Evolution of Methods for Assessing Economic Development Impacts of Proposed Transportation Projects

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Abstract .

This paper examines the evolution and development of methods used for assessing economic development impacts of proposed transportation projects. These methods have evolved over the past three decades from the measurement of business cost savings and market attraction impacts to encompass considerations of production/supply chain, labor market and global trade impacts. These classes of impact can be particularly important for proposed projects affecting highway network connectivity, borders, intermodal terminals, logistics centers, service for export industries or multiple modes of travel.

A description is provided of emerging new directions for addressing existing problems in the measurement of economic development benefits. This paper summarizes the outcomes of a variety of recent efforts to improve the measurement of economic development benefits, especially for projects aimed at multi-modal investments, economic development clusters and international trade. It discusses how these past studies have led to the development of a range of computer analysis methods that can provide both transportation planners and economic development planners with capabilities to identify how a project's multi-modal and spatial access impacts can also affect business market access and business attraction results. This review leads to the identification of ten factors that should be considered before deciding upon a framework for evaluating economic development impacts of proposed projects. The paper ends with description of one approach, which is the TREDIS ("Transportation Economic Development Impact System") framework for assessing multi-modal impact factors and incorporating them into decision-making.

1. Objective

This paper was written to highlight the breadth and continuing evolution of computer analysis models and methods that have been applied over the past three decades for estimating the likely regional economic impacts of proposed transportation projects. It also highlights lessons learned from that evolution, and identifies directions for further work in this area. It is important to note that this paper focuses specifically on regional-level economic impacts, where the study area is a county or multi-county area that comprises a rural or urban economic region. It does not address finer scale urban development patterns, which have their own set of applicable computer models and separate issues regarding application and use. Finally, it should be noted that while this article traces the evolution of *computational methods* used to evaluate economic development impacts, it complements the evolution of *policy thinking* about the nature of transportation effects, which has been discussed in a separate paper by Weiss (2002)[1].

2. Genesis of the Connection Between Transportation and Economic Development

Economic development refers to the growth and development of the economy of a nation or region, as most commonly measured by the increase in its income and job creation over time. In ancient times, the relationship between transportation and economic development was self-evident, as economic growth depended on producer and customer market access through transportation routes. Roughly two thousand years ago, ancient caravan routes such as the Silk Road, the Spice Route and the Gold and Salt Route were firmly established as the distribution backbone for bringing far away products to European markets. These distribution networks expanded jobs and income for a supply chain of producers, traders and merchants, and also supported the economy of intermediate locations that served as traveler rest and service areas. The Romans built over 50,000 miles of paved roads to support a trade network of national defense and interstate commerce routes. Caesarea was built in what is now Israel as a deep-water port and intermodal freight center connecting Roman ship routes in the Mediterranean with land routes for goods coming from Arabia and Asia.

Fast forward to only two centuries ago, and we find that the US invested in trade and freight routes for essentially the same reasons as the Romans. Early federal programs supported development of highways (e.g., Cumberland Pike in1818) and waterways (e.g., Erie Canal in 1825) as means to expand market access for agricultural products to be shipped from distant farms to the major cities. For the latter, wheat was delivered to eastern cities via waterway/land transfers.

During the 1960's, highway investment was still seen by government officials as a means for facilitating income growth through enhancement of access for labor, materials and customer markets. An early federal report focused on the benefit of the interstate highway system as increasing access by appearing to reduce effective distances between areas.[2] In 1964, a Presidential Commission reported that "economic growth in Appalachia would not be possible until the Region's isolation had been overcome" and Congress reacted the next year by funding the Appalachian Development Highway System "to generate economic development in previously isolated areas."[3]

From the ancient days to the mid twentieth century, no one would think of assessing the full economic benefit of transportation investment as merely the value of savings in driver and vehicle operating cost. It would be unthinkable to assess the job and income benefits of new transportation without also considering factors such as accessibility to markets, scale economies from market expansion, cross-border trade, intermodal connectivity or reliability. But then again, they did not have computer models.

3. Development of Computer Models for Regional Economics

In the 1960's, computers inspired a bright future of hope. That was reflected in the *Highway Research Record* article entitled: "Will Model Building and the Computer Solve Our Economic Forecasting Problems."[4] The next four decades showed that computer models in fact can have severe intrinsic limitations requiring a continuing effort by analysts to address new and emerging impact issues.

But before criticizing models any further, it is important to set reasonable expectations. After all, a computer model is by definition just "a simplified representation of processes" that attempts to represent cause and effect relationships in terms of equations. This definition is important, because it recognizes that the limits of models for predicting or evaluating expected future impacts. In other words, any computer model of transportation impacts on economic development can be expected to: (a) reasonably well represent some processes driving transportation and economic outcomes, (b) omit other processes because they depend on factors that cannot be easily measured and explained, and (c) poorly represent yet other processes due to difficulty measuring and explaining them. The remainder of this paper discusses how all three conditions have in fact occurred in the practice of applying economic impact models for transportation. Some techniques have evolved over time. However, in all cases, it is important that the coverage and limitations of data, models and methods be acknowledged. Then, effort can be made to cover issues that are not fully addressed by the models.

In the field of transportation, computers enabled urban transportation network models to emerge in the 1960s and 1970s as tools to forecast and allocate future trips among alternative routes on an urban road network.[5] In the field of economic development, computers enabled input-output models to emerge in the 1960s and 1970s as tools that allocated flows of dollars among product supplier and buyer industries.[6,7] Both models were effectively allocation techniques for tracking and forecasting future flows (for traffic in one case, and for dollars in the other case). Together, the two provided a structure for calculating the effect of road improvements on traveler costs and the impacts of those cost changes for a regional economy.

