The US emphasis has been more targeted at economic impacts specifically, and tends to be more interested in developing planning insights; while less focused on assessing investment criteria. The objective for many of the US studies has been to help identify factors that mitigate negative and accentuate positive potential impacts of different types of transportation investments.

Many of the past US case studies were originally commissioned to support future project development strategies by learning from past experience. For example, when the Pennsylvania Turnpike was considering constructing an interchange with a major interstate highway, the Pennsylvania Turnpike Commission funded a set of ex-post case studies of other built interchanges to identify how they affected the economic development of their local communities. The study found that changes in accessibility from the completion of a new interchange between major highways did generate development pressures in the area around the interchange, but that actual outcomes varied widely and were shaped more by land use limitations and regulations, local road network capacity, and development incentives (Wray *et al.*, 2000). Similarly, when the City of Roanoke (Virginia) was considering whether a new interstate highway should be routed through the city or bypass around it, it funded a set of ex-post case studies of economic impacts in other cities that had new highways built (EDR Group, 2000).

There is particularly rich literature of ex-post evaluations of highway bypasses in the US. In contrast to larger corridor programs, bypass and interchange projects can be easier to evaluate, as their impacts tend to be visible local land use and development impacts. The bypass studies compare the levels of business activity in town centers, before and after the construction of the bypass highway segments. Studies have been conducted throughout the US: in Wisconsin (Wisconsin DOT, 1998), Kansas (Burress, 1996), Iowa (Anderson and Otto, 1991), Washington State (Gillis and Casavant, 1994), Texas (TTI, 1995), North Carolina (Blackburn and Clay, 1991), and elsewhere (Collins and Weisbrod, 2000). As an example, California DOT chose to build on this experience with bypass case studies when the agency was considering its policy on rerouting local highways around smaller communities, it chose to commission a meta-analysis of those bypass case studies (System Metrics Group *et al.*, 2006).

The goal of encouraging economic development has historically been (and currently still is) a major motivation for a large share of transportation investments in the US; this applies to everything from funding for major programs to funding for individual projects. There are a variety of different examples of transportation investment programs to achieve economic development goals – particularly programs and projects aimed at helping to expand local and regional economies. National programs such as the TIGER (Transportation Investment Generating Economic Recovery) program have sought to "jump start" the economy in areas of high unemployment (US DOT, 2014). The program rules aim to focus funds on creating both immediate construction jobs and also greater long-term job growth in those areas. Longstanding programs such as the ADHS (Appalachian Development Highway System) have been funded to reduce isolation in an eastern US mountain region where the closure of coal mines and other extractive industries left pervasive unemployment and little access to markets. Looking back as far as fifty years ago, to the time that the interstate highway system was designed and funded to provide a new form of network connectivity to link urban markets across the nation, there has been a widely recognized link between transportation infrastructure investment and economic development (Pfeiffer, 2006). Common to all of these programs is the fact that transportation system investment was assumed to be the primary – and often the only – major investment required to achieve long-term social and economic goals; thereby, fostering a shift in economic activity patterns. None of these transportation investment programs were justified solely because they would reduce user travel costs for traffic moving between existing origins and destinations.

Perhaps the reason why travel time savings was not used as justification is because of the nation's large size and constantly evolving population and economic patterns, which over time led to congestion and fast growth in some areas, while other previously thriving areas became relatively isolated and poorly positioned for newly evolving forms of economic activity. The result, though, has been a continuing set of transportation investment programs and projects aimed specifically at helping regional (and sometimes local) economic development by enabling expansion of job markets for area residents, customer markets for area businesses, and inward investment to enable new land development and economic activities to emerge. Over time, there has been an evolving stream of ex-post studies to observe the extent to which those intended goals were achieved; though only a small portion of all transportation investment programs have had such follow-on analysis. Together, these studies constitute a generally coherent trajectory towards broader application of ex-post analysis.

History of ex-post studies examining economic impacts

The documentation of actual (ex-post) economic development impacts of transportation investments goes back to anecdotal studies nearly two hundred years. One of first large scale US transportation projects – the Erie Canal –opened in 1820 to connect agricultural regions in the Ohio Valley with the urban population centers of the eastern seaboard. Follow up ex-post observations made in that era documented a twenty-fold drop in the price of wheat in urban markets, followed by a major movement of population and economic activity to the Ohio Valley (New York State Archives, 2014).

Regional program impacts

Systematic ex-post analysis of the economic impacts of transport investment programs in the modern era goes back at least as far as work documenting impacts of rural interstate highways by Miller (1979). That work examined economic growth rates among rural counties and compared counties through which new highways passed to counties that did not have new highways built. More sophisticated statistical procedures were applied to this same line of inquiry, by Rephann and Isserman (1994) and later Lynch (2007). Those latter studies utilized a time-series, cross-section statistical framework with "matched pair" controls for each affected county. Each county experiencing new highways was matched to another county that had no such highway changes yet was similar in population, economic profile, income level, distance from larger cities and access to interstate highways as of 1959. Both statistical studies found evidence of positive economic growth associated with new highways; the latter study also found differential impacts associated with interstate highways (limited access motorways) as compared to Appalachian Development Highways (that typically do not have limited access).

An alternative methodological approach was undertaken in a 1995 study that tracked changes in regional employment in the Mississippi Delta region, relative to overall national trends, in response to a series of highway, seaport and railroad improvements (US FHWA, 1995). Rather than using statistical controls, the study opted for an interview-based approach to establish causality between transport infrastructure investment and resulting higher rates of employment growth. This was an early example of relying on on-the-ground research to understand the complex relationship between transportation improvements and economic impacts.

National guidance

In 1991, the US General Accounting Office [now known as the US Government Accountability Office (GAO)] issued broad guidance on ex-post program evaluation, which called for ex-post comparison with statistical control for exogenous underlying changes over the time period as well as effort to establish attribution of credit (US GAO, 1991). This GAO guidance was then used when the Appalachian Regional Commission (ARC) funded 100 case studies of the impacts of its local public works (roadway and water/sewer) projects in 2000 and an additional 100 case studies conducted in 2007 (Brandow and EDR Group, 2000; Bizminer/Brandow and EDR Group, 2007). These studies were in response to a finding by the US GAO assessing the lack of information about impact of economic development initiatives implemented by several federal agencies, including ARC (US GAO, 1996). It is interesting to note that those studies found that a significant portion of the cases had a smaller-than-expected economic impact, though others had a higher-than-expected impact leading in aggregate to slightly higher economic impacts than originally expected.

In 2001, the FHWA sponsored development of a guidebook that provided public agencies and private researchers with guidance and standards for documenting the actual ex-post economic effects of highway investments (EDR Group and Cambridge Systematics, 2001). Titled *Using Empirical Information to Measure the Economic Impact of Highway Investments*, the guide offers three prototype designs for empirical studies of the actual economic development impacts of specific highways at regional, corridor and local levels. It includes a discussion of appropriate impact measures, as well as the types of data that can be used to collect information on these measures (i.e. published sources, survey and interview data, and site observation and field work).

This guide recommended methods for ex-post time analysis that included both statistical control comparison and interview methods to determine attribution of partial credit to the transport investment. It also suggested relevant metrics: employment, wages, GDP, land development and building investment. It further noted that economic impacts typically evolve over a period of ten years in a distinct sequence: land values start to rise, followed later by building development, and yet later by observations of job and wage growth. All the while, tax revenues can increase in different ways as a consequence of each of these steps.

Project-specific studies

The US Federal Highway Administration (FHWA) subsequently sponsored two major studies to demonstrate ex-post assessment methodologies. These were studies of the economic and land use impacts of constructing four-lane Highway 29 in Wisconsin (FHWA, 2002) and economic development impacts associated with completion of the four lane expressway and designation of new Interstate highway I-86 in New York State (FHWA, 2003). Both evaluations drew on interviews with local officials and representatives of the business communities in the respective project areas. They both found evidence that expected economic impacts were indeed emerging, though both projects were completed only within five years of the study and it was too soon to definitively determine that they would reach the originally expected economic development impacts.

The FHWA continued to invest in ex-post evaluation. A 2005 study developed "economic histories" of selected rural interstates through ex-post case studies that tracked changes occurring over time in rural and small urban areas that have become connected by the new interstate highways. The study focused on "secondary interstate corridors" – i.e. those interstate highways completed after 1970 that provide regional connections for smaller communities linking to the backbone, coast-to-coast routes (FHWA, 2004). That study found evidence of significant changes in economic and land development for some regions but not others. When changes did occur, the most notable changes were inward investment and relocation of warehouses to enable more efficient regional distribution.