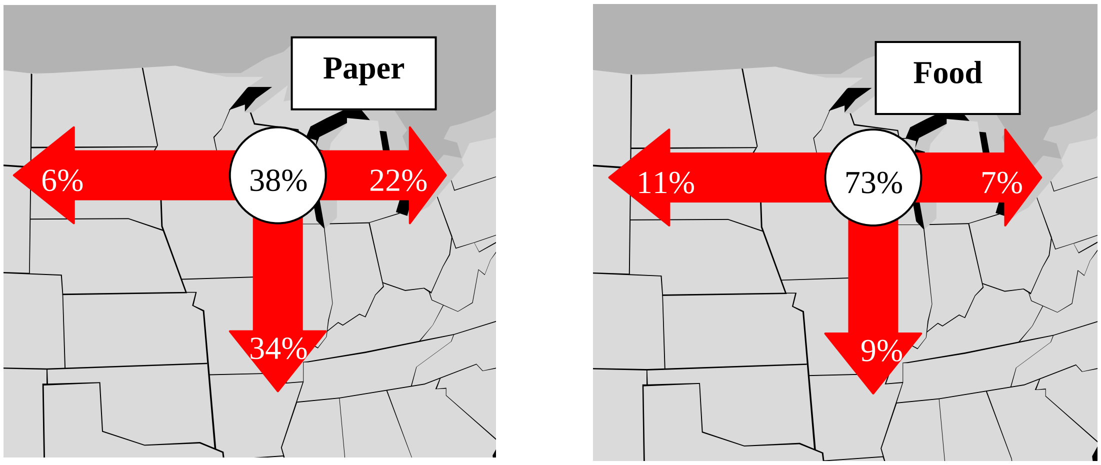
The 1980's marked the emergence of the computer simulation models that attempted to forecast the regional economic growth consequences of transportation projects. The Regional Economic Impact Model for Highway Systems (REIMHS) applied was initially developed in the mid 1980's and first applied for North Central Texas.[8] It included a series of calculations to translate capital investment (for new highways) and travel cost savings (from those from highway improvements) into expected increases in the flow of household and business income. Then an input-output model was applied to calculate the total value of additional business output, wages and jobs. REIMS was later also applied for highways in Arkansas, Louisiana, New Mexico, Oklahoma and Texas. [9]

Shortly thereafter, the REMI Policy Insight (REMI-PI) model emerged as a simulation model that could forecast year-by-year impacts of policies affecting cost factors, such as tax, wage and transportation cost changes. The core of the model was its calculation of the effect of transportation cost reductions on regional growth due to improvement in cost competitiveness for various regional industries, leading to additional shifts in wages and population movements. The first applications of the REMI policy model for transportation projects occurred during the period of 1988-1992, with studies for Wisconsin Highway 29[10,11]; Southwest Indiana Highway[12] and Iowa Highway 20.[13] The motivation for all of these studies was the realization by staff of those state DOTs that existing state highway models, and investment benefit analyses based on them, under-estimated potential benefits. That is because they assumed fixed trip generation and origin destination patterns, a process that did not recognize economic growth induced by transportation improvements nor additional income or productivity benefits accruing as part of that economic growth.

All three of those studies used the REMI-PI model to calculate the economic growth impacts of travel cost changes attributable to distance and speed improvements for the fixed forecast of future business-related travel. However, they all recognized that the REMI model could not automatically forecast additional business growth and attraction that could be realized by various industries when a particular highway improves connectivity to specific intermodal facilities, or expands the industry's delivery market bringing economies of scale in serving it, or enhances logistics/warehousing efficiencies due to highway network interconnections or enables new tourism markets. Thus all of those studies relied on separate methods to exogenously estimate those impacts and then added them to the automatically predicted travel cost saving effects.

Some of the early studies relied primarily on business and expert surveys to gauge the economic development implications of improving access and connectivity for various industries. For instance, the 1988 Wisconsin study used business surveys to profile the differing origin-destination patterns of trucking shipments by industry. It found that the various industries had dramatically different shipping patterns that would make the proposed east-west highway project, improving connections from Green Bay to Minneapolis and points west, more important for the food industry than for others such as the paper industry (see Figure 1). On the other hand, the survey showed that a new north-south freeway, improving connections from Green Bay to Chicago and points south, would be more important for the paper industry. Those survey findings were given to a panel of regional economic development experts to estimate the likely magnitude of highway project impacts on additional business attraction to Wisconsin.

Figure 1. Use of Survey to Assess Industry Access Benefit from Wisconsin Highway



Circle shows percent of shipments within the state; arrows show percent moving to/from out-of-state locations to the east, west and south; Source: Highway 29/45/10 Corridor Study: Economic Development Benefits and Cost-Benefit Evaluation, Wisconsin DOT, 1989.

4. Development of Methods for Assessing Market Access Impacts.

In the earlier studies, business surveys were recognized as a way to identify specific industries benefiting most from access improvements. However, there was more controversy about the use of expert panels for predicting the business attraction implications of additional access and connectivity improvements. For instance, an Australian government report that reviewed the original Wisconsin report concluded that while there were limitations with sole reliance on cost impacts using economic models such as the REMI model, expert panels may not be the ideal solution because personal expectations often over-estimate actual results.[14]

In response to such concerns, projects were funded during 1998- 2001 by Indiana DOT[15] and Louisiana DOT[16] that developed and refined analysis tools to identify highway project impacts on new business attraction from market access expansion. These studies used variants on the Highway Economic Development Estimator (HEDE), a spreadsheet approach to calculate the magnitude of change in regional connectivity and accessibility of rural areas to major labor markets, customer delivery markets, tourism markets and intermodal facilities. The spreadsheet then calculated the scale of likely effects on attraction of new business activity due to access and connectivity improvements. Those results were then added to the REMI-PI model's calculation of cost impact for already-existing (or projected future) business in the region. The spreadsheet methodology used in these studies calculated business attraction opportunities through a two step process. First, it measured the gap in business mix and growth in the rural areas compared to those in areas that they would be connected to in the future. Second, it identified the extent to which those gaps could be explained by deficiencies in transportation connections, which would be reduced or eliminated by the proposed new highway.

This approach further evolved during 2001-2004 as the Appalachian Regional Commission funded development of an enhanced spreadsheet tools (ARC-Opps and ARC-LEAP) aimed specifically at giving its local development districts a tool to identify opportunities for business target opportunities associated with completion of new portions of the Appalachian Development Highway System.[17, 18] These tools were also used for other highway impact studies including Tennessee[19] and Northern New York.[20] An important new feature of these models was a recognition that business growth and attraction opportunities associated with transportation improvements would be affected for some industries by the sufficiency of other factors (such as labor force training, utilities infrastructure and industrial park facilities). Figure 2 shows how those models combined the rating of transportation sufficiency with ratings of other factors.

Figure 2. Spreadsheet Approach for Rating Transportation Market Access and Cost Relative to other Business Attraction Factors

(1 = CRITICAL DISADVANTAGE; 2 = IMPORTANT DISADVANTAGE)

			Factor Costs				Labor Market		Transportation			
Sector	DEFICIENCY (# OF JOBS)	TOTAL PRODUCTIO N COSTS	LABOR COSTS	LAND COSTS	ENERGY COSTS	TAXES	WORKER BASE	SKILLED WORKER S	WATER TRANS	AIR TRANS	RAIL TRANS	HIGHWAY TRANS
Agricultural services	91	1	1				1			1		
Fishing	0	2										
General contractors	2,612											
Heavy construction	35											
Food products	507	2			2							
Textile mill products	90	2			2							2
Apparel and other textile	1,277	2								2		2
Furniture and fixtures	192	1								2		
Rubber and plastics	957	1										
Leather products	56									1		
Industrial machinery	357	1						2		2		
Electronic/electric equipm	4,724	2						2		1		1
Trucking & warehousing	610	1		1						1		1
Transportation by air	236	1	2		2		2	2		1		
Transportation services	184	1	2		2		2					
Communications	1,798							2				
Electric, gas services	321							1				
Wholesale - durables	110	1	2				2	2		1		
Wholesale - nondurables	627	1	2				2					

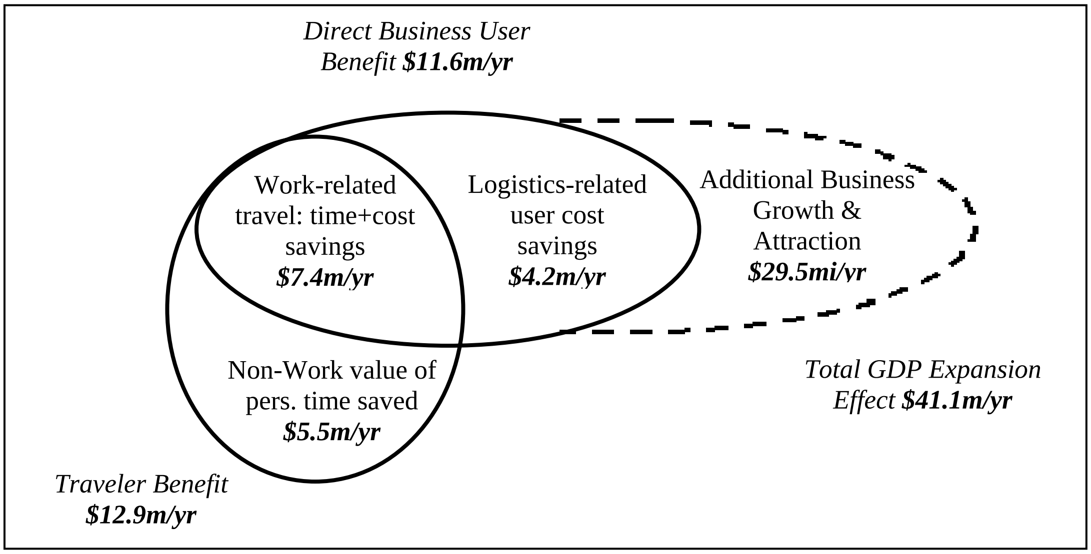
Source: Handbook for Assessing Local Economic Development Opportunities with ARC-LEAP.