Development of a systematic approach to ex-post studies

Each of the studies described above were undertaken by different organizations for different purposes, but none examined ex-post results in a systematic way that would allow direct comparison of investments across regions using consistent methods of ex-post analysis.

The Second Strategic Highway Research Program's (SHRP2) Program, authorized by the US Congress in 2005[1], recognized the need for systematic ex-post studies focused on examining the economic impacts of highway investments and sponsored research into a systematic approach to ex-post based analysis. The purpose of the research, as stated at the time, was summarized in the original research objectives:

> *"The project objectives are: (1) to provide a resource to help determine the net changes in the economic systems of an area impacted by a transportation capacity investment. The resource should include, in an economic context, impacts on land use, land value, and the environment; (2) to provide data and results from enough structured cases that project planners in the future can use the cases to demonstrate by analogy the likely impacts of a proposed project or group of projects (plan); (3) demonstrate how this fits into collaborative decision making for capacity expansion* (SHRP2, 2007)*."*

A series of research reports were produced in conjunction with this research, as was a set of on-line tools, a database and, subsequently, a set of analytic tools designed to help assess the wider economic benefits of transportation investment (EDR Group *et al.*, 2012; EDR Group *et al.*, 2013). The work products of this research are being transitioned to joint sponsorship of the US DOT's Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO). This transition and the proposed implementation program are discussed later in this paper. The US Transit Cooperative Research Program (TCRP) has funded an extension of the case-based approach to ex-post analysis that is specifically targeting public transport project economic impact assessments. That effort is expected to begin by the end of 2014.

[1] SHRP2 was authorized under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) through federal fiscal year 2009 and extended through March 2015 under a series of continuing resolutions. The total research authorization for all programs under SHRP2 currently stands at USD $232.5 million.

A national database of ex-post studies

Among the many initiatives undertaken by the SHRP2 capacity program's sponsored research, the research sponsored under Program C03 funded development of a national database of ex-post case studies to document the actual, observed economic development impacts of highway investment. The database, as subsequently developed, included a number of prior FHWA case studies, as well as those sponsored or conducted by other groups. In addition, further ex-post studies were conducted to make a more well-rounded coverage of different project types and settings; these new studies also adhered to the FHWA guidance. Now known as TPICS (Transportation Project Impact Case Studies), the on-line database and case study reference system went live in 2013 and it can now be viewed at www.tpics.us.

TPICS was built to support several different uses:

1) Planners can mine the database for examples of applicable projects elsewhere to help establish reasonable expectations concerning the range of likely impacts for proposed new projects. This is "analysis by analogy," and it can be particularly useful for early stage planning when project concepts are being considered but project details have not yet been fleshed out.

2) Case study examples can be cited at public meetings to help limit unreasonably optimistic hopes and overly pessimistic fears about project impacts by noting the range of project impacts that have actually occurred in similar situations.

3) Case study details can aid project design, planning and implementation processes by pointing out factors that have been found to accentuate or mitigate positive and negative impacts.

4) A case study database can allow researchers to conduct broad statistical analysis of factors affecting economic and land development outcomes. That information, in turn, can then be used to improve the models used for ex-ante forecasting of impacts for proposed projects. Furthermore, it can also be used to inform decision-making on transportation program funding.

This perspective of case-based ex-post assessment – to build on lessons learned – can be seen in the TPICS home page, which notes:

> *"The Case Search feature allows you to search for specific types of projects in specific types of settings. So if a specific type of project has been proposed or suggested for your area, you can use this information to inform agency planners and public meeting attendees about past experiences with similar types of projects. The available information includes descriptions of project features and pre/post data pertaining to project impacts on the local or regional economy. It also includes detailed results from local interviews on project objectives, implementation issues and other factors affecting the nature of project impacts. Aerial photos and links to other reports are also provided. Lessons learned from these experiences can be used to improve project design and implementation processes."*

2. The Approach to and Structure of TPICS Ex-post Studies

TPICS sought to establish standards for a national database of pre/post case studies. In doing so, it included requirements for: (a) ex-post impact comparison, (b) coverage of both local and regional level impacts, (c) a wide range of alternative perspectives for viewing and measuring impacts, (d) comparison of local changes over time relative to reference sources such as state and national trends, and (e) reliance on both quantitative data and qualitative observations regarding local economic conditions. In this way, the case studies highlighted the multi-faceted ways in which economic development impacts can occur, depending on the type of project and its setting.

The research program supporting the development of TPICS involved five steps:

- Step 1: Preliminary Research;
- Step 2: Data Collection Design;
- Step 3: Product Design;
- Step 4: Develop and Analyze Case Studies;
- Step 5: Develop User-based Case System and Supporting Documentation.

The first step involved preliminary research and development of the working papers needed to frame the TPICS development effort and also maintain liaison with other SHRP2 Capacity program initiatives that were being conducted concurrently. The working paper reviewed research relevant to the development of case-based ex-post studies and examined past methods used in case study development and ex-post assessments in US experience. The Working Paper produced several recommendations for conducting the study and further research, including the addition of more case studies and expansion to include highways connecting with both passenger and freight intermodal facilities. These two recommendations were included in the final TPICS research and products.

Step 2 focused on the structure of the database and development of the cases. This included defining the parameters used to classify cases (project type, project setting, and data to be collected for each case) and a review of the feasibility of gathering this data. This step in the project included identifying approximately 240 candidate case studies and surveying known information and resources for each. Then the cases were classified according to the likelihood of being able to obtain the necessary information and their ability to contribute the coverage required under the classification system proposed for the study. As a result of these compilations, recommendations were made for the testing and validation of the case study-based approach to be undertaken in Step 4.

Step 3 involved the design of the web-based product. As noted above, the intent was to create a web-based tool that was easy to use and could serve as a reference and source for early-stage assessment of the likely range of long-range economic impacts associated with a particular project type, taking into account its setting, project characteristics and purpose. Efforts in Step 3 focused on design of the user interface and the usability of the system. As part of the design, the ability to extract data from the existing set of cases and to provide a mechanism for adding new cases over time – as users began to develop their own projects and case studies – was determined to be an important element of the system. Figures 1 through 3 show a few of the images of the initial screens seen by users that emerged from the design process. The entire system is available for inspection in the web at: www.tpics.us.

Figure 1 shows the opening screen for the entire TPICS suite of tools and resources. Users can select whether they want to search cases, use the results of the meta-analysis to conduct a preliminary assessment of a project that they have in mind, or consult the various guidelines, handbooks or instructions for use that are linked through the web site. A user's forum and provisions for users to submit new cases are also provided. A feedback button is also included so that those having questions requiring personal interaction can submit an e-mail request to an info hot-line.

shows how cases are selected and displayed. Users simply check a box indicating the type of project they are interested in reviewing and general information about the setting, region of the country, economic conditions and motivation for the project. The database displays all cases that meet their criteria and allows the user to sort, scroll through and select cases that interest them. All information available for each case is downloadable in either a narrative or database (Microsoft Excel) format. In all project types and conditions are selected, allowing the user to view all 100 cases.

Figure 3 shows an example of how one particular case is presented in TPICS. A "thumbnail" sketch of the case appears in the upper left-hand corner. This thumbnail appears when each of the tabs (the horizontal list across the top of the screen) is clicked so that the user has some basic reference information when moving from screen to screen for a particular case. Five sets of information are available for each case:

- Case characteristics – A review of the selection parameters chosen for the case, including its location and cost;
- Setting – A summary of the demographic and economic conditions at the time the project was developed;
- Pre/Post Conditions – A table of eight measures of economic activity prior to project inception and subsequent to its completion and operation (the year of post-construction data were determined based on how each project developed and when the project was considered to have matured to the point that most of the economic impacts were likely to have been attained);

- Narrative (shown in

- Figure 3) – a description of the case, findings, conditions and characteristics that comprise the body of the case study (including a list of resources, data, interviewees and other information such as links to environmental reports specific to the project);
- Impacts – Estimates, based on development of each case, describing the observed effects of the project on jobs, income and output
- Images – Google Maps® images of the project location in active mode so that users can see the project area and zoom in and out to gain street-view perspectives on the location, setting and other information that may be relevant to their assessment of the case.