While these spreadsheet models were useful for identifying differences in general accessibility to markets and terminals, they did not substitute for basic market studies for situations where a highway could open up market access to enable specific local businesses to be developed. To address this latter type of situation, a direct market study (examining the nature of proposed supply, demand and competitors for the economic activity) have remained in use to analyze the potential economic impacts of building new highways to serve locations ranging from a gold mine in Canada[21] to a proposed tourism destination at the birthplace of a famous country music legend in Kentucky.[22]

5. Separating Productivity Effects from Business Attraction Effects.

It was explicitly recognized in all of the various cited studies from 1988 onward that new business investment attracted to a region could be seen at the local level as an increase in jobs and income. However, at the broader state and national levels, some of this local growth would be seen as a zero-sum shift of jobs and income between areas, although there was also some portion of the growth that was enabled by productivity enhancement (from scale economies and logistic efficiencies). In response, many of the early studies showed economic impacts from both regional and state perspectives. As illustrated in Figure 3, initial efforts were also developed to show how the elements of productivity gain could be distinguished from the larger impact of regional business attraction.[23]

Figure 3 Illustrative Example of a Study Separating Components of Regional Benefit



Source: "Comparing Approaches for Valuing Economic Development Benefits of Transportation Projects," Weisbrod, G. and M. Grovak, Transportation Research Record, #1649, TRB, 1998.

Additional FHWA-funded work developed additional measures of the impacts of connectivity and access improvements on productivity for various industries, as part of an effort to calculate the full benefits of transportation improvements.[24] Measurement of the spatial aspect of productivity improvement due to market accessibility was subsequently illustrated over the 1998-2001 period in published research on spatial productivity (Weisbrod and Treyz)[25] and congestion impacts (Vary et al).[26] The latter study calculated effects of congestion reduction scenarios on business productivity and growth related to expansion of labor markets and truck delivery markets. Using data from Chicago and Philadelphia, it showed how economic impacts could differ by industry and occupation categories for workforce and delivery market access, and it also showed the importance of using transportation networks rather than distances to calculate spatial patterns of access.

6. Development of Spatial Databases

Geographic information systems have more recently opened up new opportunities for measuring the effects of transportation projects on various elements of market accessibility (allowing for economies of scale in business operation) and intermodal connectivity (allowing for logistics efficiencies in business operations).

Initially, multi-regional economic models, including both input-output and simulation models, were developed as "spatially blind" tools that calculated impacts of a change in one region on adjoining regions based on existing patterns of purchasing and sales flowing between those regions. The "new economic geography" developed by Krugman[27] highlighted how access makes a difference in the spatial pattern of economic growth and development among regions. The most simple version of that was the TranSight model, a pre-processor to the REMI-PI model, that represented transportation project impacts as modifying the effective "distance" between two regions and thus increasing reliance on supplier-buyer relationships between those areas. That approach, however, relied on generalized distance measures between regions and did not recognize variation in speeds and travel times among various modes of travel and parts of the transportation network, nor the effect of shifting reliance on highway, rail, air and marine modes by various industries.

More detailed and realistic approaches came with the integration of geographic information systems (GIS) with transportation network data and multi-modal terminal/port data. With those tools, it was possible to improve the spatial measurement of accessibility changes on market access. They could be used to show how any given improvements in road or rail transport connections could affect the size of labor markets and shopping markets accessibility from any given location within a region. It could also show how highway transportation improvements could affect travel time access to intermodal connections such as airports, marine ports, intermodal rail/truck loading facilities and international gateways. That breakthrough facilitated the development of new analysis systems that could measure access and connectivity changes and then estimate their impacts on economic development.

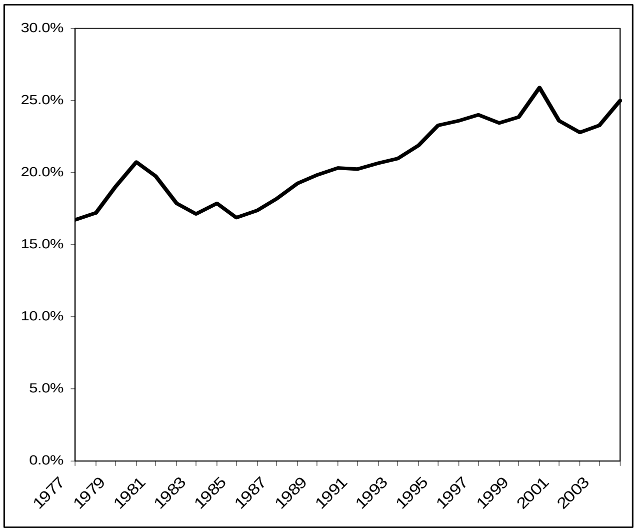
The web-based EDR-LEAP system relies on ESRI's geographic information system, a national highway network and USDOT datasets to calculate the travel time from any community in the USA to rail, air and marine terminal/port facilities having regularly scheduled services. That information is used to calculate the impacts of travel time changes on the size of population markets reachable within various travel time conditions. This information enables the system to assess impacts of alternative transportation scenarios for specific industries that were dependent on intermodal connections and delivery market access.[28] An even broader example of a GIS-based analysis framework is the Highway Economic Analysis Tool (HEAT), that was developed for Montana DOT system to integrate detailed state transportation models, commodity flow data and customized GIS software.[29] That system provides further detail on changes in access to international trade gateways as well as intermodal facilities and delivery markets for specific industries and commodities. Both accessibility approaches were designed to work with regional economic impact models to evaluate the full implications of those changes.

7. Measuring Freight Gateway and Hub Effects

The impact of transportation projects on international trade has become a matter of increasing importance in the US, especially for southern and northern border states as well as for eastern and western states with international seaports and airports. This is a result of the fact that international trade has been accounting for an increasing share of goods movement in the US (see Figure 4). However, existing regional transportation and economic growth simulation models used for transportation impact studies in the US have to date had little or no ability to identify opportunities for expanding cross-border import/export businesses.

Figure 4. US Growth of International Trade

(value of imports + exports relative to total GDP in the US)



Source: US Dept of Commerce, Bureau of Economic Analysis and International Trade Statistics

As a result, quite a few of the border and gateway states (and provinces) have initiated their own studies of the interaction between economic patterns of international trade and transportation demands on international gateways. Examples range from the Latin American Trade and Transportation Study (LATTS)[30] to the Ontario Goods Movement Study.[31] A study of international trade clusters, for the Appalachian Regional Commission, also tracked the product origin and departing port location for key industry products and showed how export gateway access for those shipments would be affected by the completion of new segments of the Appalachian Development Highway System.[32] Northeast CanAm Connections is a current initiative of US states and Canadian provinces working together to evaluate the economic development opportunities associated with improved bi-national economic integration that could result from enhancement of transportation connections. Collectively, all of these studies are examples of efforts aimed at improving both information and the state of the art for assessing transportation investment needs to support growth of international trade.

At the local level, these same connectivity and international trade issues have become of great concerns for business organizations in urban areas whose economies are most dependent on their roles as freight gateways or freight hubs. In such cities, the growth of traffic congestion is seen by business leaders as a threat to industries that are most dependent on just-in-time processing, lean logistics and scheduling for deliveries to/from airports, seaports and intermodal rail facilities. They have responded by commissioning studies to evaluate the economic development implications of congestion, with particular focus on how it affects goods movement. However, these studies could not use traditional regional economic models because those models lacked sensitivity to changes in transportation reliability, intermodal connections and international trade. As a result, variants of the newer TREDIS economic analysis framework (discussed later) were used in congestion impact studies conducted over 2003-2005 for the Vancouver Gateway Council,[33] Chicago Metropolis 2020[34] and Portland Business Alliance.[35]

8. Alternative Views of Benefit/Cost Analysis

In the transportation research literature, it has always been clear that *economic development impacts* of transportation are not the same as the *economic value of project benefits.* Yet it can be argued that one of the most dangerous element of applied economic impact modeling has been the blurring of their differences in evaluating impacts and benefits of proposed transportation projects. Some of the similarities and differences between these two concepts are illustrated in Figure 5 and summarized below:

- *Similarities* -- Business-related travel time savings and travel-related money savings (including personal household costs and business productivity impacts) affect the economy through business operating cost changes and are also elements of project benefit.

- *Factors Where Economic Development Measures are Broader* -- Impacts on the economy can <u>include</u> some factors that may not be counted in the net value of project benefits. For instance, economic growth impacts on a region or country can include short-term effects of construction spending, as well as longer-term effects of attracting business investment from another region or country. However, in benefit-cost accounting, construction spending by itself does not necessarily bring any net income benefit over the alternative of spending the same money on other investments. (That is the opportunity cost.) In addition, while business relocation decisions are typically motivated by the opportunity to increase profitability and return on investment, the net productivity benefit for the broader nation or world is usually less than the impact on a local area's economic growth.

- *Factors Where Economic Development Measures are Narrower* -- Impacts on the economy can <u>exclude</u> some factors that may be counted in the net value of project benefits. For instance, the dollar value of personal travel time improvements (an element of traveler impact) and the dollar valuation of air quality improvements (an element of social impact) are both real project benefits that can be assigned an economic value. However, that value does not automatically turn into an equivalent change in the flow of money and income in the economy. In addition, improvements in transportation safety are a clear social benefit, but they do not necessarily create any more net jobs and income in a local economy; in fact, they could lead to a loss of jobs and income in medical and car repair occupations.

Figure 5. Difference between Economic Value of Benefits and Impacts on the Economy

	Travel Efficiency Benefit	Full User Benefit[1]	Societal Benefit	Econ Development Benefit
$ Passenger Time Savings for personal travel	Yes	Yes	Yes	-- [7]
$ Passenger Time Savings for business travel	Yes	Yes	Yes	Yes
$ Travel Vehicle Operating Expense Savings	Yes	Yes	Yes	Yes
$ Shipper/Recipient Productivity Gain[2]	--	Yes	Yes	Yes
$ Indirect (Downstream) Productivity Gain[3]	--	--	Yes	Yes
$ Value of Environmental Benefits[4]	--	--	Yes	-- [7]
$ Local Income Growth from Business Attraction [5]	--	--	-- [6]	Yes

1 Transportation system users are defined as the travelers for passenger travel and the shippers for freight travel
2 defined as additional net income produced through cost savings or scale or production economies for shippers
3 "downstream" income effects on other businesses that indirectly also realize productivity or cost benefits
4 value of air quality, water quality, noise improvements, expressed in terms of "willingness to pay"
6 Attracting additional business activity from one location to another is only a societal benefit insofar as there is a benefit of redistributing income growth from richer areas to poorer areas.
7 Personal time savings and environmental improvement do not directly affect the flow of dollars in the economy (though in theory they could lead to indirect changes in economic patterns if they affect migration rates).