Step 4 involved development of data for each of the 100 cases, analysis of the database to extract trends, relationships and findings supporting the research project, and the production of the working papers for the project, which appear on the TPICS web site and are available in preliminary form on the SHRP2 Capacity program web site. Development of the cases was tied to the case potential screening carried out in Step 2. Ten projects were selected as test cases. These projects were used to coordinate case development methods, resolve consistency issues that arose as cases were being developed, and as a mechanism for exchange of techniques, successes and failures in gathering data for cases. Regular meetings with the teams developing the cases provided an exchange of ideas and insights into how to address several of the problems in deriving pre-construction information for cases – some of which had been constructed 10 to 20 year earlier. Results of this collaboration on the pilot cases, and subsequent work on the remaining 90 cases produced a set of insights into ex-post case development that are currently being integrated into an on-line course for case developers. The on-line course will be offered to those wishing to contribute new cases to TPICS.

Work on Step 5 produced the final design and population of the database for the TPICS web site and associated documentation. In addition to the technical documentation, design guides for the web site and the 100-case database, a user's guide describing how to use the web site and a handbook for practitioners designed to help users interpret and frame results from the cases effectively and as intended by the developers (e.g. as a preliminary screening tool and NOT as a final analysis of economic impacts) were prepared.

Figure 1**. Introductory TPICS Screen – Case Search, MyTools and Resources**

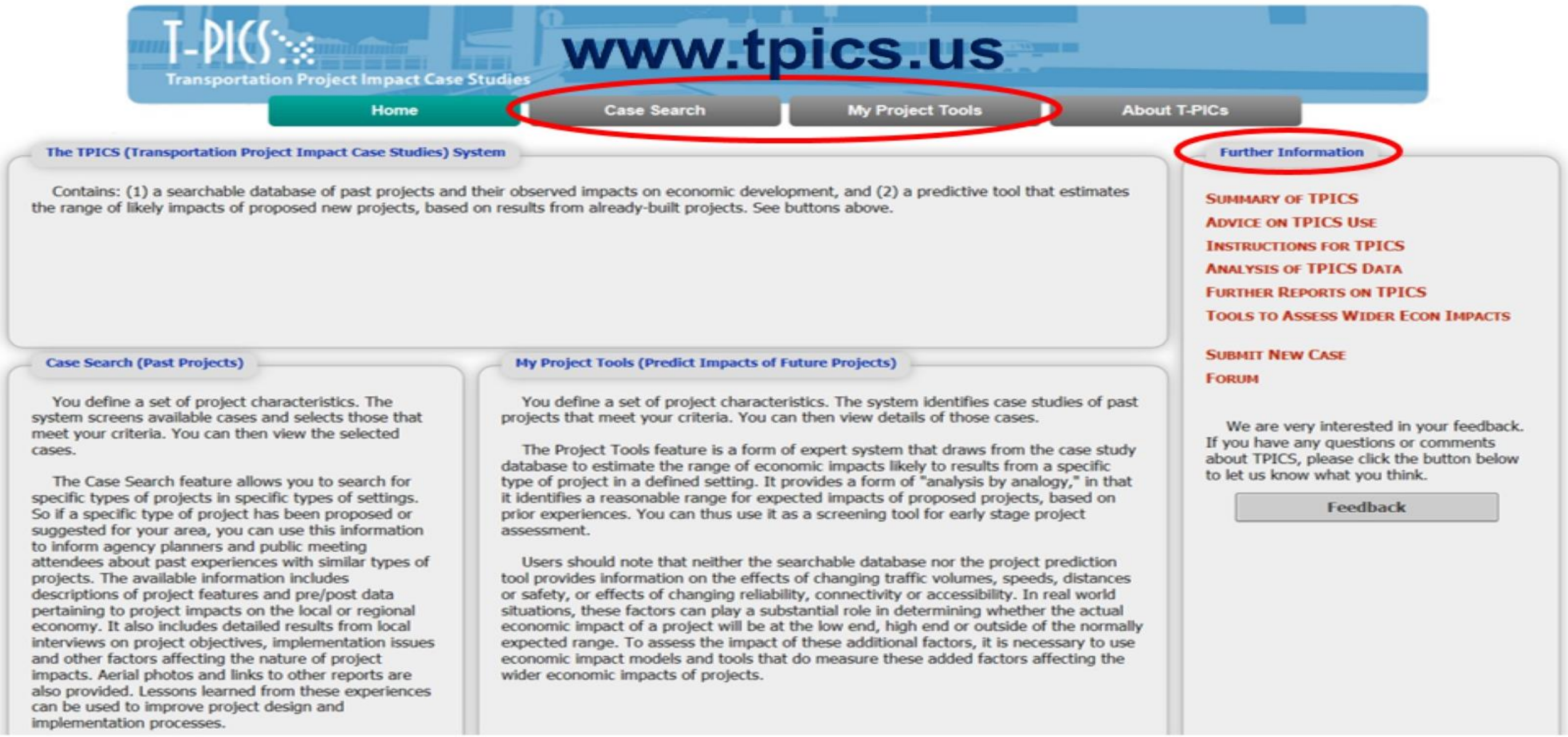


Figure 2**. Results of TPICS Case Search**

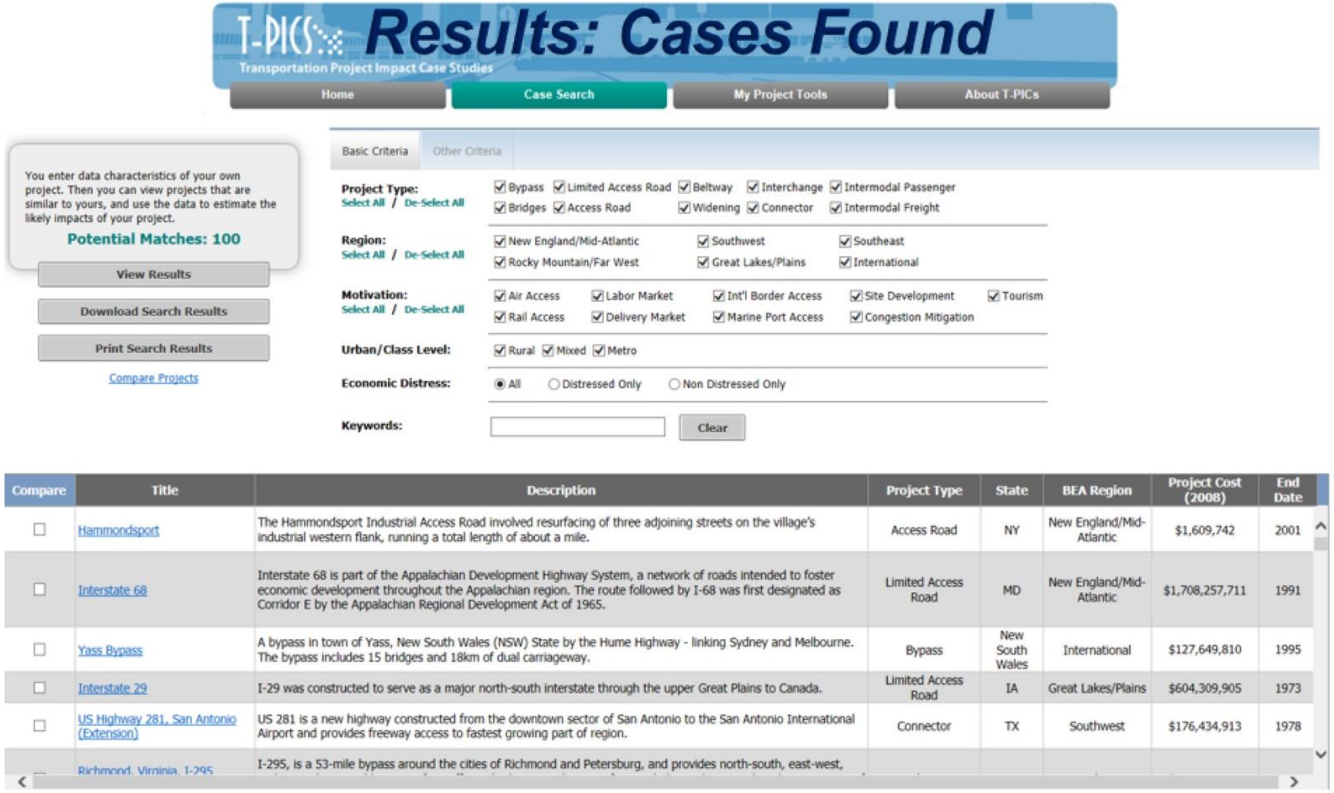
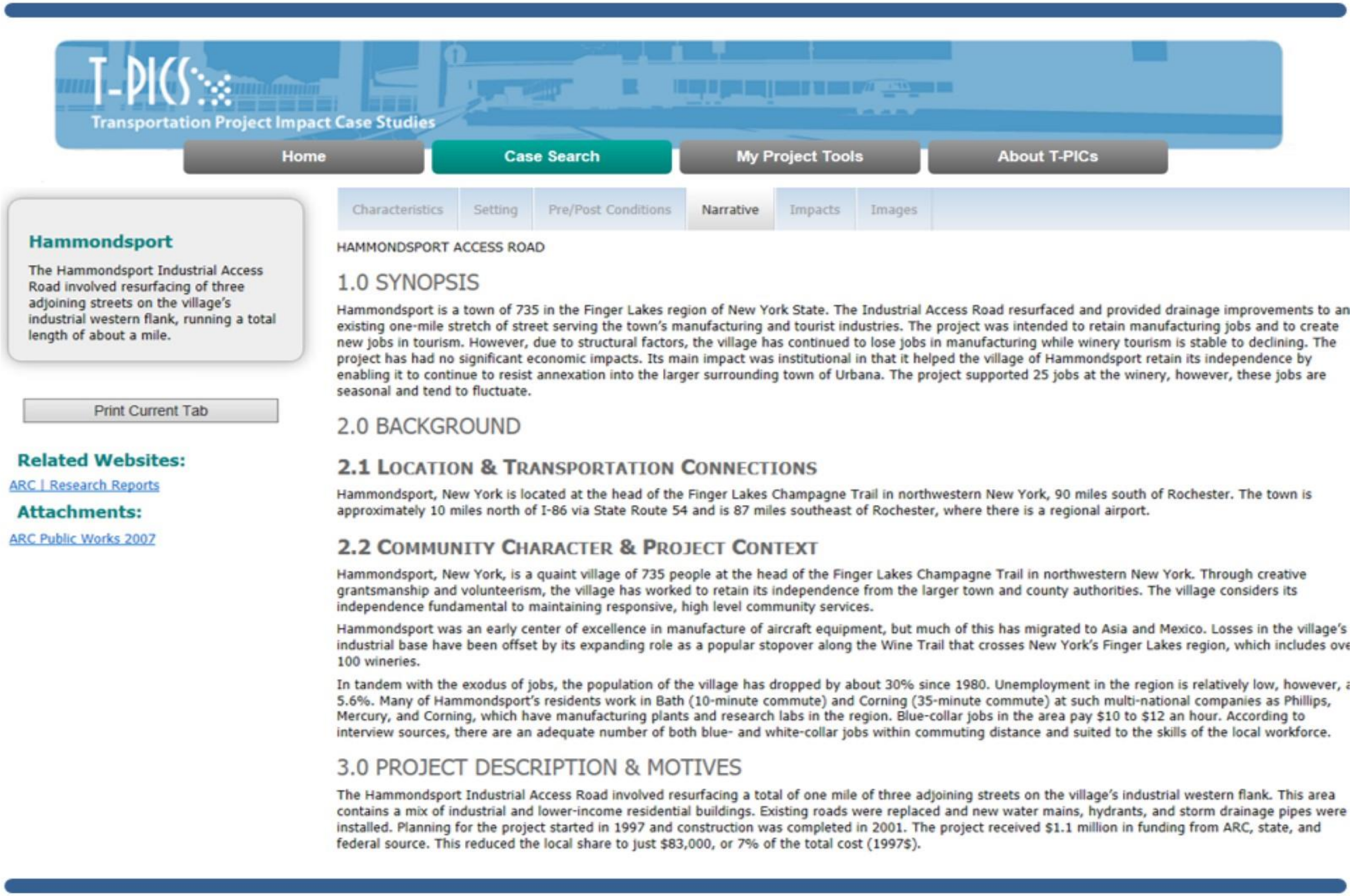


Figure 3. **Sample of Detailed TPICS Case Information**



3. Characteristics of TPICS Case Studies

The TPICS research and deliverables were focused on US highway projects (although a few international projects were included to test the validity of the approach using data from outside the US). As described above, the total number of cases was eventually set at 100, with 11 project types and coverage for most of the broadly defined regions of the US Selecting the cases and designing the data and analytic systems involved a number of choices and careful balancing of the needs of the research versus the available cases and data. Some of the key characteristics of the cases and considerations related to selecting specific locations and data are described below. The key characteristics described below include:

- Project types and locations;
- Data collected;
- Project impact measures.

Project types and locations

The case study dataset was designed to cover the full range of highway-related facilities, including: intercity highways, urban beltways and local access roads, as well as local bridge and interchange projects. In addition, highway/rail projects were included, including: both intermodal freight terminals and intermodal transit terminals. Cases were selected to a cover a wide range of project types, spanning different regions of the US and different types of urban/rural settings and economic distress levels. The initial 100 cases were distributed as shown in Table 1.

The selected projects represented capital investments intended to either enhance access to locations (via new routes and intermodal facilities) or expand effective capacity where it has been adversely affected by congestion or sub-standard operating conditions (via added lanes, interchanges, bypasses or intermodal facilities). These are the types of projects that have claimed economic development objectives. (Other types of highway investment, such as safety projects, were not covered in the case study database because there appeared to be no point in including projects that were never intended to even have any economic development impact.).