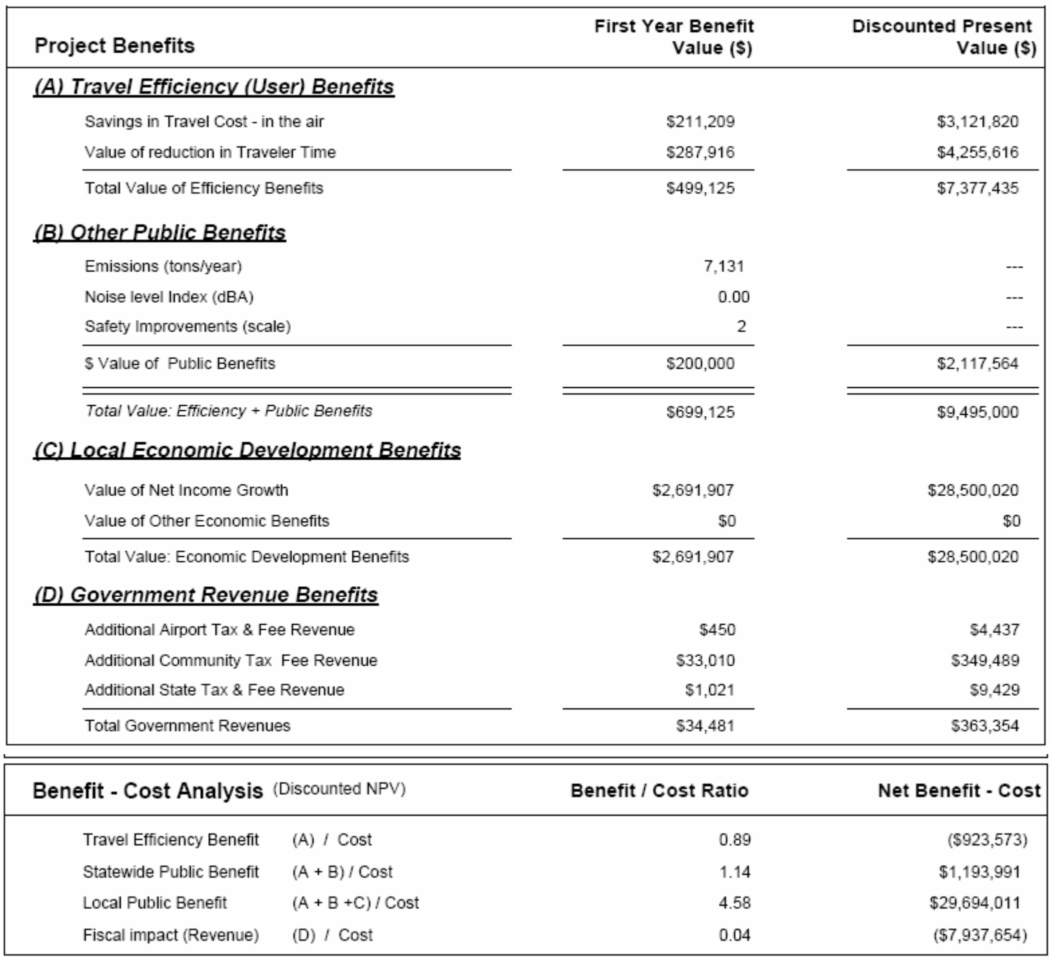
It is critical to emphasize that economic impact models are not benefit accounting systems. The separate valuation of traveler, economic and other social impacts is made clear in the NCHRP Guidebook for Assessing Social and Economic Impacts of Transportation Projects.[36] The ASCE/Caltrans internet guide to transportation benefit/cost analysis carries through on these themes by separately addressing the measurement of traveler impacts, broader economic impacts and additional social benefits. [37]

These distinctions can become confused when a regional economic impact model is used to force non-money (social and environmental) impacts to affect business productivity and economic growth measures. For instance, the REMI model has an input commonly referred to as the "amenity variable." It allows the analyst to determine a dollar value of non-money benefits such as personal time savings and air quality and then input them as a factor affecting the model's population migration equation, paralleling the impact of a reduction in housing costs. The model then predicts a rise of in-migration, causing an increase in supply of workers, which leads to a drop in wage rates, which then raises apparent productivity (ratio of output/worker) and hence makes the area appear more competitive for attracting business growth. Ultimately, that leads the model to forecast a net increase in regional jobs and income.

This method can be used to make the model predict larger economic growth impacts from a transportation project. However, the magnitude of that effect depends on assumptions concerning local population migration rates and local wage rates. Ultimately, it is a very indirect way of making the model show apparent impacts on the flow of dollars in the economy, and there is no way to be sure how the predicted impact on regional income will compare to the initial valuation of the personal time or air quality improvement. As a result, the amenity variable has been avoided in some studies that used the REMI model to assess transportation project impacts. Instead, a common practice in recent years has been to report personal time and environmental benefits separately from impacts on the flow of dollars in the economy. However, this amenity impact mechanism is automatically applied in REMI's TranSight preprocessor.

Finally, it is also important to note that impacts on the economy can appear different when measured from local, regional and national perspectives. The issue was identified in a 1997 TRB guide to assessing economic impacts of transportation.[38] The Airport Benefit Cost System used by Wisconsin DOT is an example of how a state transportation agency can clarify that issue by distinguishing and showing the various elements of local and statewide economic impact.[39] (See Figure 6.)

Figure 6. Example: Showing Economic Benefits from Alternative Perspectives
(Wisconsin Airport Benefit Cost System)



Project Benefits	First Year Benefit Value ($)	Discounted Present Value ($)
(A) Travel Efficiency (User) Benefits		
Savings in Travel Cost - in the air	$211,209	$3,121,820
Value of reduction in Traveler Time	$287,916	$4,255,616
Total Value of Efficiency Benefits	$499,125	$7,377,435
(B) Other Public Benefits		
Emissions (tons/year)	7,131	---
Noise level Index (dBA)	0.00	---
Safety Improvements (scale)	2	---
$ Value of Public Benefits	$200,000	$2,117,564
Total Value: Efficiency + Public Benefits	$699,125	$9,495,000
(C) Local Economic Development Benefits		
Value of Net Income Growth	$2,691,907	$28,500,020
Value of Other Economic Benefits	$0	$0
Total Value: Economic Development Benefits	$2,691,907	$28,500,020
(D) Government Revenue Benefits		
Additional Airport Tax & Fee Revenue	$450	$4,437
Additional Community Tax Fee Revenue	$33,010	$349,489
Additional State Tax & Fee Revenue	$1,021	$9,429
Total Government Revenues	$34,481	$363,354

Benefit - Cost Analysis (Discounted NPV)		Benefit / Cost Ratio	Net Benefit - Cost
Travel Efficiency Benefit	(A) / Cost	0.89	($923,573)
Statewide Public Benefit	(A + B) / Cost	1.14	$1,193,991
Local Public Benefit	(A + B +C) / Cost	4.58	$29,694,011
Fiscal impact (Revenue)	(D) / Cost	0.04	($7,937,654)

Wisconsin ABC Airport Benefit Cost System, Wisconsin DOT, 2001.

9. Lessons Learned

Having discussed a very wide range of issues and approaches being used to assess various elements of economic developments, it is understandable if a reader feels that both the range of issues and the range of methods needed to address those issues is overwhelming. That would, however, be the wrong conclusion to draw. The better conclusion is that there are many aspects of potential economic development impact, requiring that the analyst hone in on the most relevant and important aspects to analyze for any particular project or policy. In other words, the analysis of economic impacts cannot be just a mechanical modeling process, as it requires the application of both transportation and economic development expertise in order to focus on key issues and tailor analysis methods to address them.

From the preceding review of evolving issues and analysis methods, we can identify ten key topics that should be at least considered when designing an approach to analyze economic impacts of any particular transportation project. They are as follows:

Considerations for Assessing Economic Development Impacts of Transportation Projects

<u>Analysis Inputs</u>

1. Recognize multimodal implications, such as how a highway project can also affect travel patterns and access to airports, marine ports, rail intermodal terminals and/or international trade routes.
2. Recognize the potential for impacts to hit certain industries that particularly depend on the reliability and functionality of specific modes, travel routes and terminals.
3. Recognize the potential value of connectivity and reliability improvements for both commuting and goods movement, and obtain measures of changes in those factors.

<u>Analysis Models and Tools</u>

4. Use analysis methods that can assess inputs including changes in access, reliability, multi-modal interchange and connectivity, as well as standard network times and costs.
5. Use analysis methods that can identify when transportation impacts are magnified or constrained by other economic growth factors, such as utility infrastructure, financing, labor skills and capacity for growth.
6. Avoid confusion by using analysis methods that can separate economic (flow of dollar) impacts from value of benefits that do not directly affect the flow of dollars.

<u>Results</u>

7. Distinguish forms of impact: (a) economic, (b) social and (c) environmental effects.
8. Distinguish areas of impact: (a) local, (b) state, (c) national and (d) global impacts, as appropriate for those who will be using the analysis results.
9. Distinguish benefit and cost perspectives: (a) savings for travelers, (b) savings for all users including freight shippers and recipients, (c) generation of income in the economy, and (d) the value of all benefits to society.