Table 1. **Geographic Distribution of TPICS Project Types**

Project Type	US Region						Total
	Great Lakes/ Plains	New England /Mid-Atlantic	Rocky Mtn/ Far West	South-east	South-west	Inter-national	
Industrial Access Road	2	2		2	1		**7**
Beltway	2	1	1	2	2		**8**
Bridge	1	2	3	2	1	1	**10**
Bypass	4	1	3	2	1	2	**13**
Connector	1	1	2	3	1		**8**
Interchange	4	2	1	2	3		**12**
Intermodal Freight Terminal	2	2	1	3	2		**10**
Intermodal Passenger Terminal	2	1	3	2	1		**9**
Major Highway (Limited Access Road)	3	4	1	4	2		**14**
Widening	1	1	2	3	2		**9**
Total	**22**	**17**	**17**	**25**	**16**	**3**	**100**

Source: EDR Group *et al.*, 2011.

Table 2. **Distribution of Settings for TPICS Projects by Project Type**

Project Type	Metro	Mixed	Rural	Total
Industrial Access Road	2		5	7
Beltway	8			8
Bridge	4	3	3	10
Bypass	4	1	8	13
Connector	4	2	2	8
Interchange	10	2		12
Intermodal Freight Terminal	6	1	3	10
Intermodal Passenger Terminal	9			9
Major Highway (Limited Access Road)	5	9		14
Widening	4	3	2	9
Total	**56**	**21**	**23**	**100**

Source: EDR Group *et al.*, 2011.

Data collected

For each of the 100 selected projects, data was assembled to facilitate:

(a) comparison of pre-project and post-project changes in economic and land development conditions;

(b) contrast of observed project area changes with underlying state and national population and economic growth patterns trends occurring over that same period; and

(c) inclusion of both quantitative impact measures derived from available public sources, and qualitative assessments derived from local interviews. Five categories of data were assembled for each case study:

(1) project characteristics – type of transportation facility, years built, cost, size (length, lanes), and level of use (AADT, VMT);

(2) project objectives – congestion reduction or access enhancement;

(3) pre/post change measures – employment, population, land values, building development;

(4) settings – region of the US, population density, urban/rural class, topography, economic distress, market size, distance to key destinations;

(5) local data from interviews – land use regulations, use of business incentives; presence and use of support programs for economic development, other local factors enhancing or reducing observed economic changes.

Project impact metrics

Economic impacts of transportation facilities typically unfold in a sequence, affecting different impact metrics and spatial scales over time, as noted in the FHWA guide to case study measurement of economic impacts.[2] Acknowledging these effects, the SHRP case studies (completed in 2010) were restricted to projects that had been completed at least five years earlier. In addition, the case studies sought to measure land value and building construction effects at the level of highly localized areas, while employment, income and tax impacts were measured for both local areas and larger areas (ranging from individual municipalities to multi-jurisdictional corridors or counties). The case studies confirmed the following typical sequence of impacts:

- *Transportation impact*

Initially, a highway project is initiated to affect travel-related costs or accessibility for some area by enabling faster or more reliable travel to and from that area, or enabling access to a broader set of origin or destination opportunities. The benefitting area may be adjacent to the project, or it may include areas well beyond the endpoints of the project corridor. There are occasionally adverse impacts on adjacent areas, which tend to be offset by benefits elsewhere.