10. Towards a New Framework

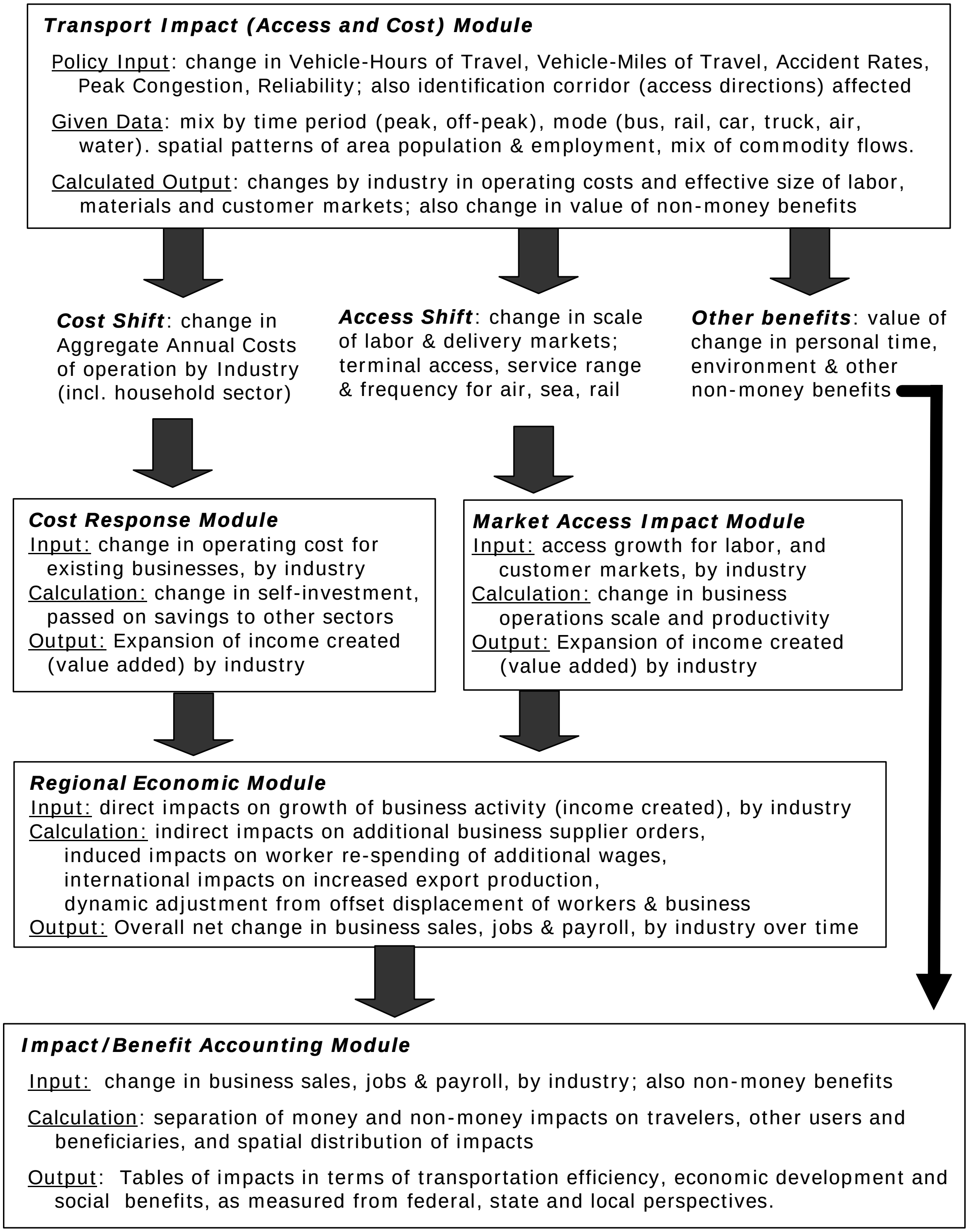
There are potentially many ways to address these ten considerations. One approach that has been recently developed to address these considerations is a web-based framework called TREDIS (Transportation Economic Development Impact System). The modular structure of this framework is shown in Figure 7. This approach has the following features:

- *Analysis Inputs* – The system is designed as an online, web-based analysis framework that provides the analyst with a comprehensive set of input screens covering patterns of travel times, costs, reliability, productivity and access factors for car, truck, air, water and rail modes of travel. The list initially looks overwhelming, though the analyst may ignore as many of those inputs as desired. However, the system is intentionally designed to put the full range of multi-modal inputs in the fact of the analyst, to ensure that there is some thought about the range of project effects. The analyst is then free to intentionally leave some effects (such as impacts of one mode on use of other modes) as zeros, but that will be an explicit choice rather than an accidental oversight or result of unknowingly choosing a product that does not account for such effects. This approach also facilitates the use of inputs from multiple sources, such as use of peak traffic congestion models, spatial access models and intermodal terminal data in addition to highway network models that only measure annual average daily changes in travel times and distances.

- *Analysis Calculations* – The system is designed as a series of modules for processing multi-modal transportation impact measures, developing multi-regional economic impact measures, and portraying overall impacts and benefits from various alternative perspectives. As a modular system, it is designed to work with a other models and information sources. First, the modular system is designed so that it can use potentially information from any model or spreadsheet analysis method that estimate changes in use and travel characteristics for road, rail, air, and water transportation. Second, the modular system is designed to potentially link to any geographic information system (GIS) for analysis of changes in highway accessibility to markets and intermodal facilities. However, it is also set with a default to automatically work with a system offered by ESRI that has been pre-populated with market and intermodal terminal data. Third, the modular system is designed so that it can potentially work with any regional economic model and source of commodity flow information. However, it is also set with a default to run with either a built-in elasticity impact model or the Regional Dynamics (REDYN) model that offers a unique tracking of the spatial pattern of commodity flows by mode of travel and type of commodity.

- *Analysis Results* – The system is designed to distinguish impacts as measured differently from local, state and national perspectives. It is also designed to distinguish measures of economic development impacts and benefit-cost analysis. Those various measures are options that can be used or ignored as appropriate for different audiences and purposes. The presence of these alterative views on one page is intended to help analysts avoid mistaking the interpretation of any single impact measure (such as seeing a measure of local economic impact and drawing conclusions about statewide impact from it).

Figure 7. Modular Structure of the TREDIS Framework



This type of framework offers a potentially flexible platform for analysts to work with local transportation planners and economic development planners and custom tailor a study to address local issues affecting the impact of transportation projects. However, there is substantial remaining need for improved information and analysis methods.

- One area in need of further improvement is refinement of better measures of economic productivity benefits. Studies of transportation project impacts in various locations indicate that some projects can bring significant efficiency benefits for supply chain logistics and economies of scale for market deliveries. However, the extent of those benefits can differ substantially depending on the local situation and industries affected.

- Another area in need of further improvement is the representation of commodity flows and international trade flows. Current databases piece together information from multiple and sometimes conflicting sources to represent patterns of inter-industry, inter-regional and inter-modal flows of freight.

- Finally, there is a need for regional economic models to better establish the reasonableness of their assumptions about how workforce migration, wage rates and private investment change over time in response to transportation costs and other transportation project impacts. Since those assumptions significantly affect measures of overall impacts over time, there is a need for published information to establish the actual rate and magnitude of such changes occurring in response to transportation projects.

It is hoped that the establishment of analysis frameworks such as TREDIS can serve to highlight the various aspects of transportation project impacts and encourage more complete studies of their impacts.

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