- *Land (property) value impact*

Upon project completion, or in anticipation of it, demand starts to grow for land at benefitting locations, typically leading to higher property values and transaction prices there.

[2] Ibid, EDR Group, 2001

- *Building construction and investment impact*

  Increased demand leads to added investment in the form of building construction. That effect is reflected initially in terms of building permits and later in terms of new or upgraded building structures.

- *Employment, income and output impacts*

  Once buildings are occupied, there can be measurable increases in population or business activity. The latter can be measured in terms of added jobs, income, value added or output growth.

- *Tax revenue impacts*

  The added land value, building structures, population and business activity together can show up as increases in property, income and/or sales tax collections.

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

Quantitative metrics on building permits (square feet), property transactions (sales levels), private investment (value of new development) and incremental tax revenues generated were more difficult to obtain because they typically came from municipal or county records, which differ widely in their format, availability and usability for time series analysis. The most problematic metric was tracking of property value changes over time, due to differences in local valuation rate and updating policies. For that reason, some case studies relied on "qualitative" data sources (i.e. impact estimates reported by local planners and business leaders) for estimates of local changes in property values, building investment and/or property sales patterns.

Table 3 shows the extent to which each of the major categories of impacts was observed or measured in the case study process. All the 100 projects studied had some measurement of its economic development impact. In general, employment change was the measure most easily obtained because of widely available datasets on annual employment changes available at the county, community, and even zip code levels across the US For this study, the measure of employment change reported as a highway impact was defined to be whatever level of geography was deemed most relevant for that project, which varied from local community to multi-county region depending on the project location or corridor length. Actual impacts associated with the project were determined through interviews, field investigations and, where available, consultation of building permits and records.

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Table 3. **Direct Observations of Impact Measures in TPICS Cases**

Measure of Impact	Number of Cases in TPICS Database		
	Qualitative: Change Observed	Some Quantitative Impact Data	Full Quantitative Data in Dataset
Employment	100	100	100
Income	*	*	*
Business Value Added or GDP	*	*	*
Building Development (Sq. Ft.)	74	38	36
Direct Private Investment ($)	57	27	30
Property Values	36	30	6
Property Tax Revenue	50	36	14

* Measures that were calculated (in the database) from employment change ratios.
Source: EDR Group *et al.*, 2011.

Because the projects differed dramatically in their size (ranging from a single bridge or intersection to a 200 mile highway corridor), the corresponding economic development impacts also varied widely. The net employment impact per project averaged 1 355 but ranged from -10 to +93 000. Building development impact ranged from 4 200 to 50 million square feet, private investment over time ranged from USD 3 million to USD 6.3 billion, and annual property tax impact ranged from nil to USD 55 million.

Summary of key findings from case studies

Individual case studies yielded a wide array of impacts and a rich set of narrative findings. The field investigations and interviews supplemented published data and provided insights into the mechanisms by which investments in highway projects contribute to economic development and overall economic growth. However, the methods used in the research conducted for this study also allowed for additional investigations into areas not usually explored when a small number of ex-post studies are conducted. Although the research published in conjunction with this study goes into great detail about the majority of the findings tied to these cases, the following highlight some of the issues that should be explored in greater depth as new cases are developed and as further research into ex-post analysis is conducted. These areas include:

- The role of project motivation and purpose;
- The role of non-transportation factors;
- Projects with no apparent net employment effects.

The role of project motivation and purpose

Project motivations were classified into nine major categories. Eight are related to economic development via enhancement of various types of access. They include: improving access to terminals of air, rail and marine modes, international borders, labor markets, delivery markets, tourism markets, or facilitating on-site development. The ninth is congestion management, which often represents an attempt to prevent further degradation in conditions rather than to enable positive enhancement compared to past or current conditions.

In the case study interviews for each project, both local planning officials and business representatives were asked to identify project motivations (e.g. reasons why the project was built). They were allowed to choose more than one reason.

Table 4 shows the range of motivations by highway, freight intermodal and passenger intermodal projects. Overall, project motivation was obtained for 77 projects, of which 66 were motivated by at least one economic development factor and 11 were motivated by congestion management alone. The motivation to mitigate congestion was most often reported for urban highway projects, while the motivation to facilitate site development was most often reported for interchange and access road projects.

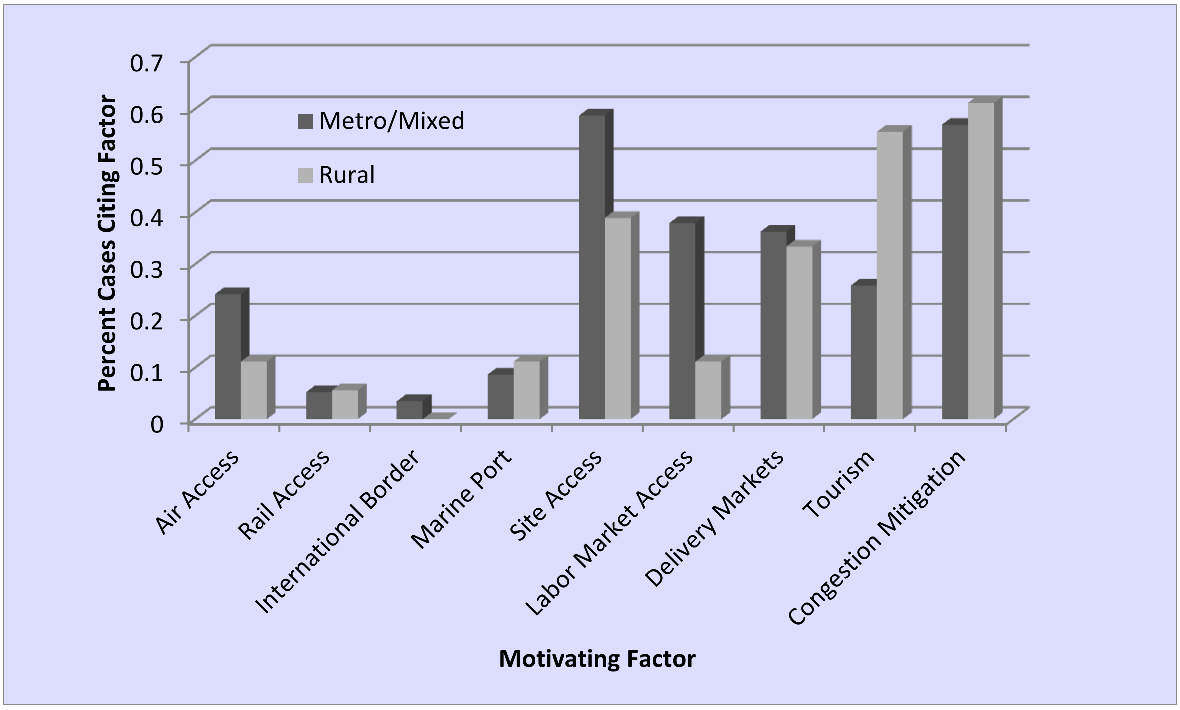
Table 4. **Motivation Reported by Project Category**

Project Motivation	Highway	Freight Intermodal	Passenger Intermodal
Improve Access to Airports	18	2	0
Improve Access to Rail	4	6	0
Improve Access to International Border	2	1	0
Improve Access to Marine Port	7	2	0
Facilitate Site Development	42	2	8
Improve Labor Market Access	26	0	4
Improve Delivery Market Access	29	3	0
Facilitate Tourism	26	0	0
Mitigate Congestion	46	0	7
All Projects Reporting Motivation	**58**	**10**	**9**
Total Number of Projects by Type	**81**	**10**	**9**

* Many projects had more than one motivation, so the column totals in this table will not sum to the total for all projects reporting a particular reason motivating the project.
Source: EDR Group *et al.*, 2011.

Figure 4 shows how project motivation varied by setting. This figure shows that the most common motivation for projects in both rural and metro areas was congestion mitigation. After congestion mitigation, site access and delivery market access were two most frequently cited motivating factors in both metro/mixed and rural settings. Tourism was an important motivator in rural areas and labor market access was a key reason motivating projects in metro/mixed areas.

Figure 4. **Project Motivation by Setting**



* Projects in metropolitan areas and projects in areas where there is a transition from metropolitan to rural (mixed) are grouped together for this chart.
Source: EDR Group *et al.*, 2011.

The role of non-transportation factors

Evidence of economic development for many of the project types was attributable to leveraging project investments with other infrastructure investments, land use policies or business development incentive programs. In some cases, effective synergy among multiple factors created a positive economic development climate that led to job creation or other economic development consequences. Yet in other cases, a lack of complementary infrastructure and supportive development policies led to disappointing economic development results. Table 5 shows the frequency with which these non-transportation factors affecting the long-term economic development impacts were cited in case study interviews.

Table 5. **Non-Transportation Factors that Influenced Economic Growth**

Policy Factors	Factor	Number Reported
Effective Synergies	Infrastructure (sewer, water, broad band, transit, etc.)–positive	33
	Land Use Management–positive	45
	Financial Incentives/ Business Climate–positive	47
Lack of Effective Synergies	Financial Incentives/ Business Climate–negative	5
	Infrastructure (sewer, water, broad band, transit, etc.)–negative	10
	Land Use Management – negative	6

Source: EDR Group *et al.*, 2011.

Projects with no apparent net employment effect

Developers of the case studies found that 15 of the 100 projects led to a zero or negative impact on job growth and economic development. Nearly all were bridges, bypasses, connectors, interchanges or passenger/freight terminals. With the possible exception of intermodal projects, these were generally projects designed more to help manage traffic flow than to generate economic growth. The finding for rural community bypass roads was also to be expected. Past bypass studies conducted for a number of different states have shown that economic impacts are either only slightly positive or negligible in most bypassed communities. That outcome is due to the offsetting positive and negative effects of shifting pass-by traffic out of local communities – which represents a potential loss for some traffic-dependent businesses, but a potential gain for others that benefit from having improved safety and a more attractive urban environment for local residents and visitors.

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

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

4. Issues in Applying Ex-post Analysis – Lessons from the TPICS Experience

Measurement issues

One of the most challenging aspects of casting a wide net in evaluating ex-post impacts for a variety of project types, vintages and locations – even through restricted to highway-oriented projects – is the development of consistent measures that allow for rigorous meta-analysis of case studies. Working with a team of contractors – even those with a great deal of knowledge and background in transportation and case study development – highlighted some of the measurement issues involved in case development. Development of TPICS also highlighted some of the issues related to developing data of the quality and consistency suitable for detailed ex-post research.

Addressing differences in transport mode and project scale

One of the challenges being faced in the development of TPICS has been the issue of how to span across modal and project scale differences. Among highway projects, there are major differences in the scale of impacts between interchange and access road projects that tend to have highly localized development impacts, and major highway (trunk road) projects that can have broad based economic development impacts spanning large regions. While the latter can generate larger total impacts on jobs and income, those impacts can be widely dispersed and, hence, hard to distinguish from underlying economic change patterns. Thus, care is needed to identify the appropriate study area that can enable measurement of post-project impacts. On the other hand, the localized projects can have highly visible impacts on land and building development, but data to measure net job impacts can be more difficult to acquire. The TPICS system thus allows for individual project cases to involve a wide range of economic impact metrics to capture changes in land values, building activity and/or employment related measures. In that system, it is left up to the discretion of researchers to select the most appropriate study area and most appropriate impact measures for each case.

Expansion of project types to include non-highway modes

The expansion of TPICS mid-way through the development of the database to also include public transport projects raised new measurement issues because many of these projects affect either very local areas (in the case of bus and light rail stops) or specialized segments of the economy (in the case of commuter rail lines that affect labor market access for specific destinations). In addition, the sources of information are different, as the economic development impact of public transport facilities may be affected by characteristics such as the time period and frequency of service – factors that do not arise when considering highway impacts. Therefore, the public transport case studies of necessity had be conducted with significant input from public transport operators.

Multimodal/intermodal effects

Measurement issues also become more complex to document when projects have multi-modal consequences – either because the projects lead to mode switching in a corridor or region, or because the projects are intermodal terminals. Projects involving public transport stations or terminals (whether for bus, rail, air or marine modes) are more likely to have land development impacts on the immediately surrounding area, particularly when developed as part of a mixed use development project. Corridor projects are more likely to have broader area consequences, though that can depend on how regional market access and intermodal connectivity change for each affected mode. Freight intermodal projects can affect the supply chain of businesses that are far removed from the facility – in other states or metropolitan areas.

Connection of economic development impacts to wider economic benefits

To further understand how market access and connectivity changes can lead to economic development impacts, the SHRP2 program funded further research to develop tools for identifying wider economic benefits of transport projects, and then tested those tools with TPICS case studies to see how they relate to actual ex-post economic development impacts (SHRP2, 2013). The new tools are essentially spreadsheet models designed to make it easier for planners and evaluators to measure changes in transport factors that have consequences beyond existing travelers and, thus, create opportunities for wider economic development impacts. They include: changes in labor market access, same-day travel access delivery, intermodal connectivity (highway-rail, highway-air and highway-seaport) and reliability for just-in-time business processes. Those tools have been completed and tested, and are now being applied for selected TPICS pilot studies. This line of research may be of particular interest because it offers the potential to document specific drivers of wider economic benefits that are not well captured by "willingness to pay" studies. In addition, this ongoing line of research provides a basis for demonstrating how benefits that are beyond traveler impacts lead to observable economic development impacts in a defined region.

Measurement of construction impacts

Ex-post measurement of economic development impacts usually focuses on long-term economic growth because most transport investments are motivated by long-term objectives. However, there are exceptions. Several recent programs for transport funding in the US have sought to stimulate economic growth in times of economic downturn. The largest was ARRA (the American Recovery and Reinvestment Act of 2009). This program, funded to help spur jobs and wage growth during a recession, subsequently funded nearly 13 000 highway projects and roughly 1 070 public transport project grants in a four year period. Another was the TIGER (Transportation Investment Generating Economic Recovery) grant program.

Both the ARRA and TIGER programs were designed with provisions to ensure accountability and transparency. For the ARRA program, most attention was focused on the documentation of (short-term) construction job generation that was created by the funding of project construction activity. Each of the fifty states was required to collect, compile and submit to the federal government both monthly and quarterly reports on directly-supported construction jobs. A study of the economic impact of ARRA-funded transportation projects reviewed the data submitted by selected states. It found that the states were struggling to document construction job generation because their surveys of directly-contracted construction companies provided complete data only for prime contractors, while information from subcontractors was often incomplete and spotty. As a result the information being reported was inconsistent. Despite these problems, there were some general findings: a national average of 10.55 direct jobs per million dollars, which ranged from 9.01 to 17.03 depending on the type of project and its setting (i.e. explanatory factors such as wage rates, topography and congestion levels).

This line of ex-post research – documenting construction impacts – is of note because it serves a policy purpose totally unrelated to benefit-cost analysis (BCA). In BCA, project expenditures and the associated construction process is all part of the cost and cannot be recast as a benefit. Yet from public policy perspective, the generation of short-term construction jobs was very much a motivation for the program funding, and a case had been made that spurring local construction jobs would do more to "jump start" local economic growth than would the alternative of refunding money to residents so that they could increase purchases of consumer products.

Recognizing urban land redevelopment impacts for "mega-projects"

The Central Artery/Tunnel project in Boston (USA), was the most costly mega project in US history. It represents an example illustrating the complexity of considering costs, benefits and economic development impacts in an ex-post study. The project involved:

(1) demolishing a major elevated interstate highway (I-93) through Boston's central core and rebuilding it underground;

(2) extending another existing highway (I-90) via an underground route through the old seaport (docklands warehouse) district; and

(3) building a new third tunnel under Boston Harbor to the airport (EDR Group, 2006a; EDR Group, 2006b).

The selected option of building all of these facilities as underground tunnels was not the lowest cost option to meet traffic flow requirements. However, that approach was chosen because of a desire by public officials to improve the region's visual and environmental quality, reknit the urban fabric of vehicle and pedestrian routes that had been split by the elevated viaduct, and facilitate new development in on the eastern side of the Central Artery corridor and in the seaport district – areas that had been isolated by the existing elevated highway structure.

Ex-post studies that were carried out after completion of the project found that:

- The final project costs (USD 15 billion) were triple the initial (USD 5 billion) estimates. The reasons for this difference have been debated, but essentially come down to some combination of: (a) lack of allowance to anticipate particularly costly difficulties encountered in the complex underground construction process; (b) lack of allowance for costly changes and additions to the project specification that were added to address later stakeholder concerns; and (c) quality of management oversight.

- The user benefits were fully achieved and in fact were running about 15-20% greater than anticipated. The reason for this difference is that regional traffic growth has actually been occurring at a slightly lesser rate than originally anticipated; this is reflective of slowing national trends of growth in vehicle-miles travelled.

- The urban redevelopment benefits have been more than ten times greater than the level that was originally anticipated. The original pre-project economic study had concluded that Boston's downtown core was largely constrained from further population and employment growth because of the Central Artery highway's capacity limitation. That study had anticipated that the completed project would enable more residential and office development, particularly in areas that had been isolated because of the highway structure, and that was correct. Yet, the actual result in terms of residential and office development was far higher than originally estimated. The reason for this difference may be due in part to the unanticipated growth of Boston's role as a world biotechnology leader, and the unanticipated shift in lifestyle decisions of the new millennial generation that are strongly opting for urban rather than suburban locations for their work and home.

The Central Artery/Tunnel project became infamous in its early years as a failure because of the massive cost overruns, but in recent years a local consensus has emerged that the project also had a massively under-estimated value in creating growth of a vibrant urban core, while also helping to reduce suburban sprawl. Traditional benefit-cost analysis is poorly equipped to incorporate the kinds of structural changes and regional economic development effects such as these.

Case development issues

Experience in developing cases designed to be used in ex-post analysis led the project team into several areas that should receive considerable thought as new rounds of grants under the TIGER program, studies and expansion of the TPICS database, and similar efforts now under consideration by US governmental agencies and organizations are planned. Should elements of the US approach be of interest to other countries, some of methods developed in this project, and many of the insights and lessons learned may useful when developing their own research and development programs.

Methodology

Even with a highly skilled team, the process of looking back in time and the unique circumstances of several of the projects encountered in this study required careful consideration of ways in which historical data needed to be developed. The most common methodological issue arose around ways in which difficult-to-obtain historical data could be reconstructed and sorting out background cyclical effects from project-related effects – especially for projects completed before many of the digitized land use and traffic data systems we currently employ were widely available. Guidance cited previously on the use of interviews, building permits and records, and local knowledge were helpful, but often required skillful interview techniques on the part of the case developer and cross-checking between developers to compare the kinds of responses being received for similarly situated cases and case types. This was especially important given the intended use of the case data in a large-scale meta-analysis.

Consistency

As the project developed, it was important to maintain regular contact amongst the case developers to ensure that guidance was being followed and the various types of problem resolution approaches were being shared. As the project progressed, new guidelines were developed and prepared that expanded on previously published guidance. These guides and “tips” have been compiled into a multi-module course on case study development and are expected to be used as part of the on-going development of new cases.

As noted above in the measurement issues section, there are a number of scale, modal and impact measurement issues that were noted during the development and review of the case studies. At times, some of the issues confronted by the case developers (e.g. resolving inconsistencies between data sources, reconciling information obtained in interviews that differ from available data sources, etc.) required close consultation between case developers and project managers. The key was regular communications and sharing of issues *at the time they arose* rather than after a case was prepared and submitted for review. The high degree of consistency and review used in developing the cases contributed to the utility of the database when used for further research, meta-analysis and design of associated tools.

Identifying the correct counter-factual case

An integral aspect of ex-post analysis is setting a reasonable "base case" or "counter-factual" scenario, against which post-project economic conditions can be compared. There are two critical dimensions to consider:

- Was the project's primary objective (motivation, as described in the TPICS cases):

  (1) To increase access through improvements enabling shorter distance, higher speed, more frequent service and/or cheaper travel costs between certain points (as provided by a new highway route or transit service);

  (2) To maintain an existing facility or service so that it does not degrade or close (as provided by reconstruction or replacement of facilities that face physical or functional obsolescence); or

  (3) To address growing congestion/bottleneck conditions that increasingly constrain capacity and reduce travel time and its reliability (as provided by capacity expansion on existing roads or transit line facilities)?

- Are travel demand and network models available to analyze travel volumes, speeds and conditions under three scenarios:

  (1) Scenario A: Pre-project conditions;

  (2) Scenario B: Post-conditions for the analysis year(s) including construction of the project; and

  (3) Scenario C: Post-project period for the analysis year(s) assuming that the project had not been built?

These dimensions are critical because they affect counter-factual expectations regarding transportation facility or service characteristics (in terms of capacity, distances, speed capabilities, etc.) and the ways that these expectations need to be addressed in evaluation. If the project was intended to improve access or connectivity, then we would expect the counter-factual case (Scenario C above) to be represented by continuation of pre-project (non-improvement) network characteristics (Scenario A). If the project was intended to prevent further degradation of a facility or service, then the counter-factual case for Scenario C would be diminished transportation network performance. However, if the project's primary objective was to mitigate congestion impacts then a special case of counter-factual conditions would apply – a scenario dependent on engineering or transport network models reflecting the effects of increased congestion (reduced speeds) on vehicle flow (reduced through-put) without mitigation measures provided by the project.

The reason for special treatment of congestion-motivated of projects is the existence of a "backward bending supply curve" for speed/flow relationships under congested conditions. This is a phenomenon of traffic flow whereby the volume (as measured by vehicle miles traveled – VMT) that can move through a facility actually diminishes as congestion increases (Walters, 1961; May *et al.,* 2000). More commonly, a congested road with start-stop conditions (occurring when the volume/capacity ratio exceeds 0.8) may be appear to be operating near capacity but may actually moving vehicles at less than half the speed as a road that appears half empty but has traffic moving at near free-flow speeds (such as 80 km/h or 50 mph). As a result of this congestion phenomenon, there are actually two levels of travel demand that can produce the same VMT in a given time period – one with a lower vehicle volume (vehicles/hour) but higher speed (miles (km)/hour), and one with a higher vehicle volume but lower speed. Yet while the VMT appears the same, one supports a higher level of economic activity than the other. (It is worth noting that this same phenomenon can apply for passengers/hour using transit facilities.)

Traffic engineers and travel modelers have recognized this phenomenon in long range studies for both regional plans and individual road links. Traffic models for regions that are economically growing often forecast that the baseline growth in trips will, over time, lead to increasing delays and reduced throughput for major highway facilities (as congestion reduces their functional capacity). They have also forecast that expansion of the physical capacity in highways and transit facilities will enable more growth in user activity and lessen future degradation of traffic conditions, but not necessarily keep facility performance up to pre-project conditions.

A case in point, which is typical for urban transportation plans in many growing metropolitan areas, is the Portland Metro Regional Long-Range Plan (EDR Group, 2005). In that case, regional transportation and economic models were applied to evaluate two policy alternatives for increasing long-term spending on transportation infrastructure. The alternatives included both highway expansion and rail transit investments to increase regional capacity for growth. Under all future scenarios, traffic delays were forecast to worsen compared to conditions at the time of the study, yet the high investment scenario was shown to be beneficial because it would lead to less degradation in level of service (delay conditions) than the lower investment scenario.

An individual project example that was included in the TPICS case studies and has been well documented is Boston’s Central Artery/Tunnel project described above. An *ex-ante* study relied on transportation and economic models to forecast that much of the project’s impact would be avoidance of a major regional bottleneck that would otherwise stunt growth of employment and investment in the city’s central core (MA DPW, 1990). Ex-post evaluation later measured actual pre/post changes in traffic speeds, volumes and economic activity compared to what had been originally forecast in the *ex-ante* study and noted the factors that led to underestimation of the economic effects of investments in congestion mitigation (EDR Group, 2006a).

Analysis of the TPICS case study database showed a related issue concerning ex-post evaluation of congestion mitigation projects. It found that projects intended to improve local access and connectivity often lead to observable changes in land values and business investment adjacent to the project area. However, it found this is less likely for projects intended to mitigate congestion because they tend to affect trip ends that are more spatially diffused and farther away from the project area (EDR Group, 2012). For major highway or rail bottleneck projects, the beneficiaries may even be outside of the metropolitan area.

Thus, when conducting ex-post analysis, care must be taken to: (1) distinguish project intent between projects that are intended to improve conditions and projects that are merely intended to reduce degradation of conditions; and (2) distinguish impact area between projects that are intended to have local benefits and projects that are intended to affect broader trade or inter-regional movements. To appropriately determine project impacts, the counter-factual (base case) scenario must be defined to reflect those differences.

Approach to TPICS Implementation

The TPICS program has been selected as one of the products developed under the SHRP2 research program to advance to implementation on a wider scale. This involves transferring the data, tools and systems developed through the SHRP2 TPICS program to the joint sponsorship of the US DOT’s

Federal Highway Administration (FHWA) and AASHTO (FHWA, 2014). This process, including coordination among all three organizations, is now underway. A series of meetings have already been held and a draft implementation plan has been drawn up for review and funding. Several aspects of the implantation program are of interest given the issues raised during the course of TPICS development.

Pilot studies

A series of pilot studies have been funded by FHWA to permit states and metropolitan governments to evaluate TPICS as a planning tool, and to begin the process of identifying projects that they are interested in developing as new cases for TPICS. Both of these objectives are vital to continued success of the program. TPICS was designed specifically to supplement the early-stage planning process as a way to illustrate how past projects have affected the economy of local and, depending on the size of the project, multicounty regions or states. Testing TPICS using the wide variety of current planning processes will help to identify the practical strengths and weaknesses of the system, the cases and the interface.

The second objective of the pilot program is to test the feasibly of adding new cases to the TPICS database. As noted earlier, once a variety of project types, regions, and settings have been identified, the number of cases needed to frame the range of possible outcomes – even with 100 cases – can be very "thin" (see The selected projects represented capital investments intended to either enhance access to locations (via new routes and intermodal facilities) or expand effective capacity where it has been adversely affected by congestion or sub-standard operating conditions (via added lanes, interchanges, bypasses or intermodal facilities). These are the types of projects that have claimed economic development objectives. (Other types of highway investment, such as safety projects, were not covered in the case study database because there appeared to be no point in including projects that were never intended to even have any economic development impact.).

Table 1). This was evident when the meta-analysis was conducted. Development of case information by a single agency would be cost-prohibitive if several hundred cases are to be added to the database. Therefore, encouraging various levels of government to validate the current methods and contribute new cases could be a very important contribution to both new case development and refinement of the information drawn from the case study database.

The selected projects represented capital investments intended to either enhance access to locations (via new routes and intermodal facilities) or expand effective capacity where it has been adversely affected by congestion or sub-standard operating conditions (via added lanes, interchanges, bypasses or intermodal facilities). These are the types of projects that have claimed economic development objectives. (Other types of highway investment, such as safety projects, were not covered in the case study database because there appeared to be no point in including projects that were never intended to even have any economic development impact.).

The pilot studies were recently awarded to the following organizations (SHRP2, 2014):

- Illinois DOT;
- Indiana DOT;
- Rhode Island Statewide Planning Program;
- UTAH DOT.

Other implementation support

The SHRP2 Implementation Program will continue for several years as outreach and pilots implemented. The Implementation Plan being developed for the program includes several key elements:

- Communications – Promote wider practice and adoption of TPICS and other SHRP2 research products;
- Product Messaging – Focus on data-driven decision support and methods making use of ex-post analysis methods;
- High-Level Outreach – Develop non-technical information for decision-makers to inform them of emerging technical advances;
- Planning Resources – Provide outreach to professional associations and research organizations to encourage technical exchanges and peer-level information sharing.

In addition, the SHRP2 Capacity program is preparing several new case studies based on initial pilot testing of TPICS in Minnesota. The SHRP2 Capacity program is also developing an on-line training course in conjunction with AASHTO. AASHTO is taking on the responsibility of hosting the TPICS web site and providing technical coordination with its regional affiliates.

The Implementation Plan is also designing performance measures to assess the success of the introduction of TPICS and the tools developed as part of the program. These measures include the following:

- Number and variety of new case studies developed for inclusion in TPICS database;
- Number of in-person training sessions;

- Number of transportation investment decisions that result from use of the Economic Analysis Tools;
- Number of hits on website hosting the TPICS online database;
- Number of downloads of the Wider Economic Benefit (WEB) spreadsheet tools; and
- Number of hits on web pages containing Economic Analysis Tools messages and information.

Potential for TIGER projects

The US DOT has established a tracking progress on all TIGER grants and is in the process of setting up a database that will include project and performance information. US DOT expects to begin funding these efforts in the current fiscal year (FY2105). They are planning to have on-going data management and tracking capabilities in place by mid-2015.

Information supporting both the short-term and long-term employment effects resulting from expenditures through the TIGER awards is being required under grant agreements that have been individually negotiated with each grantee.

There are currently more than 270 projects that have received grants since the program was first initiated in 2009. US DOT expects to award about $548 million in the current round of grants (applications that were submitted in late April 2014 and are due to be announced in September 2014) and are also expecting something on the order of $500 million to $550 million under the current authorization. US DOT expects between 45 and 70 successful grants to be awarded from this the current round, and that the relative number of awards will remain at about these levels as long as funding under this program continues to be authorized.

This source of case studies and the potential for significant ex-post analysis of recently awarded TIGER projects provides an excellent source of information for developing information using the case study approach pioneered in TPICS. However, the wide range of project types funded by TIGER and the potential for collection of data by a wide range of agencies and staff with varying degrees of skill suggests that managing any meaningful process of data development may require extensive technical oversight and management.

If TIGER projects are to form a foundation for ex-post analysis, then many of the lessons learned from TPICS – including paying close attention to consistent case data development, training in developing case analysis for the organizations involved, clear specifications for data and its collection, oversight and quality control, and an active management plan that includes regular consultations between grantees and federal agencies managing data intake are essential. Given the interest and expertise being developed as part of the TPICS implementation program by AASHTO and FHWA, it would seem advantageous to develop an active partnership between the FHWA’s SHRP2 Solutions program and the TIGER management program.

5. Conclusion and Need for Further Research

The examples offered in this paper illustrate the many ways that transportation investment can affect local and regional economic development, and the many ways in which transport projects have been conceived with the intent of supporting economic development outcomes. Transport investment can be motivated by both short-term and long-term economic impact goals, and by any combination of land use, employment and income growth goals. Public policy decisions should be made in a way that fully recognizes these types of goals and benefits in both ex-ante and ex-post studies. The interest of the planning community, the uptake by key federal agencies and transportation organizations, and continued interest by practitioners as well as state and regional planning organizations attests to the potential usefulness of ex-post analysis in supporting investment decision-making. Based on the research conducted to date and the directions that implementation plans are heading, key elements of future research related to ex-post analysis include two key areas.

Data coverage

The individual case studies, available via the TPICS web tool (www.tpics.us), are notable for their standardized approach and attempt to isolate the incremental economic development impacts of highways. This latter objective was addressed in three main ways: (1) through inclusion of ex-post comparison of change along multiple impact metrics, (2) through inclusion of comparison of changes to reference areas (to control for external business cycles), and (3) through inclusion of interviews with local planners and business representatives (to assess the extent to which observed changes were due to the highway project vs. other factors).

However, the information in several of the case studies was limited because of the unavailability of pre/post project data on changes in traffic conditions over time. In nearly all cases, neither local nor state transportation agencies had pre-project data on traffic volumes, speeds or access conditions. (The database does include post-project traffic volumes and access measures, though even pre-project speed data was limited.) Since traffic congestion, performance and access conditions are frequently noted as project objectives, it is hoped that transportation agencies will be able to more systematically collect and retain measures of these conditions in the future, so that later case studies can be added with more complete pre/post transportation data.

Use of results

The case study database and analysis methodology have value in two ways. First, they provide a basis for distinguishing the extent to which the highway project was actually responsible for observed economic development impacts. Second, they serve to highlight the ways in which local economic and institutional factors served to either mute (reduce) or amplify (expand) the magnitude of observed economic development impacts. Thus, the case studies do help to establish the extent of causal connection between highway-related improvements and resulting economic impacts, though they cannot yet relate the observed magnitude of economic impacts to the magnitude of pre/post change in transportation conditions.

The most obvious application of the current case study database and TPICS web tool is to provide transportation planners with a way to search for relevant types of projects in specific settings (region location, urban/rural population density, etc.). It also allows users an option to specify a given type of proposed project, and then see the range of impacts that have been actually observed in case studies to date. These features have three important uses. First, they can have value for early stage policy or strategy development, in which it can be useful to initially identify the magnitude and types of impact tradeoffs to be considered. Second, they can be useful for early stage “sketch planning” processes where they may provide examples of 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 educating elected officials, and in public hearings, as they provide a way of responding to the sometimes “overly-optimistic” hopes of proponents or fears of opponents, with information on the range of impacts that have actually occurred in the real world.

The case study results can also be used to provide empirical evidence 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 web tool alone cannot serve as a substitute for the detailed analyses incorporated into predictive economic impact models. While predictive economic impact models forecast shifts in economic growth resulting from complex interaction of changes in transportation conditions and changes in the underlying economy, the case studies lacked both the transportation change data and the statistical controls incorporated into such models. Consequently, it is useful to view the case study database as ideal for use as a sketch planning tool for initial planning, policy or strategy development, while economic impact models are designed to be most useful in later stages of planning and prioritization, where more details are available on the nature of proposed projects and their expected transportation system impacts.

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